

NATIONAL EXAMINATIONS - December 2010
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 planning to set up a production line for making injection molded automotive components for Ford. The engineering division of your company developed three alternative plans for the production line. The (end of year) after tax cash flows for the proposed three alternatives are given in the Table below. The planning period is four years. MARR (the minimum attractive rate of return) for your company is 12%

End of year	Alternative A	Alternative B	Alternative C
0	-\$500,000	-\$960,000	-\$X
1	\$200,000	\$345,000	\$180,000
2	\$200,000	\$405,000	\$160,000
3	\$200,000	\$465,000	\$140,000
4	\$200,000	\$525,000	\$120,000

Determine the preferred alternative

(a) using annual worth as the measure of merit if $X = 300,000$ (7 marks)

(b) using the internal rate of return as the measure of merit if $X=200,000$ (10 marks)

and determine

(c) the external rate of return of Alternative B (8 marks)

Question 2

There are three alternative proposals to improve access to Highway 401 at London, Ontario. The financial data for the three Proposals (including the monetary equivalents of perceived benefits and dis-benefits) are listed in the Table below. The planning period is 20 years. Salvage values are zero. The interest rate to be used in the analysis is $x\%$.

	Proposal 1	Proposal 2	Proposal 3
Construction cost, \$000	2,600	3,045	1,890
Maintenance cost, \$000/yr	160	115	234
Improved road safety, \$000/yr	80	80	80
Reduced traffic policing cost, \$000/yr		65	
Improved traffic flow, \$000/yr	110	45	39
Reduced noise pollution, \$000/yr		90	21
Increased air pollution, \$000/yr	55	75	

Determine:

(a) the benefit cost ratio for Proposal 3, if $x=3$ (5 marks)

(b) the maximum value of x that would make Proposal 1 still acceptable (5 marks)

(c) the preferred Proposal, if $x=2\%$ (15 marks)

Question 3

Belt conveyor #A17-8 at your company's Sudbury nickel mine requires frequent and costly repairs. Management intends to replace this conveyor at a cost of \$X. The estimated (end of year) cash flows for operating the existing and the replacement (new) conveyors are listed below. The life of this (conveyor replacement) Project is 5 years. MARR (the minimum attractive rate of return) is y%. Salvage values are zero.

Year	Existing	Replacement
1	\$120,000	\$45,000
2	\$150,000	\$45,000
3	\$180,000	\$45,000
4	\$210,000	\$45,000
5	\$105,000	\$10,000

Determine:

- (a) the maximum value of X which would (economically) justify the conveyor replacement if $y = 10$ (10 marks)
- (b) the annual saving resulting from the replacement if $X=350,000$ and $y=10$ (5 marks)
- (c) the internal rate of return of this Project if $X=500,000$ (5 marks)
- (d) the maximum value of MARR that would justify replacement if $X=300,000$ (5 marks)

Question 4

Your company purchased a manufacturing plant for \$20,000,000 from Globe Ind. It is estimated that this plant will generate a yearly income of \$X during its 8 years life. The yearly cost of production (excluding loan interest) is estimated to be \$2,600,000. Production in this plant will commence on January 15, 2011.

Payments for the plant to Globe will be made in two \$10,000,000 installments: the first on January 15, 2011 and the second on January 15, 2012. These two payments will be fully financed by a \$20,000,000 loan secured from the First National Bank at an interest rate of 6% yearly compounding. (The first half of this loan will be received on January 15, 2011, and the second half on January 15, 2012.) According to the loan agreement the loan (including both principal and interest) will be repaid by five equal annual payments of magnitude \$W. The first of these payments (\$W) will be made on January 15, 2014 and the last on January 15, 2018. (Note: all accumulated interests will be deducted from each loan payment)

MARR (the minimum attractive rate of return) is 10%. Project life is 8 years. Salvage values are zero.

Determine

- (a) the value of W (10 marks)
- (b) the outstanding loan (amount owing) immediately after the second loan payment (5 marks)
- (c) the interest portion of the third loan payment (5 marks)
- (d) the minimum value of X which would make this project economically acceptable (5 marks)

Question 5

Western Oil Corp. expected to start production in its XWR-12 oil field in the Atlantic Ocean next January. Oil production in this field is anticipated to yield \$46,000,000 in annual revenues for four years. Operating and maintenance costs are estimated to be \$23,000,000 yearly. Drilling equipment costs are \$40,000,000 and they will be sold at the termination of the Project for \$6,000,000. Leasing (drilling platform, etc.) costs are \$4,500,000 per year (payable at the end of each year).

The income tax rate is 40%. The CCA (capital cost allowance) rate for the drilling equipment is 30%. The Project life is four years. MARR (the minimum attractive rate of return) is 8%.

Determine:

- a) the before tax cash flow in year two (2 marks)
- b) the taxable income in year three (4 marks)
- c) the after tax cash flow in year four (7 marks)
- d) the present value of the after tax cash flow of the Project (12 marks)