

NATIONAL EXAMINATIONS - December 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

New ventilating equipment is required in your company's nickel mine located in Sudbury, Ont. Three alternative equipments are being considered for purchase and installation. The initial (purchase and installation) costs and the estimated (after tax) yearly operating costs for each alternative are given in the Table below. The ventilating equipment will be used for six years (project life). Salvage values are zero. MARR (the minimum attractive rate of return) for your company is $z\%$.

	Alternative 1	Alternative 2	Alternative 3
Initial cost:	\$1,500,000	\$1,450,000	\$1,670,000
Yearly operating costs:			
in year 1	\$180,000	\$135,000	\$X
year 2	\$180,000	\$145,000	\$X
year 3	\$180,000	\$155,000	\$X
year 4	\$180,000	\$165,000	\$X
year 5	\$180,000	\$475,000	\$X
year 6	\$180,000	\$185,000	\$X

Determine:

- (a) the equivalent uniform annual cost of Alternative 2 if $z = 10$ (4 marks)
- (b) the preferred (least expensive) Alternative if $X = 150,000$ and $z = 10$ (7 marks)
- (c) the maximum value of X that would make Alternative 3 preferred if $z = 10$ (7 marks)
- (c) the maximum value of z that would make Alternative 3 less expensive than Alternative 1 if $X = 145,000$ (7 marks)

Question 2

Your company is contemplating the acquisition of an engine repair facility located in Halifax for \$Z. The facility will be kept in operation for six years (2012 to 2017). The available financial information about the facility for the current (2011) fiscal year is given below:

In the current (2011) fiscal year:	
Revenue	\$6,600,000
Material and labour costs	\$3,850,000
Rent	\$ 620,000
Loan payment (principal plus interest)	\$1,057,000
The interest portion of the loan payment	\$ 275,810
All other costs (utilities, etc.)	\$ 190,000
Capital cost allowance (for the machinery and equipment)	\$ 327,870

MARR (the minimum attractive rate of return) for your company is 15%. The income tax rate is 35%. The capital cost allowance rate for the machinery and equipment in the facility is 30%. Salvage values are zero. The after tax cash flow of the facility is expected to increase by 10% in each of the next six years.

Determine

- (a) the un-depreciated capital cost (book value) of the machinery and equipment in the facility at the end of the current (2011) fiscal year (4 marks)
- (b) the taxable income and the income tax payable in the current (2011) fiscal year (7 marks)
- (c) the after tax cash flow in the current (2011) fiscal year (7 marks)
- (d) the maximum value of Z that can be economically justified (7 marks)

Question 3

Your company operates a ship loading terminal in Victoria, BC. The estimated after tax operating costs of this terminal for the next three years are given below:

End of year	1	2	3
After tax operating costs	\$850,000	\$950,000	\$810,000

An engineering consultant recommended that the material handling equipment at the terminal be replaced at a cost of \$3,200,000 in order to reduce operating costs. The yearly operating costs of the terminal using the new equipment would be \$200,000.

The capital cost allowance rate for the material handling equipment is 30%. Salvage values are zero. MARR (the minimum attractive rate of return) for your company is 12%. The income tax rate is 25%. The terminal is intended to be used for three years (project life).

Determine:

- a) the equivalent uniform annual cost of the existing equipment for the next 3 years (5 marks)
- b) the capital cost allowance and the terminal loss of the new equipment in the final (third) year of the operation (5 marks)
- c) the present value of the after tax cash flow using the new equipment (include capital expenditure and capital cost allowances) (12 marks)
- d) whether or not the consultant's recommendation is justified (economically) (3 marks)

Question 4

Three alternative road widening construction Projects were proposed to the City Council of Edmonton. The objective of the Projects is to improve traffic flow in the downtown area. One of the three Projects will be selected for implementation by the Engineering Department of the City. Costs and monetary equivalents of the benefits and dis-benefits accruing from the Projects are listed below. The planning period is 20 years. Salvage values are zero. The interest rate is 6%.

	Project 1	Project 2	Project 3
Construction cost, \$	X	15,000,000	11,000,000
Maintenance cost, \$/year	470,000	660,000	610,000
Improved road safety, \$/year	660,000	290,000	180,000
Improved traffic flow, \$/year	1,200,000	1,750,000	980,000

Reduced noise pollution, \$/year	300,000
Reduced traffic policing cost, \$/year	120,000
Increased air pollution, \$/year	185,000

Determine:

- (a) the maximum value of X which would make Project 1 economically acceptable (5 marks)
- (b) the benefit cost ratio of Project 2 (5 marks)
- (c) the preferred (economically superior) Project, if $X=12,000,000$.
Use the benefit cost ratio method. (15 marks)

Question 5

A stand-by turbo-generator is installed at Hamilton airport to supply electricity in case of emergency. The initial cost of this turbo-generator is \$620,000, and its salvage value is \$140,000. The yearly operating and maintenance (O&M) costs of this unit are \$120,000 in the first year, and these costs increase by \$40,000 in each subsequent year. The generator is required for an indefinite period. In order to reduce costs, it is decided that the turbo-generator will be replaced (i.e., a new generator will be installed) in every n years. MARR (the minimum attractive rate of return) for your company is 10%.

Determine

- (a) the equivalent uniform annual cost of the turbo-generator, if $n=3$ (5 marks)
- (b) the present value cost of the turbo-generator for a 40 year period, if $n=4$ (5 marks)
- (c) the economic life of the turbo-generator (i.e., the value of n which would minimize costs) (15 marks)