University of Toronto
Faculty of Applied Science and Engineering

FINAL EXAMINATION -- APRIL, 2001

Fourth Year - Program 9

ECE472S-Engineering Economic Analysis & Entrepreneurship
Exam Type: D
Examiner: R. Vander Kraats

*Answer all questions; questions are **not** of equal value.
*The course textbook and a calculator may be used. No other aids allowed.
*Total time allowed: 2.5 hours.

NOTE: Show cash flow diagrams or tables for all parts of problems where applicable. State your assumptions and explain clearly the rationale for, and steps in, the solution procedure. Where appropriate, round your answers to the nearest dollar.

Question 1 [25 marks]

i. An engineering graduate has accumulated $15,000 in student loans. She has agreed to pay back the loan in 12 equal semi-annual payments with the first payment occurring one year from now. The interest rate is 6% compounded semi-annually and interest charging begins today. How much is each payment (in dollars and cents)? [5]

ii. Maintenance costs (at the end of each year) of a public facility exhibit the following pattern over a 5-year maintenance cycle: $3000, $2000, $5000, $0 and $1000. What is the capitalized cost of the facility's maintenance if the facility will be in use for a very long period of time? Assume a time value of money of 4%. [5]

iii. A government project was originally estimated to have the following financial aspects:

Annual Benefits	$300,000	Annual Costs	$200,000
Annual Disbenefits	$250,000	Annual Savings	$195,000

A subsequent decision resulted in the imposition of annual user fees equal to 2% of the initial Annual Cost estimate. By what percentage did the value of the B/C ratio change as a result of the user fees? [5]

iv. A video-arcade action-game machine can be purchased for $15,000 and is expected to have a useful life of 4 years. Each game will cost $1.50 to play. The annual operating and maintenance costs are expected to be $3,000. What is the average annual number of games required to make this machine an economic venture? Use a before-tax analysis and let the MARR be 10%. [5]

v. A piece of diagnostic test equipment is purchased at the end-of-year 0 for $100.000. The equipment is allowed a CCA depreciation rate of 35%. The company purchasing the equipment is profitable and pays tax at the rate of 40%. If the equipment is sold at the end-of-year 3 for $50,000, what is the after-tax cash flow at the end-of-year 3 associated with the ownership and sale of the test equipment? Use the appropriate provisions of the Canadian Income Tax Act. The company's after-tax MARR is 20%. **[5]**

Question 2 [20 marks]

i. An investor is considering purchasing 100 shares of the Canadian Imperial Bank of Commerce (CIBC). A share of CIBC is currently trading for $50.00 on the Toronto Stock Exchange. CIBC has just paid a dividend of $1.50. He is forecasting an annual growth in dividends of 6% over the next five years and expects that the dividend will be paid at the end of each year. He expects to own the stock for five years and will sell it shortly after receiving the fifth dividend. His estimate for the share price at the end of year 5 is $65.00. He considers CIBC to be a "blue chip" company and therefore expects an annual rate of return of 8%. On a before-tax basis, is CIBC a good investment for him? His stockbroker charges 2% of the share price to buy or sell a stock. (Assume that the share purchase is being made at the beginning of the year.) Briefly discuss how any profit on the sale of his shares will be taxed. **[8]**

ii. A young couple would like to celebrate their 10^{th} anniversary by going on an extended cruise; the cost of which today is $20,000 each. They will celebrate that anniversary in the Spring of 2011. They plan on saving for this cruise by investing in a mutual fund of bonds that has an expected annual return of 5.5%. They expect that this mutual fund will have a real return of 2% per year. They will start investing now and they will invest an equal amount annually until their last investment in the Spring of 2010. The couple assumes that the cost of the cruise will increase at the general inflation rate.

(a) What will the cruise cost in the Spring of 2011? **[3]**
(b) How much do they need to invest each year? **[4]**

iii. An assistant vice-president of engineering economics advised the company's engineering trainees,

> "We always use the Internal Rate of Return method for evaluating our engineering projects. It gives use the same project rankings as the discounted cash flow approach and our senior management can identify more readily with the percentage rate of return on each of the projects being evaluated. This makes it easier for them to approve the appropriate projects."

Comment on the above statement. Outline situations where this policy may not be the best for choosing the projects that will most increase shareholder value or wealth as well as suggest the reason for the difference. **[5]**

Question 3 [20 marks]

A regional government is evaluating three proposals for a flood control project that is designed to significantly reduce the flood damage that occurs each year. In all proposals, secondary benefits include the value of the impounded water for recreational use. The regional government has included plans for a park in the evaluation of each proposal. In addition, it plans to advertise the new park to its constituents for the first three years only of the project. Proposal estimates are as follows:

Proposal	Construction Costs	Annual Operating Costs	Annual Flood Reduction	Annual Recreation Value	Annual Advertising Budget (First 3 Years Only)
I	1,000,000	125,000	150,000	60,000	20,000
II	2,000,000	150,000	200,000	80,000	20,000
III	3,500,000	200,000	410,000	100,000	20,000

In all three project proposals, the dams that are constructed have no residual value at the end of the project life. The regional government need not proceed with any flood control project. The planning period is 50 years and the government's time value of money is 5%.

i. Using an EUAC approach, which alternative is preferred? The regional government uses Benefit/Cost Ratio analysis in evaluating its public projects. **[12]**

ii. The regional government has a chronic funding shortfall problem and has decided to use the "opportunity cost" approach to select the appropriate interest rate in evaluating its public works projects. Discuss this approach and how it will affect the interest rate that will be used for evaluating public projects? **[3]**

iii. Use the "opportunity cost" approach that you outlined in part (b) to re-evaluate your recommendation in part (a). At what approximate interest rate (the nearest percentage point) will your recommendation no longer be in the public interest? **[5]**

Question 4 [25 marks]

i. Snowmobile manufacturers are willing to supply snowmobiles according to the following supply schedule:

$$Q_S = 2.5(p + 10{,}000)$$

where p is the price per snowmobile and Q_S is the quantity supplied (units per year). The following schedule represents the public's demand for snowmobiles:

$$Q_D = 55{,}000 + 10(1{,}000\text{-}p)$$

where p is the price per snowmobile and Q_S is the quantity demanded (units per year).

(a) In a free market, how many snowmobiles will producers actually sell and what price will consumers pay? Roughly draw a sketch of the supply and demand curves. **[5]**

(b) Unusually mild winter weather has reduced consumers' demand for winter sporting equipment and the demand for snowmobiles has dropped by 5,000 units per year. Show how this would affect your supply and demand schedules drawn for part (a) determine the resulting number of snowmobiles sold and their new free-market price. **[5]**

ii. Teledata operates a fleet of 25 customer-service vehicles to support its very profitable installation and maintenance services. Teledata currently trades in its entire fleet of vehicles every four years. The cost of maintenance and the cost of productivity loss due to vehicle downtime escalate as the vehicles become older. The following per-vehicle data have been collected for the fleet:

Age of customer-service vehicle (Years)	1	2	3	4
End of Year Maintenance and Operating Costs ($/year)	4,000	6,000	8,000	10,000
End of Year Trade-In Value ($)	16,000	12,000	10,000	4,000

When purchasing in quantity, the cost of a new vehicle is $25,000. The company's after-tax MARR is 10% and it pays tax at a rate of 40%. These vehicles are allowed a 30% CCA rate of depreciation.

(a) Compute and plot the after-tax annual cost (EUAC) of a vehicle in terms of its service life. (The service life of a vehicle can be any integer number of years from one to four.) Use the relevant provisions of the Canadian Income Tax Act. Because Teledata will always have a fleet of service vehicles, any terminal loss considerations may be ignored. **[12]**

(b) Determine the economic life of a vehicle for Teledata. **[1]**

(c) How much would Teledata save annually if the fleet were to be replaced at the end of their economic lives instead their current policy? **[2]**