ENMG 400
J. Exam

ENMG400
Engineering Economy
Fall 2004/2005
Exam 2 (AlKhal, Nizam & Traboulsi)

INSTRUCTIONS
1. Before starting this exam, place your name, student ID No., and name of your instructor on the booklet provided.
2. Answer all questions on the booklet provided.
3. Show all work, equations, calculations, and cash flow diagrams.
4. Partial credit will be given only when your work is neatly shown and is conceptually correct.
5. You have ninety (90) minutes to complete this exam.
6. This is an open book exam.

Question 1 (25 points)
A firm is considering three mutually exclusive alternatives for the design of a certain system. This system is expected to provide annual savings in labor. The alternatives and their relevant information are shown below.

	Design A	Design B	Design C
Initial Investment ($)	12,000	18,000	5,000
Net Annual Savings ($/year)	3,200	5,000	1,800
Useful Life (years)	5	10	5

Salvage values for all design alternatives are considered to be zero and the firm's MARR is 15%.

(a) At what interest rate will Design A and Design C have the same equivalent worth?

Find i such that
PW(A-C) = 0
-7000 + 1400(P/A,i%,5) = 0 (P/A,i%,5) = 5
i = 0% since the sum of the 5 annual amounts of 1400 exactly equals the initial amount of 7000.

(b) Using IRR analysis, recommend the most economically attractive design alternative.

A design has to be chosen, hence the Do-Nothing is not an option.
Rank designs in increasing initial investment: C, A, B

A-C: $\Delta i_{(A-C)}$ = 0% from part (a)
Since $\Delta i_{(A-C)}$ < 15%, reject A and keep C

B-C: Using PW we repeat design C twice.

PW(B-C) = -13000 + 3200(P/A, $\Delta i_{(B-C)}$,10) + 5000(P/F, $\Delta i_{(B-C)}$,5) = 0

Substituting $\Delta i_{(B-C)}$ = 15%

-13000 +3200(P/A, 15%,10) + 5000(P/F, 15%,5) = 5546

This means that $\Delta i_{(B-C)}$ > 15%

Hence, reject C and recommend B.

Question 2 (25 points)

Four proposals are under consideration by your company. Proposals A and C are mutually exclusive, proposals B and D are also mutually exclusive and cannot be implemented unless proposal A or C has been selected. No more than $200,000 can be spent at time 0. The MARR is 15%.

	Proposals			
	A	B	C	D
Initial Investment ($)	70,000	40,000	150,000	60,000
PW @ 15%	6,500	4,200	9,650	6,100
Life (years)	5	5	5	5

(a) List all feasible combinations of proposals.

{Do-Nothing}, {A}, {C}, {A,B}, {A,D}, {B,C}

(b) Select from the above the best economically justified projects.

Select the feasible combination with the highest PW.
Select {B,C} with a total PW of $13,850 and a total budget of $190,000.
It is assumed that that any unused amount from the budget is invested at the MARR.

Question 3 (30 points)

A textile company is considering the replacement of its 3-year-old knitting machine which has a current market value of $8,000. Because of a rapid change in fashion style, the existing machine is not expected to meet required standards after 5 years. The estimated operating costs and salvage values for the old machine are given as follows:

	End of Year				
	1	2	3	4	5
Operating Cost	1,000	1,500	2,000	2,500	3,000
Salvage Value	6,000	4,000	3,000	2,000	0

As an alternative, a new improved machine is available on the market at a price of $10,000 and has an estimated life of 6 years. The pertinent cost information can be summarized as follows:

	End of Year					
	1	2	3	4	5	6
Operating Cost	700	900	1,100	1,300	1,500	3,000
Salvage Value	8,000	6,000	4,000	2,000	0	0

If the interest rate is 15%, determine which alternative should be selected and how long should the selected machine be kept in service.

Defender MARR 15.00%

Year	Operating Cost	Salvage Value	PW	EAUC
0		8000		
1	-1000	6000	-3652.17	4,200.00
2	-1500	4000	-6979.21	4,293.02
3	-2000	3000	-9346.26	4,093.45
4	-2500	2000	-11604.69	4,064.72
5	-3000	0	-14239.73	4,247.93

Challenger

Year	Operating Cost	Salvage Value	PW	EUAC
0		10,000		
1	-700	8000	-3652.17	4,200.00
2	-900	6000	-6752.36	4,153.49
3	-1100	4000	-9382.43	4,109.29
4	-1300	2000	-11612.27	4,067.37
5	-1500	0	-13501.54	4,027.72
6	-3000	0	-14798.52	3,910.32

Replace the defender and keep it for 6 years

Question 4 (20 points)

Three flood-control projects are being considered. In summary, the initial investment required and the annual benefits, dis-benefits, and costs resulting from these investments are as follows (in millions of $):

	P1	P2	P3

Operation and Maintenance	6.5	8.25	7
Benefits from savings to the government	3.5	3.5	3.5
Benefits to the public	10	13.2	11.2
Dis-benefits to the public	3.25	4.3	3.6
Initial investment	25	33	28
Expected Life	40	40	45

If an interest rate of 5% is used, determine which alternative should be chosen using the **modified** benefit-cost analysis.

	P1	**P2**	**P3**	**P2-P1**	**P3-P1**
Operation and Maintenance	6.5	8.25	7	1.75	0.5
Savings to the government	3.5	3.5	3.5	0	0
Benefits to the public	10	13.2	11.2	3.2	1.2
Dis-benefits to the public	3.25	4.3	3.6	1.05	0.35
Initial investment	25	33	28		
Expected Life	40	40	45		
AW of the Initial Investment	1.46	1.92	1.58	0.47	0.12
		modified B/C		0.86	2.96
		Choose		**P1**	**P3**