

National Exams December 2014
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

A small business is looking for a bank loan to buy needed equipment to start a new project. There are three different banks to choose between. Bank A charges 10% compounded daily, bank B charges 10.25% compounded weekly, and bank C charges 10.5% compounded monthly. (Hint: 1 year could be 366 or 52 weeks)

- Find the effective annual interest rate charged by each of the three banks (8 Marks)
- Find the effective quarterly interest rate charged by each of the three banks (8 Marks)
- Which bank should be chosen? (3 Marks)
- How much should the interest rate be for bank A in order to break-even with bank B? (6 Marks)

QUESTION 2

A major city in West Canada is planning to build a new wastewater treatment plant to accommodate the increasing water consumption of the city. Plant construction will start in 2018 and is going to take five years at a cost of \$30 million per year. After construction is completed, the cost of operation, maintenance is expected to be \$2 million for the first year, and to increase by 1% per year thereafter. The salvage/scrap value of the wastewater treatment plant at the end of year 2052 is estimated to be \$6 million. Consider the present to be the end of 2014/beginning of 2015 and the interest rate to be 6%.

- Draw a cash flow diagram for this project (from present till end of year 2052) (8 Marks)
- Find the Present Worth of this project (10 Marks)
- Find is the Future Worth of this project (7 Marks)

QUESTION 3

North-Star Manufacturing Company, in southern Ontario, is looking to upgrade its Hydro-forming operation. The engineering department is choosing between two hydro forming press models (Press A, or B). The company has a MARR (Minimum Acceptable Rate of Return) of 9%. Salvage value for both presses at the end of their service lives is expected at \$150,000. Answer the following questions using the information in the table below.

	Press A	Press B
Down payment	\$600,000	\$700,000
Annual Instalment	\$9,000	\$7,000
Maintenance cost	\$3000 for the first year, increasing by \$400/year thereafter	\$2,000 for the first year, increasing by \$300/year thereafter
Running cost per year	\$6,000	\$4,000
Service Life	20 years	25 years

- What is the assumption needed in comparing mutually exclusive alternatives of different lives? (4 Marks)
- Based on Annual Worth comparison, which alternative should be selected? (6 Marks)
- Based on Present Worth comparison, which alternative should be selected? (6 Marks)
- Do both methods (Present Worth and Annual Worth) always yield to the same decision? (3 Marks)
- For a twenty-year study period, what salvage value for press B would make it a better choice? (6 Marks)

QUESTION 4

Three projects are being evaluated by RTCI Engineering Inc. The table below summarizes estimated cash flows for each of the three projects over the next five years. Due to the company capacity constraints, RTCI can only select one out of the three projects. At a MARR (Minimum Acceptable Rate of Return) of 8%, answer the following.

Investment	Initial Cost	Expenses per Year	Return at end of year 5
1	\$250,000	\$75,000	\$1,000,000
2	\$350,000	\$100,000	\$1,450,000
3	\$450,000	\$150,000	\$1,900,000

- Determine the economically best project for RTCI using a rate of return method (14 Marks)
- Is it expected to have different results if the comparison is based on Annual Worth? (Hint: no calculations are needed) (6 Marks)
- Is it always necessary for the alternative with the highest rate of return to be the best alternative? (5 Marks)

QUESTION 5

A hydraulic pump to be used by an automotive assembly plant in Essex County costs \$15,000 to buy. The new hydraulic pump requires a running-in period that costs \$600 immediately. Operating and maintenance costs are estimated at \$1,500 for the first year, increasing by \$660 per year thereafter. The salvage value of the pump can be estimated at any time by a declining-balance rate of 15% and the interest rate is 10%.

- What is meant by the term “sunk cost” and how would it affect a replacement decision? (4 Marks)
- Find the EAC (Equivalent Annual Cost) for the hydraulic pump over one year, two years, three years and four years of service life (12 Marks)
- Assuming cash flows and interest rates are to be constant over the plant time horizon; how often should the hydraulic pump be replaced? (5 Marks)
- What depreciation rate will result in a \$1,500 book value for the pump after four years? (4 Marks)