

NATIONAL EXAMINATIONS - MAY 2003

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

Northern Mining Corp. plans to develop a new copper mine in New Caledonia. The anticipated cash flow for this project is given below:

End of year	0	1	2	3	4	5
Cash flow, \$10⁶	-12	3	3	5	5	X

The minimum attractive rate of return (MARR) for the company is y .

Determine:

- (a) the present value of the cash flow if $X = 6$
and $y = 12\%$ quarterly compounding (5 marks)
- (b) the value of X if the future value of the cash flow (at the end
of year five) is \$3,900,000 and $y = 12\%$ yearly compounding (5 marks)
- (c) the payback period if $X = 9$ (5 marks)
- (d) the internal rate of return if $X = 5$ (5 marks)
- (e) the external rate of return if $X = 5$ and $y = 10\%$ yearly compounding (5 marks)

Question 2

Northern Mining Corp. purchased all of the capital equipment for its New Caledonia copper mine from MNS Development Co. for \$12,000,000 payable on June 1, 2003. Northern Mining Corp. can either use its equity funds or obtain a commercial loan to pay the \$12,000,000. Equity financing would necessitate selling a sufficient number of \$100 nominal value Bell Canada Bonds held by Northern Mining Corp. These bonds pay 6.5% interest on May 31 each year and will mature on May 31, 2006. These bonds can be sold on June 1, 2003 for \$96 each. Alternatively, a three year loan could be obtained from the Canadian Investment Bank on June 1, 2003 at 10% yearly compounding interest. Three equal yearly payments, covering both principal and interest, would be required to repay the loan. The first such loan payment would be due a year after obtaining the loan, i.e., on June 1, 2004.

The minimum attractive rate of return (MARR) for the company is 12%. The income tax rate is 40%.

Determine:

- (a) the yearly loan payment and the interest portion of
each loan payment (5 marks)
- (b) the present value of the after tax cost of loan financing (5 marks)
- (c) the present value of the after tax cost of equity financing
(i.e., the present value of the after tax opportunity cost) (10 marks)
- (d) the yearly saving the company would realize by using the economically
more advantageous method of financing the project (5 marks)

Question 3

On May 1, 2001 K&G Corp. opened a manufacturing facility in a leased building in Halifax to produce compressors blades under contract for Pratt & Whitney Corp. The following information is available about this project for the current fiscal year starting on May 1, 2003:

Revenue	\$ 8,650,000/year
Labour cost	\$ 2,100,000/year
Material cost	\$ 1,600,000/year
Overhead	60% of the labour cost
Lease cost	L / year

The cost of the capital equipment, purchased for the project on May 1, 2001 using equity funds, was \$18,000,000. The CCA (capital cost allowance) rate for this equipment is 30%. In addition, \$12,000,000 working capital was also required for the project, and this amount was borrowed from the Manitoba Savings Corp. The yearly loan payment to be made to the Manitoba Savings Corp. on April 30 each year is \$3,165,570. In the current fiscal year the interest portion of the loan payment is \$787,230.

The income tax rate is 45% and the minimum attractive rate of return (MARR) for the company is 12 %.

Determine:

- (a) the book value of the equipment at the end of the third year of the project (5 marks)
- (b) the before tax cash flow in the current fiscal year, $L = \$300,000$ (5 marks)
- (c) the after tax cash flow in the current fiscal year, $L = \$300,000$ (5 marks)
- (d) the maximum lease cost that would still make the after tax cash flow positive in the current fiscal year (5 marks)
- (e) the sensitivity of the after tax cash flow to the lease payment in the current fiscal year (5 marks)

Question 4

The operating and maintenance costs of the air cleaning, supply and exhaust system installed by Northern Mining Corp. in its copper mine located in New Caledonia are \$120,000 in the first year of operation and they are expected to increase by 15% in each subsequent year. The initial cost of the air cleaning, supply and exhaust system, including installation, is \$640,000. The physical life of the system is five years. The salvage value is zero at any time, however the cost of removing the air cleaning, supply and exhaust system is \$150,000

The minimum attractive rate of return (MARR) for the company is 10 %.

Determine:

- (a) the present value cost of the air cleaning, supply and exhaust system for three years, if the system is replaced after three years of use (5 marks)
- (b) the economic life of the air cleaning, supply and exhaust system (15 marks)
- (c) the yearly saving if the air cleaning, supply and exhaust system is replaced at the end of its economic life instead of at the end of each three years (5 marks)

Question 5

Coltex Ltd. plans to produce a newly developed washing machine for the domestic market. The washing machines would be manufactured at the rate of 50,000 units per year for a four year period. The motor for the washing machine can either be manufactured in-house (alternative A) or purchased from a South Korean supplier (alternative 2).

The cash flows for the two alternatives are given in the Table below:

end of year	0	1	2	3	4
alternative A	-\$6,000,000	-\$1,200,000	-\$1,600,000	-\$2,000,000	-\$Y
alternative B		-\$X	-\$X	-\$X	-\$X

The minimum attractive rate of return (MARR) for the company is 15 %.

Determine:

- (a) the preferred alternative if $X=3,500,000$ and $Y=2,400,000$ **(10 marks)**
- (b) the value of X that would make the two alternatives economically equivalent if $Y=2,000,000$ **(5 marks)**
- (c) the probability that alternative A is the economically superior alternative if $X=3,000,000$ and the probability distribution of Y is: **(10 marks)**

Y	1,500,000	1,700,000	2,100,000	2,400,000
probability	10%	30%	50%	10%