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: \_\_\_

31stAugust2016

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| --- | --- | --- |
| Question | Points | Marks |
| Q1 | 10 |  |
| Q2 | 10 |  |
| Q3 | 10 |  |
| TOTAL | 30 |  |

**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.

1. 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)
2. 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)
3. 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$15,000,000 - $18,333,333$18,333,333 and Up | 34.33..3%38%35% | $5,150,000 + 0.38 (D)$6,416,666 + 0.35 (D) |

**SOLUTION:**

 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****BVn** |
| **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 |

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)

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)

**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%.

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| INCOME | 0 | 1 | 2 | 3 |
| STATEMENT |
| 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 |

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.

**Q3. (10 Marks)**

1. **(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.

1. Fill the following table for the defender.

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

1. Find the economic service life for the defender and its cost.

**Solution:**

**(i)**

|  |
| --- |
| **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  |

 (1 mark)

1. **Defender:**

**CR = (I-S)(A/P, 15%, N) + 0.15\*S**

**AECO&M = 50,000 + 5000 (A/G, 15%, N)**

**AEC = CR + AECO&M**

**N=1:**

CR = (100,000-83,000)\*1.15 + 0.15\*83,000 = 32,000

AECO&M = 50,000 + 5000\*0 = 50,000

AEC = CR + AECO&M = 32,000 + 50,000 = 82,000 (1 mark)

**N=2:**

CR = (100,000-68,890)\*0.6151 + 0.15\*68,890 = 29,469

AECO&M = 50,000 + 5000\*0.4651 = 52,326

AEC = CR + AECO&M = 29,469 + 52,326= 81,795 (1 mark)

**N=3:**

CR = (100,000-57,179)\*0.4380 + 0.15\*57,179 = 27,332

AECO&M = 50,000 + 5000\*0.9071 = 54,536

AEC = CR + AECO&M = 27,332+ 54,536= 81,868 (1 mark)

Since AEC(N=3) > AEC(N=2), the economic service life of the defender is Nd\*=2 and its AECd\*=$81,795. (1 mark)

1. **(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  |

1. Find the economic service life for the defender and the challenger and their cost.
2. 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)**

1. Economic service life of defender, Nd\*=3, and AECd\* = $168,992.

Economic service life of challenger, Nc\*=6, and AECc\* = $169,757.

 (1 mark)

1. **Marginal Analysis:**

Since AECd\*=$168,992< AECc\* = 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< AECc\* = 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 > AECc\* = 169,757, this means that we should replace the defender by the challenger at the end of the fourth year. (1.5 marks)

