National Exams December 2012

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 four (4) of the five questions constitute a complete exam paper. Only the first four questions, as they appear in the answer book, will be marked.

4. Each question is of equal value.

QUESTION 1

Akadaka Ltd. manufactures filing cabinets, and they have had a contract with a supplier to purchase the plastic handles for $0.50 each. The contract has just expired, but it could be renewed for a further five years. However, their supplier has told them that the unit price will go up by 12% due to increases in raw material costs and labour. Therefore, Akadaka is considering buying some equipment to produce the handles in-house, and have therefore prepared the following estimates:

Plastic injection molder	$6,000
Raw material for molding	$0.25 / part
Electricity	$0.10 / part
Molding labour	$0.20 / part
Machine maintenance costs	$1,200 / year

The salvage value of the molder at the end of five years is expected to be only 10% of the original cost. Akadaka's marginal tax rate is 40%, and their MARR (minimum attractive rate of return) is 15%. The equipment can be considered a Class 43 property with a CCA rate of 30%.

a) If 10,000 handles are needed per year, determine the projected net after-tax cash flows for making the handles in-house. **(15 marks)**
b) Compute the Annual Equivalent Worth of making the handles in-house. **(3 marks)**
c) Is it better to renew the contract to purchase handles, or to make them in-house? Justify your answer. **(7 marks)**

QUESTION 2

Shirley, a graphic designer who established her own publishing services to produce brochures and posters, had borrowed money from a bank to finance the required computer and printing equipment. The bank's terms allowed her to defer payments (including interest) on the loan for six months and to make 36 equal end-of-month payments thereafter. The original bank loan was for $8,000 with an interest rate of 12% compounded monthly. After 16 monthly payments, Shirley found herself in a poor financial situation and went to a loan company for assistance in lowering her monthly payments. The loan company offered to pay her debts in one lump sum if she would pay the company $175 per month for the next 36 months.

a) How much is the monthly payment to the bank? **(6 marks)**
b) How much does Shirley still owe the bank after the 16^{th} payment? **(4 marks)**
c) What monthly rate of interest is the loan company charging on this transaction? **(7 marks)**
d) Instead of going with the loan company, if Shirley went back to the bank and they renegotiated to let her pay $175 per month, but keeping the interest rate that they are charging her the same as before, how long would it take her to pay off the loan to the bank? **(8 marks)**

QUESTION 3

A company is considering replacing a machine that has been used to make a certain kind of packaging material. The new, improved machine will cost $64,000 installed and will have an estimated economic life of 10 years, with a salvage value of $5,000. Operating costs are expected to be $2,000 per year throughout the service life of the new machine. The old machine (still in use) was purchased four years ago, and it current has a market value of $15,800. If the firm retains the old machine, its updated market values and operating costs for the next four years will be as follows:

Year-End	Market Value	Operating Costs
0	$15,800	
1	$8,600	$6,400
2	$6,600	$7,400
3	$2,200	$9,600
4	0	$11,700

The firm's MARR is 12%.

a) Working with the estimates of market values and operating costs over the next four years, determine the remaining economic life of the old machine. **(13 marks)**
b) Determine whether it is economical to make the replacement now. **(7 marks)**
c) If the firm's decision is to replace the old machine, when should it do so? Justify your answer. **(5 marks)**

QUESTION 4

The Portology Company needs to acquire a new lift truck for transporting its final product to the warehouse. One alternative is to purchase the truck for $40,000, which will be financed by the bank at an annual interest rate of 8%. The loan must be repaid in four equal installments, payable at the end of each year. If they purchase the truck, Portology estimates the maintenance costs at $0.10/km, payable at the end of each year. The truck has an expected salvage value of $10,000 after four years. Alternatively, Portology could lease the truck under a four-year contract for a lease payment of $11,000 per year, with no charge per kilometer up to 40,000 km/year. Each annual lease payment must be made at the beginning of the year. The truck would be maintained by the lessor. After four years, Portology plans to replace the truck irrespective of whether it leases or buys. Based on historical records, they drive the truck about 20,000 km per year. Portology has a MARR (minimum attractive rate of return) of 15%. Ignore taxes and depreciation.

a) What is the Present Worth if Portology purchases the truck? **(10 marks)**
b) What is the Present Worth if Portology leases the truck? **(4 marks)**
c) Should the truck be leased or purchased? **(3 marks)**
d) How many kilometers per year would Portology have to use the truck to be indifferent between purchasing and leasing? **(8 marks)**

QUESTION 5

Consider the following two mutually exclusive investment projects, which have unequal service lives:

	Project's Cash Flow	
n (yrs)	A1	A2
0	-$2,700	-$5,400
1	-1,200	-900
2	-1,200	-900
3	-1,200 + 600	-900
4		-900
5		-900
6		-900
7		-900
8		-900 + 1,500

a) What assumption(s) do you need in order to compare a set of mutually exclusive investments with unequal service lives? **(5 marks)**

b) With the assumption(s) defined in (a) and using a discount rate i=10%/year, determine which project should be selected using a Present Worth analysis. **(12 marks)**

c) If your analysis period (study period) is just three years, what should be the salvage value of project A2 at the end of year 3 to make the two alternatives economically indifferent? **(8 marks)**