

NATIONAL EXAMINATIONS - December 2009
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 install a new facility in its Edmonton plant for manufacturing air cleaning equipment for coal fired power stations. The project life is 8 years. MARR (the minimum attractive rate of return) is i %. The anticipated after tax cash flows of the project (in millions of dollars) are given below:

End of year	0	1	2	3	4	5	6	7	8
Cash flow	-6.5	2.0	2.0	2.0	$X+2.0$	2.0	2.0	2.0	$Y+2.0$

Determine:

- the value of Y if the present value of the project is \$4,600,000, $X=0$ and $i=12\%$ (monthly compounding) (5 marks)
- the present value of the Project if $Y=X$, the equivalent uniform annual value of the project is $1.5X$ and $i=10\%$ (yearly compounding) (5 marks)
- the value of Y if $X = 0$, $i = 10\%$ (yearly compounding) and the external rate of return of the Project is 20% (5 marks)
- the internal rate of return if $X = -3.0$ and $Y = 1.0$ (5 marks)
- the minimum value of X that would make the project (economically) acceptable if $i = 10\%$ (yearly compounding) and $Y=4X$ (5 marks)

Question 2

X. I. Metals Ltd. operates an assembly plant in Winnipeg. This plant, which was opened three years ago, is equipped with a variety of production machinery (equipment) having a book value of \$1,209,600 at the end of the third year of the operation of the plant. The capital cost allowance rate for this equipment is 40% . The purchase of this equipment (three years ago) was partially financed by a \$3,000,000 bank loan. This bank loan is being repaid (principal as well as interest) by five equal (end of year) annual payments. The loan interest rate is 8% (yearly compounding). The income tax rate is 30% .

Some additional financial information – estimated revenue and costs in the fourth year of operation of the plant are given below:

Revenue	\$14,800,000
Material cost	\$ 3,600,000
Labour cost	\$ 5,100,000
Overhead costs	\$ 1,200,000
Rent	\$ 860,000

Determine:

- the yearly loan payment (3 marks)
- the interest portion of the fourth loan payment (4 marks)
- the initial cost of the equipment (4 marks)
- the income tax payable (in the fourth year) (7 marks)
- the after tax cash flow (in the fourth year) (7 marks)

Question 3

General Ind. manufactures car seats in Oshawa. Chromium plating of certain components of the seats are currently done by a sub-contractor for \$Y/year. The Engineering Department of General Ind. prepared three alternative proposals for building a plating shop at the company's Mississauga plant to perform the plating work in-house. The planning period for this plating shop is n years. MARR (the minimum attractive rate of return) for the company is 12 %. The financial information regarding the proposals is given below:

	proposal 1	proposal 2	proposal 3
Initial cost, \$	3,780,000	4,200,000	5,050,000
Operating cost, \$/year	X	370,000	165,000
Salvage value, \$	300,000	300,000	300,000

Determine:

- the preferred proposal if $X = 440,000$ and $n = 8$. (10 marks)
- the yearly saving if the preferred proposal is implemented and $Y = 1,600,000$ (5 marks)
- the minimum value of n that would make implementation of proposal 2 economically justified if $Y = 1,300,000$ (5 marks)
- the maximum value of X that would make proposal 1 preferred (5 marks)

Question 4

Vancouver City Council considers three alternative proposals for implementation for widening Stanley Bridge and its access roads. The Project life is 20 years. The interest rate is i %. The financial details of the proposals (costs, savings, and the perceived monetary equivalents of benefits and disbenefits resulting from the implementation of the Project) are given below:

Proposal:	A	B	C
Construction cost, \$	22,500,000	17,000,000	X
Road maintenance costs, \$/year	910,000	780,000	530,000
Traffic flow improvements, \$/year	1,350,000	1,200,000	1,980,000
Travel safety improvements, \$/year	430,000	880,000	970,000
Reduced air pollution, \$/year	250,000		120,000
Increased noise pollution, \$/year		500,000	
Traffic policing costs reduction, \$/year	460,000	360,000	

Determine:

- the present value of the benefits minus costs for Proposal B if $i = 4\%$ (5 marks)
- the benefit cost ratio for Proposal A if $i = 4\%$ (5 marks)
- the maximum value of X that would make Proposal C acceptable (5 marks)
- the preferred Alternative if $i = 4\%$ and $X = 28,500,000$ (10 marks)

Question 5

A CNC lathe, used in a production process, requires major repair. The machine could either be completely overhauled (repaired) for \$X or replaced by a new machine for \$1,100,000. MARR (the minimum attractive rate of return) is 10 %. The lathe is required for 5 additional years. The O/M (operating and maintenance) costs and the salvage values for both (existing and new) machines are given below:

End of year	1	2	3	4	5
Existing machine:					
O/M cost, \$/year	140,000	140,000	140,000	320,000	140,000
Salvage value, \$	0	0	0	0	0
New machine:					
O/M cost, \$/year	55,000	55,000	115,000	55,000	55,000
Salvage value, \$	900,000	760,000	430,000	200,000	65,000

Determine:

- the equivalent uniform annual cost** of keeping (repairing and using) the existing machine if $X = 470,000$ **(5 marks)**
- the range of values of X** for which repair would be preferred **(5 marks)**
- the yearly saving if the machine is replaced** and $X = 710,000$ **(5 marks)**
- the internal rate of return** of this Project if the machine is replaced and $X = 750,000$ **(10 marks)**