

NATIONAL EXAMINATIONS - May 2011

98-CS-1 Engineering Economics

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.
2. The use of any non-communicating calculator is permitted. This is an open book examination.
3. Any four questions constitute a complete paper. Only the first four questions, as they appear in your answer book, will be marked.
4. The questions are of equal value.

Question 1

Your company is considering the modernization of its factory in Edmonton, Alberta, in order to increase its productivity. The estimated initial cost of this Project (the modernization of the factory) is \$2,200,000. The estimated (end of year) net income (revenue minus all costs except initial costs) of the existing and the modernized factories for the next seven years are given below. The Project life (operation of the modernized factory) is x years. MARR (the minimum attractive rate of return) for the company is 8%. Salvage values are zero for the existing plant and \$600,000 for the modernized plant.

Year	End of Year Net Income	
	Existing Factory	Modernized Factory
1	\$800,000	\$1,100,000
2	\$750,000	\$1,100,000
3	\$700,000	\$1,100,000
4	\$650,000	\$1,100,000
5	\$600,000	\$1,100,000
6	\$550,000	\$1,100,000
7	\$500,000	\$1,100,000

Determine:

- (a) the present value of the net income of the existing plant if $x=6$ (3 marks)
- (b) whether or not the Project is justified (economically) if $x = 5$ (7 marks)
- (c) the internal rate of return of this Project if $x = 7$ (5 marks)
- (d) the minimum value of x that would justify the Project (5 marks)
- (e) the external rate of return of this Project if $x=7$ (5 marks)

Question 2

Your company intends to install a new air conditioning system in its office building to reduce maintenance and operating costs and improve service. It is estimated that this system will generate yearly savings of \$ Y . The cost of the new system is \$4,200,000 and it will be partially financed by a \$3,200,000 four year loan obtained from the local branch of the Empire Bank at a yearly compounding interest rate of 5%. Both principal and interest of the \$3,200,000 loan will be repaid by four equal annual (end of year) payments. The Project life is x years. MARR (the minimum attractive rate of return) for your company is z %. Salvage values are zero.

Determine

- (a) the outstanding loan (amount owing) immediately after the third loan payment (5 marks)
- (b) the interest portion of the last loan payment (2 marks)
- (c) the value of Y which would justify this Project, if $x = 12$ and $z = 10\%$ (8 marks)
- (d) the maximum value of z which would make this project economically acceptable if $Y = \$660,000$ and $x = 8$ (10 marks)

Question 3

There are two alternative proposals to improve traffic flow in downtown Hamilton, Ontario. Costs and monetary equivalents of benefits and dis-benefits are listed in the Table below. The planning period is n years. Salvage values are zero. The interest rate is x %.

	Alternative 1	Alternative 2
Initial road construction cost	\$29,800,000	\$11,000,000
Road maintenance cost/year	\$ 350,000	\$ 210,000
Improved traffic flow/year	\$ 1,200,000	\$ 750,000
Reduced noise pollution/year	\$ 300,000	\$ 0
Improved road safety/year	\$ 460,000	\$ 190,000
Reduced traffic policing cost/year	\$ 120,000	\$ 0
Increased air pollution/year	\$ 55,000	\$ 120,000
Reduced car idling time/year	\$ 85,000	\$ 0

Determine:

- (a) the benefit cost ratio for Alternative 2, if $n = 30$ and $x = 3$ (5 marks)
- (b) the minimum value of n that would make Proposal 1 acceptable if $x = 2\%$ (10 marks)
- (c) the preferred Alternative, if $n = 28$ and $x = 3\%$ (10 marks)

Question 4

Alberta Energy Corp. intends to start generating electricity using its recently installed wind turbines located north of Edmonton. The electricity generated by the turbines is sold under contract to RBC Ind. for \$ M per year. The yearly operating and maintenance costs of the turbines are estimated to be \$850,000. The initial cost of purchasing and installing the turbines is \$6,000,000. The income tax rate is 30%. The CCA (capital cost allowance) rate for wind turbines is 20%. (Note that CCA is available at one half of the normal rate in the year in which the asset is acquired.) MARR (the minimum attractive rate of return) for Alberta Energy Corp. is 10%. Salvage values are zero. The Project life is 5 years.

Determine:

- a) the income tax payable in year three of the Project if $M = 2,600,000$ (3 marks)
- b) the after tax cash flow in year three of the Project if $M = 2,600,000$ (2 marks)
- c) the rate of return of the after tax cash flow for this Project if $M = 2,600,000$ (10 marks)
- d) the minimum value of M that would still make this Project economically acceptable (10 marks)

Question 5

Three Alternatives are proposed for upgrading the software your company uses for aiding its air conditioning and ventilating design and construction activities. The (end of year) after tax cash flows for the three alternatives are given in the Table below. The planning period is five years. MARR (the minimum attractive rate of return) for your company is 10%

End of year	Alternative A	Alternative B	Alternative C
0	-\$3,500,000	-\$W	-\$3,400,000
1	\$1,200,000	\$1,345,000	\$1,180,000
2	\$1,200,000	\$1,405,000	\$1,180,000
3	\$1,200,000	\$1,465,000	\$1,180,000
4	\$1,200,000	\$1,525,000	\$1,180,000
5	\$1,200,000	\$1,585,000	\$1,180,000

Determine

- (a) the maximum value of W that would make Alternative B acceptable (3 marks)
- (b) the value of W which would make Alternatives A and B economically equivalent (3 marks)
- (c) the preferred Alternative using **annual worth** as the measure of merit
if $W = 3,300,000$ (8 marks)
- (d) the preferred Alternative using **the internal rate of return** as the measure
of merit if $W = 4,600,000$ (11 marks)