NATIONAL EXAMINATIONS - May 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 intends to commence production of polyvinyl chloride automotive components for Magna Int. The anticipated life of this project is six years. The annual (end of year) revenue is expected to be $X/year (in each of the six years). MARR (the minimum attractive rate of return) for your company is r%. The estimated costs of this project (including initial costs) are given below:

End of year	Costs
0	$22,500,000
1	$ 4,000,000
2	$ 5,000,000
3	$ 6,000,000
4	$ 7,000,000
5	$ 8,000,000
6	$ Z

Determine:

a) **the present value of all costs** if $Z = 3,500,000$ and $r = 12\%$ (3 marks)

b) **the value of Z** if the equivalent uniform annual value of the cash flow is
    $3,200,000, X=2Z, and r =10\%$ (5 marks)

c) **the value of X** that would make the external rate of return of the Project 12%
    if $Z = 9,000,000$ and $r = 10\%$ (5 marks)

d) **the internal rate of return of the project** if $X = 14,500,000$ and
    $Z = 9,000,000$ (5 marks)

e) **the minimum value of X that would make the project** (economically)
    acceptable if $r = 15\%$ and $Z = 5,000,000$ (7 marks)

Question 2

Your company intends to operate its highly polluting coal-fired power plant located in Alberta for 4 more years before demolishing it (i.e., the Project life is 4 years). The steam turbines of the plant are defective and they have to be either overhauled (repaired) at a cost of $Y/turbine or replaced. The life of a turbine after an overhaul is 2 years (and after two years it has to be overhauled again in order to keep it in operation). The cost of a new turbine is $X and its expected life is 5 years. MARR (the minimum attractive rate of return) is 10 %. Salvage values are zero. The O/M (operating and maintenance) costs of the new and overhauled turbines are given below:

End of year	1	2	3	4
Overhauled turbine, $/year	420,000	420,000	-	-
New turbine, $/year	140,000	140,000	140,000	140,000

Determine:

a) **the present value of the cost** of keeping one existing turbine in operation
(for four years) using overhauls if Y = 820,000   (3 marks)

b) **the equivalent uniform annual cost** of a new turbine (if it is used for four
years) and X = 2,300,000   (5 marks)

c) **the yearly saving** if a turbine is replaced instead of keeping an existing
turbine in service by overhauls. X = 2,300,000 and Y = 820,000   (5 marks)

d) **the internal rate of return** of the cash flow of the savings if a turbine is
replaced (instead of keeping an existing turbine in service).
X = 2,300,000 and Y = 820,000   (5 marks)

e) **the range of values of X** that would economically justify replacement of a
turbine if Y = 500,000   (7 marks)

Question 3

The Finance Committee of the London, Ont. City Council considers three alternative proposals for improving access to highway #401. The Project life is 25 years. The interest rate is i %. The financial details of the proposals (costs, savings and financial equivalents of benefits and dis-benefits) are given below:

Proposal:	A	B	C
Road construction cost, $	5,000,000	4,000,000	6,000,000
Road maintenance costs, $/year	450,000	600,000	350,000
Safety improvements, $/year	350,000	400,000	550,000
Traffic flow improvements, $/year	150,000	189,000	210,000
Increased noise pollution, $/year		120,000	
Reduced traffic policing costs, $/year	160,000		

Determine:

a) **the present value of the <u>benefits minus costs</u>** for Proposal A if i = 5%   (4 marks)
b) **the <u>benefit cost ratio</u>** for Proposal B if i = 6%   (4 marks)
c) **the maximum value of i** that would make Proposal C acceptable   (6 marks)
d) **the preferred Proposal** if i = 4%   (11 marks)

Question 4

Nova Ind. must modernize its assembly plant located in Hamilton, Ont. Management considers four alternative proposals for implementation. The planning period is n years. MARR (the minimum attractive rate of return) for the company is 15%. The relevant financial information regarding the proposals: initial costs and yearly cash flows (income minus expenses) are given below:

Proposal	A	B	C	D
Initial cost, $	4,000,000	3,500,000	5,000,000	6,000,000
After tax cash flow, $/year	750,000	X	980,000	Y

Determine:

a) **the yearly saving** if proposal C instead of A is implemented and n=12   (5 marks)

b) **the minimum value of n** that would make proposal B acceptable if
    X=600,000   (5 marks)

c) **the maximum value of (Y-X)** that would make proposal D economically
    superior to B if n=10   (5 marks)

d) **the preferred proposal** if X = 600,000, Y = 1,100,000 and n = 8   (10 marks)

Question 5

General Food Corp. operates a water filtering and purification system at its Halifax plant. This system was purchased four years ago at a cost of $4,200,000. The purchase was partially financed by a $4,000,000 loan obtained from the Commercial Bank of Halifax. The loan is being repaid (principal and interest) by six equal (end of year) annual payments. The loan interest rate is 6% (yearly compounding). The income tax rate is 30%. The capital cost allowance rate for water filtering and purification systems is 30%.

Some additional financial information – estimated revenues and costs for the current (fifth) year of operation of this system are given below:

Revenue	$8,220,000
Operating cost	$3,600,000
Maintenance cost	$1,100,000

Determine:

a) **the capital cost allowance** in the current (fifth) year   (3 marks)

b) **the yearly loan payment**   (3 marks)

c) **the interest portion of the fifth loan payment**   (3 marks)

d) **the income tax payable** in the current (fifth) year   (9 marks)

e) **the after tax cash flow** in the current (fifth) year   (7 marks)