IE2111 ISE Principles & Practice II
Solutions to Tutorial #5

Question 1.

Cost Basis B = \$60,000, Useful life N = 14 years, SV_N = \$12,000.

(*a*) Classical Straight Line Method:

Annual depreciation amount $d_k = (B - SV_N)/N$ for k=1 to 14.
$= (60{,}000 - 12{,}000)/14$
$= \$3{,}428.57$

Year	Depreciation	EoY BV
0		60,000.00
1	3,428.57	56,571.43
2	3,428.57	53,142.86
3	3,428.57	49,714.29
4	3,428.57	46,285.71
5	3,428.57	42,857.14
6	3,428.57	39,428.57
13	3,428.57	15,428.57
14	3,428.57	12,000.00

Depreciation in the 3rd year = **\$ 3,428.57**
BV at the end of the 5th year = 60,000 – 5 (3,428.57) = **\$ 42,857.14**

(*b*) 200% DB method:

$R = 2/N = 2/14 = 0.142857$
Annual depreciation amount $d_k = R \times BV_{k-1}$ for k=1 to 14

Year	Depreciation	EoY BV
0		60,000.00
1	8,571.43	51,428.57
2	7,346.94	44,081.63
3	6,297.38	37,784.26
4	5,397.75	32,386.51
5	4,626.64	27,759.86
6	3,965.69	23,794.17
13	1,348.01	8,088.03
14	1,155.43	6,932.60

Depreciation in the 3rd year = **\$ 6,297.38**
BV at the end of the 5th year = **\$ 27,759.86**

(*c*) Claiming Capital Allowances over 3 years:

This is equivalent to straight line over 3 years with zero salvage value.
The annual depreciation amounts are

- $d_k = B/3$ = \$ 60,000 / 3 = \$20,000 for $k = 1, 2, 3$
- d_k = \$0 for $k > 3$

The BV at the end of each year are:

Year k	Depreciation d_k	BV_k
0		60,000.00
1	20,000.00	40,000.00
2	20,000.00	20,000.00
3	20,000.00	0
4	0	0
5	0	0
…	…	…
13	0	0
14	0	0

Depreciation in the 3rd year = \$ 20,000.00

BV at the end of the 5th year = \$ 0

(*d*) 1-Year Capital Allowances Scheme:

The annual deprecation amounts are:

- $d_1 = B$ = \$ 60,000
- d_k = \$ 0 for $k = 2, 3, 4, \ldots 14$.

The BV at the end of each year are:

Year k	Depreciation d_k	BV_k
0		60,000.00
1	60,000.00	0
2	0	0
…	…	…
13	0	0
14	0	0

Depreciation in the 3rd year = \$ 0

BV at the end of the 5th year = \$ 0

Question 2.

Cost Basis of tractor = \$ 195,000
3-year capital allowance scheme
MV at end of 6 years = \$20,000

(*a*)

Annual Depreciation Amounts

- $d_k = 195{,}000 / 3 = \$\,65{,}000$ for $k = 1, 2, 3$
- $d_k = \$\,0$ for $k > 3$

The BV at the end of each year are:

EoY k	d_k	BV_k
0		195,000
1	65,000	130,000
2	65,000	65,000
3	65,000	0
4	0	0
5	0	0
6	0	0

(*b*)

At the end of year 6:

- $BV_6 = 0$
- $MV_6 = \$20{,}000$
- $MV_6 - BV_6 = \$20{,}000$

Hence there is **<u>Balancing Charge</u>** of \$20,000
Taxable Income = \$20,000
Income tax cash flow = $-0.17 \times 20{,}000 =$ **– \$ 3,400**

The company needs to pay \$3,400 in additional tax that year.

(*c*)

At the end of year 2:

- $BV_2 = \$65{,}000$
- $MV_2 = \$40{,}000$
- $MV_2 - BV_2 = -\$25{,}000$

Hence there is **<u>Balancing Allowance</u>** of \$25,000
Taxable Income = – \$25,000
Income tax cash flow = $-0.17 \times -25{,}000 =$ **\$ 4,250**

The company **saves** \$ 4,250 from its total tax that year.

Question 3.

Initial Cost = \$200,000
Useful life = 10 years
MV at end of useful life = 0
Annual O&M cost = \$64,000

Current annual cost without robot = \$100,000
Hence Annual benefit of robot = 100,000 – 64,000 = \$36,000

After-tax $MARR$ = 8%
Tax rate = 17%.

After-tax cash flows analysis for the project:

	(A)	(B)	(C) = (A) - (B)	(D) = - t (C)	(E) = (A) + (D)
EoYk	BTCF	Depreciation	Taxable Income	Tax CF	ATCF
0	-200,000.00				-200,000.00
1	36,000.00	200,000.00	-164,000.00	27,880.00	63,880.00
2	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
3	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
4	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
5	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
6	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
7	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
8	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
9	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
10	36,000.00	0.00	36,000.00	-6,120.00	29,880.00
10	0.00		0.00	0.00	0.00

After-tax IRR is i such that

$$-200{,}000 + (63{,}880 - 29{,}880)\,[P/F,\, i\%,\, 1] + 29{,}880\,[P/A,\, i\%,\, 10] = 0$$

Using an equation solver or Excel Goal Seek:

After-tax IRR = 11.89% > after-tax $MARR$ = 8%

Hence the robot should be acquired.

Question 4.

After-tax $MARR$ = 12%
Tax rate = 17%.

Tank Purchase

- Investment cost = $30,000
- Useful life = 8 years
- Depreciation = 3-year CA claims
- MV at end of useful life – 0
- Relining cost at EoY 4 = $10,000

Assume *Repeatability* and relining occurs only once at EoY 4 for each tank.

After-Tax Cash Flow Analysis for Purchase Alternative over 1 life cycle of 8 years:

	(A)	(B)	(C) = (A) – (B)	(D) = – t (C)	(E) = (A) + (D)	(F) = (E)/$(1+i)^k$
EoY	BTCF	Depreciation	Taxable Income	Tax CF	ATCF	
0	-30,000.00				-30,000.00	-30,000.00
1		10,000.00	-10,000.00	1,700.00	1,700.00	1,517.86
2		10,000.00	-10,000.00	1,700.00	1,700.00	1,355.23
3		10,000.00	-10,000.00	1,700.00	1,700.00	1,210.03
4	-10,000.00	0.00	-10,000.00	1,700.00	-8,300.00	-5,274.80
5		0.00	0.00	0.00	0.00	0.00
6		0.00	0.00	0.00	0.00	0.00
7		0.00	0.00	0.00	0.00	0.00
8		0.00	0.00	0.00	0.00	0.00
8	0.00		0.00	0.00	0.00	0.00
					PW(12%)=	**– $ 31,191.69**

$BV_8 = 0$, $MV_8 = 0$

After-tax PW over 8 years = -30,000 + 1,700 [P/A, 12%, 3] – 8,300 [P/F, 12%, 4]
= **– $ 31,191.69**

Or

After-tax PW over 8 years

$$= -30{,}000 + \frac{1{,}700}{(1+0.12)} + \frac{1{,}700}{(1+0.12)^2} + \frac{1{,}700}{(1+0.12)^3} - \frac{8{,}300}{(1+0.12)^4} = \text{-\$31,191.69}$$

After-tax AW = – $ 31,191.69 [A/P, 12%, 8] = **– $ 6,278.98**

If the tank is leased at $ X per year, annual ATCF $= -(1-t)X = -0.83X$.

For tank leasing to be more economical then purchasing:

$-0.83X >$ After-tax AW(12%) for purchasing = – $ 6,278.98

$\Rightarrow \quad X < 6{,}278.98 / 0.83 = \$\ 7{,}565.03$

Hence the greatest amount the company can afford to pay for tank leasing is **$ 7,565.03**

Question 5.

	Machine A	Machine B
Capital Investment	\$20,000	\$30,000
Useful Life	12 years	8 years
MV at end of useful life	\$4,000	\$0
Annual receipts	\$150,000	\$188,000
Annual expenses	\$138,000	\$170,000

Tax rate =17%, after-tax $MARR$=10%, Depreciation method = 3-year CA

After-tax Cash flows Analysis for Machine A:

	(A)	(B)	(C) = (A) – (B)	(D) = – t (C)	(E) = (A) + (D)	(F) = (E)/(1+i)^k
EoYk	BTCF	Depreciation	Taxable Income	Tax CF	ATCF	PW of ATCF
0	–20,000.00				–20,000.00	–20,000.00
1	12,000.00	6,666.67	5,333.33	–906.67	11,093.33	10,084.85
2	12,000.00	6,666.67	5,333.33	–906.67	11,093.33	9,168.04
3	12,000.00	6,666.67	5,333.33	–906.67	11,093.33	8,334.59
4	12,000.00		12,000.00	–2,040.00	9,960.00	6,802.81
5	12,000.00		12,000.00	–2,040.00	9,960.00	6,184.38
6	12,000.00		12,000.00	–2,040.00	9,960.00	5,622.16
7	12,000.00		12,000.00	–2,040.00	9,960.00	5,111.05
8	12,000.00		12,000.00	–2,040.00	9,960.00	4,646.41
9	12,000.00		12,000.00	–2,040.00	9,960.00	4,224.01
10	12,000.00		12,000.00	–2,040.00	9,960.00	3,840.01
11	12,000.00		12,000.00	–2,040.00	9,960.00	3,490.92
12	12,000.00		12,000.00	–2,040.00	9,960.00	3,173.56
12	4,000.00		4,000.00	–680.00	3,320.00	1,057.85
					PW(10%)=	**51,740.66**

BV_{12} = 0. Final SV_{12}=\$4,000

The amount \$4,000 (Balancing charge) at the end of year 12 is taxable.

After-Tax PW_A(10%) over 12 years = \$ **51, 740.66**

After-tax AW_A(10%) = \$ 51,740.66 [A/P, 10%, 12] = **\$ <u>7,593.63</u>**

After-tax Cash Flows Analysis for Machine B:

	(A)	(B)	(C) = (A) - (B)	(D) = - t (C)	(E) = (A) + (D)	(F) = (E)/$(1+i)^k$
EoYk	BTCF	Depreciation	Taxable Income	Tax CF	ATCF	PW of ATCF
0	–30,000.00				–30,000.00	–30,000.00
1	18,000.00	10,000.00	8,000.00	–1,360.00	16,640.00	15,127.27
2	18,000.00	10,000.00	8,000.00	–1,360.00	16,640.00	13,752.07
3	18,000.00	10,000.00	8,000.00	–1,360.00	16,640.00	12,501.88
4	18,000.00		18,000.00	–3,060.00	14,940.00	10,204.22
5	18,000.00		18,000.00	–3,060.00	14,940.00	9,276.56
6	18,000.00		18,000.00	–3,060.00	14,940.00	8,433.24
7	18,000.00		18,000.00	–3,060.00	14,940.00	7,666.58
8	18,000.00		18,000.00	–3,060.00	14,940.00	6,969.62
8	0.00		0.00	0.00	0.00	0.00
					$PW(10\%)$ =	53,931.45

Balancing charge/allowance = 0 at the end of 8 years as $BV = MV = 0$.

After-Tax $PW_B(10\%)$ over 8 years = \$ 53,931.45

After-tax $AW_B(10\%)$ = \$ 53,931.45 [A/P, 10%, 8] = **\$ <u>10,109.13</u>**

Based on Repeatability assumption, we can compare the after-tax AW for the two machines:

Decision: <u>Choose Machine B which has higher after-tax AW</u>.

Question 6.

	Method I	Method II
Initial Investment	\$10,000	\$40,000
Useful Life	5 years	10 years
MV at end of useful life	\$1,000	\$5,000
Annual expenses		
Labor	\$12,000	\$4,000
Power	\$600	\$300
Rent	\$1,000	\$500
Maintenance	\$500	\$200
Property taxes and insurance	\$400	\$2,000
Total annual expenses	\$14,500	\$7,000

Tax rate = 17%.
After-tax *MARR* = 15%
Depreciation method: 3 Year-CA for both alternatives

After-tax Cash Flows Analysis for Method I:

	(A)	(B)	(C) = (A) - (B)	(D) = - t (C)	(E)= (A) + (D)	(F)=(E)/$(1+i)^k$
EoY k	BTCF	Depreciation	TI	Tax CF	ATCF	PW of ATCF
0	–10,000.00				–10,000.00	–10,000.00
1	–14,500.00	3,333.33	-17,833.33	3,031.67	-11,468.33	-9,972.46
2	–14,500.00	3,333.33	-17,833.33	3,031.67	-11,468.33	-8,671.71
3	–14,500.00	3,333.33	-17,833.33	3,031.67	-11,468.33	-7,540.62
4	–14,500.00	0.00	-14,500.00	2,465.00	-12,035.00	-6,881.05
5	–14,500.00	0.00	-14,500.00	2,465.00	-12,035.00	-5,983.52
5	1,000.00		1,000.00	–170.00	830.00	412.66
						-48,636.70

After-Tax $PW_I(15\%)$ over 5 years = **–\$ <u>48,636.70</u>**

After-tax $AW_I(15\%)$ = – \$51,551.48 [A/P, 15%, 5] = **–\$ <u>14,509.08</u>**

After-tax Cash Flows Analysis for Method II:

	(A)	(B)	(C) = (A) - (B)	(D) = - t (C)	(E)= (A) + (D)	(F)=(E)/(1+i)^k
EoY	BTCF	Depreciation	TI	Tax CF	ATCF	PW of ATCF
0	–40,000.00				–40,000.00	–40,000.00
1	–7,000.00	13,333.33	-20,333.33	3,456.67	-3,543.33	-3,081.16
2	–7,000.00	13,333.33	-20,333.33	3,456.67	-3,543.33	-2,679.27
3	–7,000.00	13,333.33	-20,333.33	3,456.67	-3,543.33	-2,329.80
4	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-3,321.89
5	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-2,888.60
6	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-2,511.82
7	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-2,184.19
8	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-1,899.30
9	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-1,651.56
10	–7,000.00	0.00	-7,000.00	1,190.00	-5,810.00	-1,436.14
10	5,000.00		5,000.00	-850.00	4,150.00	1,025.82
						–62,957.92

After-Tax $PW_{\text{II}}(15\%)$ over 10 years = –**$ <u>62,957.92</u>**

After-tax $AW_{\text{II}}(15\%)$ = –$ 62,957.92 [A/P, 15%, 10] = **–$ <u>12,544.50</u>**

Decision: <u>Based on the Repeatability Assumption, select Method II.</u>