

**National Exams May 2013**  
**11-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. Any non-communicating calculator is permitted. This is an open book exam.
3. Any five (5) of the six questions constitute a complete exam paper. Only the first five questions, as they appear in the answer book, will be marked.
4. Each question is of equal value.

## QUESTION 1

RTC Financial Inc., in Essex County is considering the following two investments: the first investment pays 1% interest per month, compounded monthly, while the second pays 3% interest per 3 months, compounded quarterly.

- a) What is the effective quarterly interest rate for each of the two investments? (6 Marks)
- b) What is the effective annual interest rate for each of the two investments? (6 Marks)
- c) Which investment should RTC Financial Inc. select? (2 Marks)
- d) How much should the interest rate be (per month, compounded monthly) for the first investment so that neither of the two investments is preferred over the other after one year of investment? (6 Marks)

## QUESTION 2

The municipality of a major city in East of Canada is planning to build a new bridge to decrease the traffic load on the two old bridges connecting both sides of the city across the river. Construction is to start in 2015 and is expected to take four years at a cost of \$25 million per year. After construction is completed, the cost of operation and maintenance is expected to be \$2.5 million for the first year, and increase by 2.8% per year thereafter. The scrap/salvage value of the bridge at the end of year 2048 is estimated to be \$5 million. Consider the present to be the end of 2013/beginning of 2014 and the interest rate to be 8%.

- a) Draw a cash flow diagram for this project (from present till end of year 2048). (6 Marks)
- b) Find the Present Worth of this project. (8 Marks)
- c) Find the Future Worth of this project. (6 Marks)

## QUESTION 3

Luxury Homes Limited in mid west is to install a new laundry system for one of its elegant residential buildings. The company is choosing between three laundry systems. System A has a leasing cost of \$500 per year (10-year contract and lease payments are made at the end of the year) and installation cost of \$1,000. Annual Savings of this system is expected to be \$700 per year (energy savings). System B has a purchase price of \$3,000, and installation cost of \$600. It has a salvage value of \$500 after 10 years of service, and is expected to provide savings of \$750 per year. System C has a purchase price of \$5,000, including installation. A quarter of this cost is paid now, and the rest is paid at the end of the first year. It has a salvage value of \$1,000 after 10 years, and is expected to provide savings of \$800 per year. Maintenance is covered by laundry systems providers up to 10 years and Luxury Homes has a MARR (Minimum Acceptable Rate of Return) of 12%.

- a) Using a rate of return method, which laundry system should be installed? (Hint: one system must be chosen). (12Marks)
- b) Should the best alternative in this type of analysis (rate of return) be always the one with the highest rate of return? (4 Marks)
- c) Are you expecting different results if the comparison is based on Annual Worth? (4 Marks)

## QUESTION 4

A small business office is considering buying a new photocopier. The office is choosing between two mid-range photocopiers of comparable specifications. The office has a MARR (Minimum Acceptable Rate of Return) of 7%. The salvage value for both photocopiers at the end of their service lives is expected to be \$200. Use the information in the table below to answer the following questions.

	Photocopier A	Photocopier B
Price	\$3,200	\$2,200
Running cost per year	\$600	\$700
Maintenance cost	\$300 for the first year, increasing by \$50/year thereafter	\$200 for the first year, increasing by \$70/year thereafter
Life	6 years	4 years

- What is the necessary assumption for comparing mutually exclusive alternatives of different lives? (3 Marks)
- Which alternative is preferable based on Annual Worth comparison? (5 Marks)
- Which alternative is preferable based on Present Worth comparison? (5 Marks)
- For a four-year study period, what salvage value for photocopier A would make it the preferred choice? (5 Marks)
- Do both methods (Present Worth and Annual Worth) always yield to the same decision? (2 Marks)

## QUESTION 5

Xenon Electric is considering buying a new printed circuits tester that would cost \$16,000. As a result of this deal, the company will be saving \$3,000 per year due to expected quality improvements. The salvage value of the tester is estimated to be \$2,000 after 8 years of service life. After-tax MARR of Xenon Electric is 10% and it is taxed at 45%. Tax rules in Xenon Electric country specify that capital allowance for industrial equipment is to be calculated using straight-line depreciation scheme, with a life of 7 years and a 0 salvage value.

- Based on after-tax present worth analysis, should this investment be made? (Hint: use generic after-tax calculations) (8 Marks)
- How much is the approximate after-tax IRR (Internal Rate of Return) on this investment? (6 Marks)
- Based on approximate after-tax IRR analysis, should this investment be made? (3 Marks)
- Does the approximate after-tax IRR analysis always lead to the same decision of the accurate after-tax IRR analysis? (3 Marks)

## QUESTION 6

A company purchased a packaging machine seven years ago for \$45,000 in addition to an installation cost of \$3,000. The market value of the machine has been declining by 15% each year for last seven years. The finance department of the company has forecasted that the rate of decline of the machine is expected to continue at a rate of 10% till the end of its service life. Costs of operation and maintenance of the machine are estimated to be \$2,000 this year, and are expected to increase by \$270 each year. The MARR is 9%.

- How much should the EAC (Equivalent Annual Cost) of a new packaging machine be over its economic life to justify replacing the old one? (12 Marks)
- When to perform such a replacement? (4 Marks)
- What effect do installation and capital costs incurred up to this time have on your analysis? (4 Marks)