

NATIONAL EXAMINATIONS - December 2008
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 the development of a new coal mining facility in Nova Scotia. The estimated cash flows of this proposed project are listed below:

End of year	0	1	2	3	4	5	6	7	8
Cash flow, \$,000	-X	120	120	120	120	120	Y	120	120

The project life is 8 years, and MARR (the minimum attractive rate of return) is $z\%$.

Determine:

- the **minimum value of Y which would make this project economically acceptable** provided that $X=600$ and $z = 12\%$ yearly compounding (5 marks)
- the **present value of the cash flow of the project** if $X=500$, $Y=120$ and $z=10\%$ monthly compounding (5 marks)
- the **equivalent uniform annual value of the cash flow of the project** if $X=800$, $Y=360$ and $z=8\%$ half yearly compounding (5 marks)
- the **value of X if the external rate of return of the project is 15%**, $Y=120$ and $z = 10\%$ yearly compounding (5 marks)
- the **internal rate of return of the project** if $X= 650$ and $Y = 120$ (5 marks)

Question 2

Your company proposes to set up a manufacturing facility to supply disc brakes for Ford. The project requires new automated equipment. Two different types of equipment, equally suitable for the task, are being considered for purchase and installation by the Engineering Department. The costs of these equipments are listed below:

End of year	0	1	2	3	4
Equipment 1	\$1,200,000	\$80,000	\$180,000	\$280,000	\$380,000
Equipment 2	\$ 900,000	\$280,000	\$280,000	\$280,000	\$280,000

The expected project life is four years. The equipment salvage values at the termination of the project are 20% of their initial costs. MARR (the minimum attractive rate of return) for the company is 12%. The annual net revenue derived from this project (excluding equipment costs and salvage values) is expected to be \$R. The company intends to purchase and install the less expensive equipment.

Determine:

- which is **the less expensive equipment** (5 marks)
- the **equivalent uniform annual saving** if the less (as opposed to the more) expensive equipment is purchased and installed (5 marks)
- the **minimum value of R** that would make the project economically acceptable (5 marks)
- the **internal rate of return** of the project if $R= 600,000$ (5 marks)
- the **decrease in the present value of the project** if the project life is reduced to three (from four) years and $R= 650,000$ (5 marks)

Question 3

The Engineering Department of the City of Halifax prepared three alternative plans for improving the flow of traffic over a congested bridge in the City. The project life is 30 years. The interest rate is 5%.

The financial details and the perceived monetary equivalents resulting from changes in traffic flow, road safety, noise pollution, and environmental conditions due to the implementation of the project are listed below:

Plan:	1	2	3
Construction cost, \$	6,300,000	5,800,000	4,600,000
Maintenance costs, \$/year	600,000	180,000	190,000
Traffic safety improvements, \$/year	850,000	580,000	720,000
Traffic policing cost reduction, \$/year	120,000		140,000
Traffic flow improvements, \$/year	430,000	25,000	
Increase in noise pollution, \$/year	200,000		260,000
Environmental degradation, \$/year	145,000		90,000

Determine:

- a) the **present values of the net benefits** for each Plan (6 marks)
- b) the **present values of the net costs** for each Plan (6 marks)
- c) the **Plan (if any) you would recommend for implementation** (13 marks)

Question 4

Your company intends to set up a new division in its Oakville, Ontario plant to manufacture heat pumps. The cost of equipment required for this project is \$4,600,000. The CCA (capital cost allowance) rate for this equipment is 20%. The project life is four years. At the end of four years the equipment will be sold. The income tax rate is 35%. MARR (the minimum attractive rate of return) is 15%.

The estimated after tax (end of year) cash flows for the first three years of the project are: \$1,200,000; \$720,000 and \$890,000. The estimated financial information for the fourth (last) year of the project is listed below:

Revenue	\$X
Labour, material and overhead costs	\$1,200,000
Lease payment	\$ 280,000
Loan payment	\$1,130,000
The interest portion of the loan payment	\$ 819,537
Receipt from equipment sale	\$1,600,000
(Assume that income and expenses listed above occur at the end of year four)	

Determine:

- a) the **CCA** in the final (fourth) year of the project (5 marks)
- b) the **after tax cash flow** in the final year of the project if $X=4,760,000$ (10 marks)
- c) the **minimum value of X** that would make the project economically acceptable (10 marks)

Question 5

Your client, The Canadian Western Bank, requires a new air conditioning and ventilating system in its head office in Victoria. The engineering department developed three alternative proposals for the new system. The initial costs and the estimated yearly operating and maintenance (O&M) costs for the three systems are given below:

	initial cost	yearly O&M cost
System 1	\$4,500,000	\$720,000
System 2	\$6,400,000	\$315,000
System 3	\$3,700,000	\$990,000

(The yearly O&M costs are paid at the end of each year.) The project life is n years. MARR (the minimum attractive rate of return) is x %.

Each system fully satisfies the technical requirements. It is your task as a consultant to recommend to your client one of the three Systems (the preferred system) for installation. The preferred system is selected on the basis of economic considerations only.

Determine:

- a) the **preferred system** if $n = 8$ and $x = 12$. (Use the internal rate of return method in your calculation!) **(10 marks)**
- b) the **annual cost** of the preferred system if $n = 8$ and $x = 12$ **(5 marks)**
- c) the **minimum value of n** that would make the annual cost less than \$1,400,000 if $x = 12\%$ **(5 marks)**
- d) the **maximum value of x** that would make the annual cost less than \$1,400,000 if $n = 8$ **(5 marks)**