



NATIONAL EXAMINATIONS - DECEMBER 2002

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

Delta Ind. recently purchased a five-axes CNC milling machine for \$1,290,000. The machine, installed in Delta's manufacturing plant in Oshawa, is expected to generate \$400,000 revenue annually. Its yearly operating and maintenance costs are expected to be \$87,000. In addition to this, \$180,000 will have to be spent on a major preventive maintenance operation after using the machine for four years. The machine will be in service for eight years and then it will be replaced by a new machine costing \$1,290,000. The salvage value of the eight years old machine is \$350,000.

Delta opens a sinking fund account at the local branch of the National Bank for accumulating capital for the eventual replacement of the machine, and makes equal end-of-year annual deposits into this account during the life of the machine (eight years). The account earns interest at the rate of 8% annually. The minimum attractive rate of return (MARR) for Delta Manufacturing Co. is 14%.

Determine:

- (a) the yearly sinking fund payment (5 marks)
- (b) the value of the sinking fund account immediately after the third deposit (5 marks)
- (c) the capital recovery cost of the machine (5 marks)
- (d) the capitalized cost of the machine (include all costs) (5 marks)
- (e) the payback period (5 marks)

Question 2

Rolco Engineering Ltd. has \$8,000,000 capital available for investment. Management contemplates the following two alternative business opportunities:

(A) commissioning a manufacturing plant in Brampton, Ont. for producing replacement valves for the K245-2 motorcycle engine. The equipment for the facility costs \$8,000,000 initially, with an additional \$1,600,000 payment three years later, and a final \$2,200,000 payment an additional two years later. The expected net revenue (income minus operating costs) of this facility is expected to be \$1,950,000 annually. The salvage value of the equipment at the end of the project's ten years life is \$800,000.

(B) acquiring special commercial bonds issued by Exwal Corp. for \$8,000,000. These bonds will mature in ten years and pay interest at the rate of x % annually.

The minimum attractive rate of return (MARR) for Rolco Engineering is y %

Determine:

- (a) the present value of alternative (A) if $y = 12$ (5 marks)
- (b) the present value of alternative (B) if $x = 13$ and $y = 12$ (5 marks)
- (c) the break-even value of x if $y = 12$ (5 marks)
- (d) the break-even value of y if $x = 13$ (10 marks)

Question 3

The steam turbine of an auxiliary electricity generating facility at the Sudbury mine of General Zinc Corp. has the following operating and maintenance costs:

End of Year		2	3	4
Operating and Maintenance Cost, \$/year	48,000	76,000	108,000	70,000

The cost of the turbine is \$440,000. The CCA (capital cost allowance) for turbines is 20 %. The salvage value of the turbine is equal to its book value. The income tax rate is 45 %. The minimum attractive rate of return (MARR) is 10 %.

Determine:

- (a) the yearly CCA (use the half year rule according to the Canadian tax law) **(5 marks)**
- (b) the yearly after tax cash flow **(5 marks)**
- (c) the economic life of the turbine **(15 marks)**

Question 4

Quantum Steel Co. considers manufacturing special zink/cadmium plated tubes for off-shore oil drilling equipment. The initial capital cost of the equipment for the project is \$18,000,000 with zero salvage value at the end of the project's ten year life. The annual revenue is expected to be \$X and the annual operating cost is \$2,600,000. Although the exact value of X is unknown, it is estimated that it will be between \$3,500,000 and \$8,000,000 with the following associated probabilities:

probability, %	20	25	45	10
annual revenue, \$million	3.5	6.5	W	8.0

The minimum attractive rate of return (MARR) for Quantum Steel Co. is 12 %.

Determine:

- (a) the external rate of return of the project if $W = 7.0$ **(5 marks)**
- (b) the internal rate of return of the project if $W = 2.0$ **(5 marks)**
- (c) the minimum value of W that would still make the project economically acceptable **(15 marks)**

Question 5

Ten new centrifugal air blowers are needed in the Mississauga paint-shop of Atlas Metals Inc. The following two blowers are considered for purchase and installation by the chief engineer:

(A) the PK-200 blower, manufactured by Teledyne Ltd., and sold for \$120,000. Its operating and maintenance costs are \$11,000 per year. In addition, it will be necessary to replace the rotor at a cost of \$15,000 after two years of service.

(B) the 280XG blower, manufactured by Steuer Engineering. It costs \$85,000, and its operating and maintenance costs are \$28,000 annually.

The blowers are required for three years, and at the end of the three years they will be scrapped (zero salvage value). Atlas Metals pays 40 % income tax. The CCA (capital cost allowance) for the blowers is 30 %. MARR (minimum attractive rate of return) is 10 %. The blowers are equity financed.

Determine:

(a) the after tax cash flow of alternative (A) **(5 marks)**

(b) Which of the two blowers is more economical ?

Use after tax internal rate of return as the measure of merit **(20 marks)**