

**National Exams May 2015**  
**11-CS-1, Engineering Economics**  
**3 hours Duration**

**NOTES:**

1. Assumptions could be made about questions that are not clear to the candidate, but that should be stated clearly.
2. Candidates are urged to draw cash flow diagrams whenever applicable.
3. Any non-communicating calculator is permitted. This is an open book exam.
4. Any four out of the five questions constitute a complete exam paper. Only the first four questions, as they appear in the answer book, will be marked.
5. Each question is of equal value.

## QUESTION 1

The City Council of a fast growing city in the west of Canada is planning to construct a new express way to help improve the traffic flow in the city. Construction is to start in 2020 and is expected to last four years at a cost of \$40 million per year. After construction is completed, the regular cost of operation and maintenance is expected at \$3 million for the first year, increasing by 1% per year thereafter. Major overhauling (major repair) for the express way is needed every 10 years at a cost of \$5 million (each time). Consider the present to be the end of 2015/beginning of 2016. The service life of the express way is 40 years and the interest rate is 6%.

- Draw a cash flow diagram for the new express way project (from present till end of year 2063). (8 Marks)
- Determine the Present Worth of the project. (10 Marks)
- Determine the Annual Worth of the project (Hint: make use of the PW calculated in b). (7 Marks)

## QUESTION 2

You need to choose between two saving accounts in two different banks. Bank A offers 6% interest per six months, compounded semi-annually, while bank B offers 3% interest per three months compounded quarterly.

- What is the nominal interest rate for each bank? (6 Marks)
- Find the effective annual interest rate for each bank. (8 Marks)
- Which bank would be better for you to save your money in? (4 Marks)
- How much should the interest rate (per 3 months, compounded quarterly) offered by bank B be so that neither of the two banks is preferred over the other after a year of saving? (7 Marks)

## QUESTION 3

RTCE Stamping Corp. is a major steel stamping company in the southern region of Canada. The company is looking to buy a new high-speed press to increase its production capacity. The company received two quotes from two different manufacturers: Offer 1 (from a USA manufacturer) and Offer 2 (from a Korean manufacturer). The Minimum Acceptable Rate of Return (MARR) for TCE Stamping Co. is 9%. Answer the following questions using the information in the table below.

	Offer 1	Offer 2
<b>Selling price</b>	\$1,000,000	\$1,150,000
<b>Shipment and installation cost</b>	\$50,000	75,000
<b>Maintenance cost</b>	\$8,000 for the first year, increasing by 1,000 per year thereafter	\$7,000 for the first year, increasing by 800 per year thereafter
<b>Annual operating cost</b>	\$8,500	\$7,500
<b>Salvage Value</b>	210,000	300,000
<b>Service Life</b>	15 years	20 years

- Which offer is better, based on Annual Worth comparison? (7 Marks)
- Which offer is better, based on Future Worth comparison? (5 Marks)
- Do both methods (Annual Worth and Future Worth) always lead to the same result? (3 Marks)
- For a fifteen-year study period, what salvage value for the press in offer 2 would make it a better choice? (6 Marks)
- State the assumption made to compare mutually exclusive alternatives of different lives? (4 Marks)

#### QUESTION 4

A new heat treatment furnace to be used by an aluminum fabrication plant in Southern Ontario costs \$30,000 to buy. The new furnace will also cost the plant \$1,200 immediately in installation and training expenses. Operating and maintenance costs are estimated at \$3,000 for the first year, and to increase by \$1,320 per year thereafter. The scrap value of the furnace can be estimated at any time by a declining-balance rate of 15% and the interest rate is 10%.

- Determine the EAC (Equivalent Annual Cost) for the furnace over one year, two years, three years and four years of service life. (12 Marks)
- How often should the furnace be replaced, assuming cash flows and interest rates are to be constant over the plant time horizon? (5 Marks)
- What depreciation rate will lead to \$3,000 book value for the furnace after four years of use? (4 Marks)
- What does the term "sunk cost" refer to and how would it affect a replacement decision? (4 Marks)

#### QUESTION 5

Three projects are being evaluated by a national financial corporation. The table below summarizes expected cash flows for each of the three projects over the next seven years. Due to budget limitations, the corporation will only choose one project out the three projects. At a MARR (Minimum Acceptable Rate of Return) of 8%, answer the following.

Project	Initial Cost	Expenses per Year	Return at end of year 7
1	\$100,000	\$40,000 for the first year, increasing by \$2,000 per year thereafter	\$600,000
2	\$360,000	\$85,000 for the first year, increasing by \$4,000 per year thereafter	\$1,600,000
3	\$185,000	\$55,000 for the first year, increasing by \$3,000 per year thereafter	\$850,000

- Determine the economically best project for the corporation using a rate of return method. (14Marks)
- Is it always the case for the project with the highest rate of return to be the economically best alternative? (5 Marks)
- Are you expecting different results if the comparison is based on Present Worth? (Hint: no calculations are needed). (6 Marks)