NATIONAL EXAMINATIONS - May 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 plans to install a wind turbine for generating electricity for the company's aluminum smelter located in Nova Scotia. The project life is 30 years. MARR (the minimum attractive rate of return) is i %. The anticipated after tax cash flows of the (wind turbine) project are given below:

End of year	Cash flow
0	-$10,000,000
1 to 29	$1,300,000
30	$X

Determine:

a) the present value of the project if X = $2,000,000 and i=12% (yearly compounding) **(3 marks)**
b) the value of X if the equivalent uniform annual value of the project is $240,000 and i=10% half yearly compounding **(7 marks)**
c) the external rate of return if X = $1,300,000 and i = 15% (yearly compounding) **(3 marks)**
d) the internal rate of return if X = $1,800,000 **(7 marks)**
e) the minimum value of X that would make the project (economically) **acceptable** if i = 15 % (yearly compounding) **(5 marks)**

Question 2

Northern Metals Ltd. intends to install a new furnace in its steel processing plant in Hamilton, Ontario. Two alternative furnaces are under consideration for this Project. The relevant financial information - initial costs, operating and maintenance costs, and salvage values (income received at the end of the Project or when the furnace is replaced) – are given in the Table below:

	Furnace 1	Furnace 2
Initial (purchase and installation) cost, $	2,500,000	1,800,000
Furnace (maximum functional or useful) life, years	8	6
Yearly operating costs, $/year	475,000	568,000
Yearly maintenance costs, $/year	125,000	162,000
Salvage value at the end of 2 years, $	960,000	830,000
Salvage value at the end of 4 years, $	850,000	630,000
Salvage value at the end of 6 years, $	590,000	420,000
Salvage value at the end of 8 years, $	480,000	---

The planning period is n years and MARR (the minimum attractive rate of return) is i %.

Determine:

a) the present value of all costs if Furnace 1 is installed,
n = 10 years and i = 12 % (yearly compounding) **(4 marks)**
b) the equivalent uniform annual value of all costs if Furnace 2 is installed,
n = 10 years and i = 15% (yearly compounding) **(4 marks)**
c) which of the two Furnaces is economically superior if n = 14 years
and i = 12 % (yearly compounding) **(12 marks)**
d) the equivalent uniform annual loss if the economically inferior furnace
is installed, n = 14 years and i = 12 % (yearly compounding) **(5 marks)**

Question 3

The Chief Engineer of Mississauga City Council considers two alternative proposals for implementation to improve access to Highway 410 at City Centre. The Project life is 30 years. The interest rate is i %. The financial details of the two proposals - costs, savings, and the perceived monetary equivalents of benefits and disbenefits resulting from the implementation of the Project - are given in the Table below:

Proposal:	**A**	**B**
Construction cost, $	21,000,000	16,000,000
Road maintenance costs, $/year	840,000	780,000
Traffic flow improvements, $/year	1,350,000	1,200,000
Travel safety improvements, $/year	320,000	880,000
Reduced air pollution, $/year	100,000	
Increased noise pollution, $/year		400,000
Traffic policing cost reduction, $/year	460,000	360,000

Determine:

a) the present value of the benefits minus costs for Proposal A if i = 5% **(5 marks)**
b) the benefit cost ratio for Proposal B if i = 5% **(5 marks)**
c) the minimum value of i that would make Proposal B acceptable **(5 marks)**
d) the preferred Alternative if i = 4 % **(10 marks)**

Question 4

Western Oil Corp. intends to build an oil processing and recovery plant in Alberta. The life of the Project is 4 years. MARR (the minimum attractive rate of return) is 12 %. The cost of equipment (initial cost) required for the Project is $42,000,000. The CCA (capital cost allowance) rate for this equipment is 30 %. The income tax rate is 25%.

The anticipated after tax cash flows for the first three years of the Project are:

End of Year	0	1	2	3
After tax cash flow, $	-42,000,000	12,000,000	15,500,000	16,800,000

The following financial information is available for the final (fourth) year of the Project:

Revenue (end of year)	$56,000,000
Material, labour and overhead costs (end of year)	$36,300,000
The book value of the equipment at the beginning of year 4	$12,600,000
Salvage value of equipment (end of year income)	$7,000,000
Loan payment (end of year)	$16,850,000
Interest portion of the loan payment	$ 2,568,000

Determine:

a) **the before tax cash flow** in the final year of the Project **(3 marks)**
b) **the after tax cash flow** in the final year of the Project **(15 marks)**
c) **the (after tax) rate of return** of the Project **(7 marks)**

Question 5

A new air control system is designed for the main terminal of Vancouver Airport. The initial (equipment and installation) cost of the system is $2,000,000. The Project life is n years. The operating costs and the salvage values are given below:

Operating costs in the first year	$600,000
Yearly increase in operating costs	$400,000
(i.e., the operating costs in the second year is $1,000,000, etc.)	
Salvage value (income) at the end of one year	$1,200,000
Yearly reduction in salvage value	$100,000
(i.e., the salvage value at the end of two years is $1,100,000)	
MARR (the minimum attractive rate of return)	10 %

Determine:

a) **the equivalent uniform annual cost** of the system if n = 5 **(4 marks)**
b) **the present value of all additional costs** if the Project life is increased from 5 to 6 years **(4 marks)**
c) **the economic life** of the system **(13 marks)**
d) **the yearly savings** if n=20 and the system is regularly replaced at the end of its economic life instead of at the end of each 5 years. **(4 marks)**