KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Department of Systems Engineering

Final Exam

Summer 2015-2016 (153)

ISE 307 Engineering Economic Analysis

Name: _____

ID: _____

Section _____SN: ___

31st August2016

Question	Points	Marks
Q1	10	
Q2	10	
Q3	10	
TOTAL	30	

IMPORTANT, to get full credit in any question, you need to show your detailed work

Q1. (10 Marks)

A U.S. company buys an asset at a cost of (I) = $700,000, with salvage value (S) =$0. The useful life of the asset is 7 years.

a. Compute the annual depreciation allowances and the resulting book values by using the DDB method with switching to the SL method. Show that the book value at the end of 7 years will be zero. (4 points)
b. Assume that the asset will be sold after 3 years at a price of $750,000 and that it would be classified as 7-year MACRS property. Calculate ordinary gains, capital gains, and net proceeds from sale if the ordinary gains and capital gains are taxed at 40% and 35%, respectively. (4 points)
c. If the company estimated its taxable income for the first year to be $18,000,000, find the marginal and average tax rates in the first year using the U.S. Corporate Tax Schedule given below. (2 points)

Taxable income	Tax rate	Tax computation
0- $15,000,000	34.33..3%	
$15,000,000 - $18,333,333	38%	$5,150,000 + 0.38 (D)
$18,333,333 and Up	35%	$6,416,666 + 0.35 (D)

SOLUTION:

a.

SL Dep. Rate = 1/7 = 0.1143
DDB Rate = (200%) (SL Dep. Rate) = 2/7 = 0.286

n	DDB method DDB Rate = 2/7	SL method SL Dep. Rate = 1/7	Book Value BV_n
0	**$0**	**$0**	**$700,000**
1	200,000	**/7 100,000**	500,000
2	142,857.143	**/6 83,333**	357,142.857
3	102,040.816	**/5 71,428.57**	255,102.041
4	72,886.2973	**/4 63,775.5**	182,215.744
5	52,061.641 shift to SL	/3 60,738.58	121,477.164
6		60,738.58	60.738.58
7		60,738.58	0

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b.

Total depreciation =700,000 (0.1429+0.2449+0.1749/2)=$332,675 (1 mark)
Book value=700,000-332,675=$367,325
Ordinary gains=700,000-367,325=$332,675 (1 mark)
Capital gains=750,000-700,000=$50,000 (1 mark)
Amount of tax paid=332,675(0.4)+50,000(0.35)=133,070+17,500=$150,570
The net proceeds from sale=750,000-150,570=$599,430 (1 mark)

c.

Marginal income rate =38% (1 mark)
Tax amount= 5,150,000 + 0.38 (18,000,000 – 15,000,000)=$6,290,000
Average tax rate =6,290,000/18,000,000=34.9% (1 mark)

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Q2. (10 Marks)

A Computerized Machining Center (CMC) has been proposed for small tool manufacturing company. If the new system, which costs $250,000, is installed, it will generate annual revenues of $185,000 and will require $20,000 in annual labor, $12,000 in annual material expenses and another $8,000 in annual overhead (power and utility) expenses. The CMC would be classified as a 7-year MACRS property. The company expects to dispose out the facility at the end of year 3 and will be sold for $100,000. Assume a tax rate of 35%.

a. Develop the project's cash flow over its project life by filling up the following Table.
b. Determine the net present worth (NPW) at the company's MARR of 15%? Is this project acceptable?

INCOME STATEMENT	0	1	2	3
Revenues:		185000	185000	185000
Expenses:				
Labor		20000	20000	20000
Material		12000	12000	12000
Overhead		8000	8000	8000
Depreciation		0.1429*250000= 35725	0.2449*250000= 61225	(0.1749/2)*250000 =21852.5
Taxable Income		185000-20000-12000-8000-35725=109275	185000-20000-12000-8000-61225=83757	185000-2000-12000-8000-21852.5=123137.5
Net Income		109275*(1-0.35) =71028.75	83757*(1-0.35) =54453.75	123137.5*(1-0.35) =80039
CASH FLOW STATEMENT				
Net Income		71028.75	54453.75	80039
Depreciation		35725	61225	21852.5
Investment	-250000			
Salvage Val.				100000
Gain (loss) tax				10915.5
NET CASH FLOW	-250000	71028.75+35725= 106754	54453.75+61225= 115679	80039+21852.5+ 100000+10915.5= 212818

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Please show your detailed calculations of the following elements:

Total depreciation:

35725+61225+21852.5=118812.5

Book Value:

250000-118812.5 = 131187.5

Gain (or loss):

100000-131187.5 = -31187.5

Gain tax (or credit):

-31187.5*0.35 = -10915.5

b.

NPV=-250000+106754/1.15+115679/1.15^2+212818/1.15^3=70230

Since NPV > 0, the project is acceptable.

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Q3. (10 Marks)

(i) (5 Marks)

Higgins Machine Tools, Inc. is currently manufacturing one of its products on a hydraulic stamping press machine. The machine has an operating and maintenance cost of $50,000 in the first year, and this cost is expected to increase by $5,000 each year. The machine has a remaining useful life of five years and could be sold on the open market now for $100,000. Its market value declines at a rate of 17%. A new machine would cost $200,000, and its operating and maintenance cost is expected to be $33,000 each year. The new machine has an expected service life of five years and its market values reduces at a rate of 20%.

The required MARR is 15%. The firm does not expect a significant improvement in the machine's technology to occur, and it needs the service of either machine for an indefinite period of time.

a) Fill the following table for the defender.

Defender		
n	**Market Value**	**O&M Cost**
0		
1		
2		
3		
4		
5		

b) Find the economic service life for the defender and its cost.

Solution:

(i)

a)

Defender		
n	**Market Value**	**O&M Cost**
0	$100,000	
1	$83,000	$50,000
2	$68,890	$55,000
3	$57,179	$60,000
4	$47,458	$65,000
5	$39,390	$70,000

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(1 mark)

b) Defender:

CR = (I-S)(A/P, 15%, N) + 0.15*S
$AEC_{O\&M}$ = 50,000 + 5000 (A/G, 15%, N)
AEC = CR + $AEC_{O\&M}$

N=1:

CR = (100,000-83,000)*1.15 + 0.15*83,000 = 32,000
$AEC_{O\&M}$ = 50,000 + 5000*0 = 50,000
AEC = CR + $AEC_{O\&M}$ = 32,000 + 50,000 = 82,000 (1 mark)

N=2:

CR = (100,000-68,890)*0.6151 + 0.15*68,890 = 29,469
$AEC_{O\&M}$ = 50,000 + 5000*0.4651 = 52,326
AEC = CR + $AEC_{O\&M}$ = 29,469 + 52,326= 81,795 (1 mark)

N=3:

CR = (100,000-57,179)*0.4380 + 0.15*57,179 = 27,332
$AEC_{O\&M}$ = 50,000 + 5000*0.9071 = 54,536
AEC = CR + $AEC_{O\&M}$ = 27,332+ 54,536= 81,868 (1 mark)

Since AEC(N=3) > AEC(N=2), the economic service life of the defender is N_d*=2 and its AEC_{d*}=$81,795. (1 mark)

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(ii) (5 Marks)

The following data for a defender and a challenger in the tables given below show the market value, operation and maintenance cost (O&M Cost), capital recovery cost (CR), annual operation cost (AOC) and annual equivalent cost (AEC). Assuming 15% MARR and that the service of either machine is needed for an indefinite period of time:

Defender					
n	**Market Value**	**O&M Cost**	**CR(15%)**	**AOC(15%)**	**AEC(15%)**
0	$200,000				
1	$160,000	$100,000	$70,000	100000	$170,000
2	$128,000	$111,000	$63,488	105116.3	$168,605
3	$102,400	$122,000	$58,107	109978.4	$168,085
4	$81,920	$133,000	$53,647	114588.8	$168,236
5	$65,536	$144,000	$49,943	118951	$168,894
6	$52,429	$155,000	$46,858	123069.1	$169,927

Challenger					
n	**Market Value**	**O&M Cost**	**CR(15%)**	**AOC(15%)**	**AEC(15%)**
0	$450,000				
1	$337,500	$60,000	$180,000	$60,000	$240,000
2	$253,125	$60,000	$159,070	$60,000	$219,070
3	$189,844	$60,000	$142,419	$60,000	$202,419
4	$142,383	$60,000	$129,105	$60,000	$189,105
5	$106,787	$60,000	$118,404	$60,000	$178,404
6	$80,090	$60,000	$109,757	$60,000	$169,757

a) Find the economic service life for the defender and the challenger and their cost.
b) Using marginal analysis, determine when the defender should be replaced by the challenger.

Note: Show all details of your solution and show all results rounded to the nearest integer. If a problem can be solved by a series, you are required to solve it as a series, otherwise you will be penalized.

Solution:

(ii)

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a) Economic service life of defender, N_d*=3, and AECd* = $168,992.
Economic service life of challenger, N_c*=6, and AEC_{c*} = $169,757.

(1 mark)

b) Marginal Analysis:

Since AEC_{d*}=$168,992< AEC_{c*} = 169,757, then we need to keep the defender for its economic service life i.e., 3 years. (1 mark)

Next, we need to find the cost of using the defender for the fourth year.

I = 102,400, S = 81,920, OMC = 133,000
Cost = 102,400 (F/P,15%,1)+ 133,000-81,920
=102,400*1.15+133,000-81,920=168,840

Since 168,840< AEC_{c*} = 169,757, this means that we should keep the defender for the fourth year. (1.5 marks)

Next, we need to find the cost of using the defender for the fifth year.
I = 81,920, S = 65,536, OMC = 144,000
Cost = 81,920 (F/P,15%,1)+144,000-65,536
= 81,920*1.15+144,000-65,536 = 172,672

Since 172,672 > AEC_{c*} = 169,757, this means that we should replace the defender by the challenger at the end of the fourth year. (1.5 marks)

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15.0%

	Single Payment		Equal Payment Series				Gradient Series		
N	Compound Amount Factor (F/P,i,N)	Present Worth Factor (P/F,i,N)	Compound Amount Factor (F/A,i,N)	Sinking Fund Factor (A/F,i,N)	Present Worth Factor (P/A,i,N)	Capital Recovery Factor (A/P,i,N)	Gradient Uniform Series (A/G,i,N)	Gradient Present Worth (P/G,i,N)	N
1	1.1500	0.8696	1.0000	1.0000	0.8696	1.1500	0.0000	0.0000	1
2	1.3225	0.7561	2.1500	0.4651	1.6257	0.6151	0.4651	0.7561	2
3	1.5209	0.6575	3.4725	0.2880	2.2832	0.4380	0.9071	2.0712	3
4	1.7490	0.5718	4.9934	0.2003	2.8550	0.3503	1.3263	3.7864	4
5	2.0114	0.4972	6.7424	0.1483	3.3522	0.2983	1.7228	5.7751	5
6	2.3131	0.4323	8.7537	0.1142	3.7845	0.2642	2.0972	7.9368	6
7	2.6600	0.3759	11.0668	0.0904	4.1604	0.2404	2.4498	10.1924	7
8	3.0590	0.3269	13.7268	0.0729	4.4873	0.2229	2.7813	12.4807	8
9	3.5179	0.2843	16.7858	0.0596	4.7716	0.2096	3.0922	14.7548	9
10	4.0456	0.2472	20.3037	0.0493	5.0188	0.1993	3.3832	16.9795	10
11	4.6524	0.2149	24.3493	0.0411	5.2337	0.1911	3.6549	19.1289	11
12	5.3503	0.1869	29.0017	0.0345	5.4206	0.1845	3.9082	21.1849	12
13	6.1528	0.1625	34.3519	0.0291	5.5831	0.1791	4.1438	23.1352	13
14	7.0757	0.1413	40.5047	0.0247	5.7245	0.1747	4.3624	24.9725	14
15	8.1371	0.1229	47.5804	0.0210	5.8474	0.1710	4.5650	26.6930	15