6. ADVANCED CONCEPTS IN INVESTMENT DECISIONS

ASSIGNMENT SOLUTIONS

PROBLEM NO: 1

Note: Cost of land is irrelevant for decision making as it is a sunk cost.

Following expenses are also irrelevant for decision making as they are common costs.

a) Consultants remuneration

b) Travel and conveyance

c) Special allowances

Calculation of Net Present Value using Incremental approach

Step - 1: Calculation of Present Value of Cash Outflows

Particulars	Amount (Rs.)
Cost of land	-
Construction Cost	20,00,000
Present Value of Cash Outflows	20,00,000

Step - 2: Calculation of Present Value of Operating Cash Inflows (Rs. in lakhs)

Particulars	Y_1	Y_2	Y_3	Y_4	Y_5
Savings accommodation Expenses	9.0	10.0	11.0	12.0	13.0
Savings in ETP Cost	1.0	1.0	1.0	1.0	1.0
	10.0	11.0	12.0	13.0	14.0
Less: Incremental Expenses					
i) A.M.C	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
ii) Depreciation $\left(\frac{20L-0}{5}\right)$	(4.0)	(4.0)	(4.0)	(4.0)	(4.0)
PBT	3.5	4.5	5.5	6.5	7.5
PAT @ 50%	1.75	2.25	2.75	3.25	3.75
Add: Deprecation	4.0	4.0	4.0	4.0	4.0
CFAT	5.75	6.25	6.75	7.25	7.75
PVF @ 12%	0.893	0.797	0.712	0.636	0.567

Present value of Operating Cash inflows = Rs. 23,92,725

Step - 3: Present value of Terminal Cash Inflows = 0

Step - 4: Calculation of Net Present Value

Net Present Value = Present Value of cash inflows - Present Value of cash outflows

= Present Value of operating Cash Inflows + Present Value of Terminal Cash Inflows - Present Value of Cash Outflows.

= 23,92,725 + 0 - 20,00,000

= Rs.3,92,725

Assumptions:

- Cash flows are assumed to accrue at the end of each year.
- Interim cash inflows at the end of each year are assumed to be reinvested at the rate of cost of capital.
- Cash flows given in the problem are assumed to be certain.

Conclusion: Since Net Present Value is positive it is beneficial for the company to construct own consultancy centre.

PROBLEM NO: 2

Calculation of Net Present Value using Incremental approach

Step - 1: Calculation of Present Value of Cash Outflows

Particulars	Amount (Rs.)
Cost of Machine	10,00,000

Step - 2: Calculation of Present Value of Operating Cash Inflows **(Rs. in lakhs)**

Particulars		Year 1 - 10 (Rs.)
Revenue (40,000 x 20)		8,00,000
Savings in disposal cost (40,000 x 3)		1,20,000
Operating Expenses:		
i) Variable Cost (40,000 x 10)	4,00,000	
ii) Advertisement Cost	50,000	
iii) Annual Fixed Cost	50,000	(5,00,000)
PBDT		4,20,000
Less: Depreciation $\left(\frac{10,00,000-0}{10 \text{ years}}\right)$		(1,00,000)
PBT		3,20,000
PAT @ 60% (3,20,000 x 60%)		1,92,000
Add: Depreciation		1,00,000
CFAT		2,92,000

Present Value of Operating Cash inflows = Rs. 2,92,000 x 6.145 (10%, 10 yrs.) = Rs. 17,94,340

Step - 3: Present value of Terminal Cash Inflows = 0

Step - 4: Calculation of Net Present Value

Net Present Value = Present Value of cash inflows - Present Value of cash outflows

= Present Value of operating Cash Inflows + Present Value of Terminal Cash Inflows - Present Value of Cash Outflows.

= 17,94,340 + 0 - 10,00,000 = Rs.7,94,340

Conclusion: Since Net Present Value is positive, the waste processing project should be accepted.

Note:

i) Research costs incurred Rs. 1,00,000 is treated as sunk cost. Hence these costs not considered in decision making

ii) General administrative overheads allocated are not considered while decision making.

PROBLEM NO: 3

Step 1: Calculation of Incremental Depreciation

Particulars	Amount (Rs.)
Depreciation on New machine $\left(\frac{\text{Rs. } 10,00,000 - \text{Rs. } 40,000}{8 \text{ years}}\right)$	1,20,000 (per annum)
Depreciation on Old machine $\left(\frac{\text{Rs. } 3,30,000}{11 \text{ years}}\right)$	30,000 (per annum)
Incremental Depreciation	90,000 (per annum)

Step 2: Calculation of P.V of Incremental initial cash outflow

Particulars	Amount (Rs.)
Cost of New machine	10,00,000
Less: Sale proceeds of existing machine	(2,00,000)
Net incremental initial Cash Outflows	8,00,000

Step 3: Calculation of P.V of incremental Operating Cash inflows

Particulars	Amount (Rs.)
Incremental No. of units	45,000 Units
Incremental sales Revenue @ 15/- p.u	6,75,000
Less: Cost of Operation	
Material @ 4 per unit 1,80,000	
Labour (3,000 x 70 - 3,000 x 40) 90,000	(2,70,000)
Incremental Contribution	4,05,000
Less: Indirect Cash Cost	(15,000)
Incremental PBDT	3,90,000
Less: Incremental Depreciation	(90,000)
Incremental PBT	3,00,000
Less: Tax @ 30%	(90,000)
Incremental PAT	2,10,000
Add: Depreciation	90,000
Incremental CFAT	3,00,000

P.V thereof = Rs.3,00,000 x 4.968 = Rs.14,90,400

Step 4: Calculation of P.V of incremental terminal Cash inflows: Rs.40,000 x 0.404 = Rs.16,160

Step 5: Calculation of Incremental NPV: Rs.14,90,400 + 16,160 - 8,00,000 = Rs.7,06,560

Step 6: Decision making

Since incremental NPV is positive, it is advisable replace the existing machine with new machine.

PROBLEM NO: 4

Statement showing the Calculation of incremental Cash Inflow After Taxes:

Particulars	Rs.
A. Incremental Contribution	12,16,000
B. **Less:** Incremental Depreciation	(4,80,000)
C. Increment Earning before Tax	7,36,000
D. **Less:** Tax @ 30%	(2,20,800)
E. Incremental Earning after Tax	5,15,200
F. **Add:** Incremental Depreciation	4,80,000
G. Incremental Cash Flow after taxes (CFAT) (for years other than last year)	9,95,200
H. **Add:** Incremental Cash Salvage Value of Asset at the end of Useful Life	85,000
I. Total Incremental CFAT for the last year	10,80,200

Statement showing Incremental Net Present Value:

Particulars	Year	PV factor @ 20%	Amount (Rs.)	PV @ 20% (Rs.)
Purchase Price	0	1	(25,00,000)	(25,00,000)
Net Sale Proceeds of Existing Machine	0	1	1,00,000	1,00,000
Tax on Sale of existing Machine @ 30% of Rs. 1,00,000	0	1	(30,000)	(30,000)
Increment CFAT for 1 – 4 years	1 to 4	2.589	9,95,200	25,76,573
Increment CFAT for 5th year	5	0.402	10,80,200	4,34,240
Increment NPV				5,80,813

Recommendation: The New Machine should purchased, since the NPV is positive

Working notes:

i) Calculation of Increment Contribution

Particulars	Existing Machine	New Machine	Incremental (New - Old)
A. Units Produced	40,000	50,000	
B. Selling Price per unit	160	160	
C. Variable Cost per unit	(138.4)	(118.4)	
D. Contribution per unit	21.6	41.6	
E. Total Contribution (A x D)	8,64,000	20,80,000	12,16,000

ii) Calculation of Increment al Depreciation

Particulars	Existing Machine	New Machine	Incremental (New - Old)
Cost of Machine	-	25,00,000	
Estimated Salvage Value	-	(1,00,000)	
Depreciation Amount	-	24,00,000	
Useful Life	5 years	5 years	
Depreciation	---	4,80,000	4,80,000

iii) Calculation of Incremental Tax Advantage:

Particulars	Existing Machine	New Machine	Incremental (New - Old)
Book Value at the end	-	1,00,000	85,000
Less: Cash Salvage Value	(15,000)	(1,00,000)	

iv) Since the fixed overheads are allocation from other departments plus the depreciation of plant & machinery, differential fixed overheads other than depreciation are irrelevant.

PROBLEM NO: 5

Step 1: Calculation of modified NPV for Project X

Calculation of Modified Value

Year	CFS (Rs.)	No. of years	Re-invest Rate	FVF @ 15%	FV (Rs.)
1	40,000	6	15%	2.313	92,520
2	50,000	5	15%	2.011	1,00,550
3	60,000	4	15%	1.749	1,04,940
4	70,000	3	15%	1.521	1,06,470
5	80,000	2	15%	1.322	1,05,760
6	90,000	1	15%	1.150	1,03,500
7	1,00,000	0	15%	1.000	1,00,000
					7,13,740

Modified NPV = (Rs. 7,13,740 x 0.425) - 3,00,000 = Rs.3,03,339.5 - 3,00,000 = Rs.3,339.5

Step 2: Calculation of modified NPV for project Y

Year	CFS (Rs.)	No. of years	Re-invested rate	FVF@15%	FV (Rs.)
1	80,000	6	15%	2.313	1,85,040
2	70,000	5	15%	2.011	1,40,770
3	60,000	4	15%	1.749	1,04,940
4	60,000	3	15%	1.521	91,260
5	50,000	2	15%	1.322	66,100
6	40,000	1	15%	1.150	46,000
7	30,000	0	15%	1.000	30,000
					6,64,110

Modified NPV = (6,64,110 x 0.425) - 3,00,000 = (Rs. 17,753)

PROBLEM NO: 6

Calculation of Modified Value

Year	CFS (Rs.)	No. of years	Re-investment Rate	FVF @ 4%	F values (Rs.)
1	50,000	3	4%	1.125	56,250
2	40,000	2	4%	1.082	43,280
3	30,000	1	4%	1.040	31,200
4	10,000	0	4%	1.000	10,000
					1,40,730

Calculation of Modified IRR

Particulars	Amount (Rs)
Initial investment (PV)	1,00,000
Terminal Value (FV)	1,40,730
No. of years	4 years
FV	PV x FVF (n years r %)
1,40,730	1,00,000 x FVF (4 years r %)
FVF(4 years, r%) = 1.4073	

Trace this Value against 4 years in FVF Table, r = 9%

∴ Modified IRR = 9%

PROBLEM NO. 7

i) **Calculation of Net Present Value for each project:**

Year	Cash flows		PVF @ 10%	PV of Project A (Rs.)	PV of Project B (Rs.)
	Project A	Project B			
0	(1,00,000)	(3,00,000)	1	(1,00,000)	(3,00,000)
1	50,000	1,40,000	0.909	45,450	1,27,260
2	60,000	1,90,000	0.826	49,560	1,56,940
3	40,000	1,00,000	0.751	30,040	75,100
NPV				**25,050**	**59,300**

ii) **Calculation of Internal Rate of Return for each project:**

Since by discounting cash flows at 10% we are getting values very far from zero. Therefore, let us discount cash flows using 20%discounting rate.

Year	Cash flows		PVF @ 20%	PV of Project A (Rs.)	PV of Project B (Rs.)
	Project A	Project B			
0	(1,00,000)	(3,00,000)	1.000	(1,00,000)	(3,00,000)
1	50,000	1,40,000	0.833	41,650	1,16,620
2	60,000	1,90,000	0.694	41,640	1,31,860
3	40,000	1,00,000	0.579	23,160	57,900
NPV				**6,450**	**6,380**

Since by discounting cash flows at 20%we are getting values very far from zero. Therefore, let us discount cash flows using 25%discounting rate.

Year	Cash flows		PVF @ 25%	PV of Project A (Rs.)	PV of Project B (Rs.)
	Project A	Project B			
0	(1,00,000)	(3,00,000)	1.000	(1,00,000)	(3,00,000)
1	50,000	1,40,000	0.800	40,000	1,12,000

2	60,000	1,90,000	0.640	38,400	1,21,600
3	40,000	1,00,000	0.512	20,480	51,200
NPV				**(1,120)**	**(15,200)**

The internal Rate of Return is, thus more than 20% but less than 25%. The exact rate can be obtained by interpolation:

$$IRR = LR + \frac{NPV\ @LR}{NPV\ @LR - NPV\ @HR} \times HR - LR$$

$$\text{IRR of Project A} = 20\% + \frac{6,450}{6,450 - (1,120)} X(25\% - 20\%) = 20\% + \frac{6,450}{7,570} x5\% = 24.26\ \%\ \text{(approx.)}$$

$$\text{IRR of Project B} = 20\% + \frac{6,380}{6,380 - (15,200)} X(25\% - 20\%) = 20\% + \frac{6,380}{21,580} X5\% = 21.48\%\ \text{(approx.)}$$

Overall Position:

Particulars	Project A	Project B
NPV @ 10%	25,050	59,300
IRR	24.26%	21.48%

According to NPV, Project 'B' is preferable and according to IRR, Project 'A' is preferable. Therefore, there is a conflict in ranking of projects between NPV & IRR.

Reasons for conflict:

a) Projects are mutually exclusive.

b) Size disparity (difference in size of projects)

Conflict Resolution: (For Academic interest only)

Although from NPV point of view Project B appears to be better but from IRR point of view Project A appears to be better. Since, both the projects have unequal sizes, selection on the basis of these two methods shall not be proper. In such a situation we shall use any of the following methods:

i) Incremental Net Present Value criterion:

Year	Incremental Cash flows	PVF @ 10%	Present Value
0	(2,00,000)	1	(2,00,000)
1	90,000	0.909	81,810
2	1,30,000	0.826	1,07,380
3	60,000	0.751	45,060
Net Present Value			**34,250**

Since incremental NPV is positive, then it is beneficial to invest in bigger Project i.e. project 'B'.

ii) Incremental Internal Rate of Return criterion:

Year	Incremental Cash flows	NPV at Lower guess rate of 19%		NPV at Higher guess rate of 20%	
		PVF @ 19%	PV	PVF @ 20%	PV
0	(2,00,000)	1	(2,00,000)	1	(2,00,000)
1	90,000	0.840	75,600	0.833	74,970
2	1,30,000	0.706	91,780	0.694	90,220
3	60,000	0.593	35,580	0.579	34,740
NPV			**2,960**		**(70)**

$$\text{Using Interpolation, IRR} = LR + \frac{NPV\ @LR}{NPV\ @LR - NPV\ @HR}(HR - LR)$$

$$= 19\% + \frac{2,960}{2,960 - (70)}(20\% - 19\%) = 19.98\%\ \text{(Approx.)}$$

Since Incremental IRR, 19.98% is greater than cost of capital (10%) therefore, it is beneficial to invest in bigger project i.e. Project 'B'.

PROBLEM NO. 8

Step 1: Calculation of Depreciation for both the projects

Particulars	Project X	Project Y
Cost of the project	120 lacs	120 lacs
Salvage value	-	-
Estimated use full life	8 Years	6Years
Depreciation	15 lacs	20 lacs

Step 2: Calculation of NPV

Years	PVF @ 15%	Project X		Project Y	
		Cash inflows	PV Cash flows	Cash inflows	PV Cash flows
0	1.00	(120)	(120)	(120)	(120)
1	0.870	25	21.75	40	34.8
2	0.756	35	26.46	60	45.36
3	0.658	45	29.61	80	52.64
4	0.572	65	37.18	50	28.6
5	0.497	65	32.31	30	14.91
6	0.432	55	23.76	20	8.64
7	0.376	35	13.16	-	-
8	0.327	15	4.91	-	-
	4.488		NPV = 69.14		NPV = 64.95

Step 3: Calculation of Annualized NPV:

$$\text{Project X} = \frac{NPV}{PVAF(r,n)} = \frac{69.14}{PVAF(15\%,8years)} = \frac{69.14}{4.488} = 15.4 \text{ lacs}$$

$$\text{Project Y} = \frac{NPV}{PVAF(r,n)} = \frac{64.95}{PVAF(15\%,6years)} = \frac{64.95}{3.785} = 17.16 \text{ lacs}$$

Since annualized NPV more, it is beneficial to select project Y.

PROBLEM NO. 9

Step 1: Equivalent Annual Cost of Machinery A **(Amount Rs.)**

Year	Cash Flows (Rs.)	PVF @ 9%	Present values (Rs.)
0	7,50,000	1	7,50,000
1 to 3	2,00,000	2.531	5,06,200
			12,56,200

$$\text{Equivalent Annual Cost} = \frac{PVCOF}{PVAF(3,9\%)} = \frac{12,56,200}{2.531} \text{ (COF - cash out flows)} = 4,96,325$$

Step 2: Equivalent Annual Cost of Mach B

Year	Cash Flows (Rs.)	PVF @ 9%	Present values (Rs.)
0	5,00,000	1	5,00,000
1 to 2	3,00,000	1.759	5,27,700
			10,27,700

$$\text{Equivalent Annual Cost} = \frac{PVCOF}{PVAF(2,9\%)} = \frac{\text{Rs. } 10,27,700}{1.759} = \text{Rs. } 5,84,252$$

Step 3: Decision Since equivalent Annual Cost of machinery A is Lower than equivalent Annual Cost of machinery B, it is advisable to accept machine A.

PROBLEM NO. 10

Since the life span of each machine is different and time span exceeds the useful lives of each model, we shall use Equivalent Annual Cost method to decide which brand should be chosen.

a) If machine is used for 20 years:

i) Calculation of Present Value (PV) of cost if machine of Brand MNO is purchased:

Period	Cash flows (Rs.)	PVF @ 12%	Present Value
0	10,00,000	1.000	10,00,000
1-5	25,000	3.605	90,125
6-10	28,000	2.045	57,260
11-15	32,000	1.161	37,152
15	(50,000) *	0.183	(9,150)
			11,75,387

PVAF for 1-15 years = 6.811

- Equivalent Annual Cost = $\frac{\text{Present Value of cost}}{\text{Present Value of Annuity Factor}(r,n)}$
- Equivalent Annual Cost = $\frac{\text{Rs. } 11,75,387}{6.811}$ = Rs. 1,72,572

ii) Calculation of Present Value (PV) of cost if machine of Brand PQR is purchased:

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	7,50,000	1.000	7,50,000
1-5	40,000	3.605	1,44,200
6-10	60,000	2.045	1,22,700
10	(95,000) *	0.322	(30,590)
			9,86,310

PVAF for 1-10 years = 5.65

- Equivalent Annual Cost = $\frac{\text{Rs. } 9,86,310}{5.65}$ = Rs.1,74,568

Decision: Since Equivalent Annual Cash Outflow is least in case of purchase of Machine of brand MNO the same should be purchased.

b) If machine is used for 5 years:

i) Calculation of Present Value (PV) of cost if machine of Brand MNO is purchased:

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	10,00,000	1.000	10,00,000
1-5	25,000	3.605	90,125
5	(5,50,000) **	0.567	(3,11,850)
			7,78,275

ii) Calculation of Present Value (PV) of cost if machine of Brand PQR is purchased:

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	7,50,000	1.000	7,50,000
1-5	40,000	3.605	1,44,200
5	(3,20,000) **	0.567	(1,81,440)
			7,12,760

iii) **Calculation of Present Value (PV) of cost if machine of Brand PQR is taken on Rent:**

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	1,20,000	1.000	1,20,000
1-4	1,25,000	3.037	3,79,625
Penalty	1,25,000 ***	0.567	70,875
			5,70,500

Decision: Since Cash Outflow is least in case of lease of Machine of brand PQR the same should be taken on rent.

Working Notes:

* **Salvage Value**

Particulars	MNO (Rs.)	PQR (Rs.)
Cost of asset	10,00,000	7,50,000
Less: Depreciation (Y_1)	(2,50,000) (10,00,000 x 25%)	(2,50,000) (7,50,000 x 1/3)
	7,50,000	5,00,000
Less: Depreciation for Y_2 to Y_{15}	(7,00,000)	-
Y_2 to Y_{10}	(10 lakhs x 5% x 14 yrs.)	(4,05,000)
		(7,50,000 x 6% x 9 yrs.)
Salvage Value	50,000	95,000

** **Salvage Value if machinery used for 5 years:**

Scrap Value of Machine of Brand MNO: Rs.10,00,000 - Rs.2,50,000 - Rs.10,00,000 x 0.05 x 4 = Rs.5,50,000

Scrap Value of Machine of Brand PQR: Rs.7,50,000 - Rs.2,50,000 - Rs.7,50,000 x 0.06 x 4 = Rs.3,20,000

*** Penalty for 5 years: $\frac{2,50,000}{10 \text{ years}}$ x 5 years = 1,25,000

PROBLEM NO. 11

Calculation of NPV at different discounting rates:

Particulars	Project A			Project B		
0%	(10,000) 2,000 4,000 12,000	1.00 1.00 1.00 1.00	(10,000) 2,000 4,000 12,0000	(10,000) 10,000 3,000 3,000	1.00 1.00 1.00 1.00	(10,000) 10,000 3,000 3,000
			NPV= 8,000 RANK I			NPV= 6,000 RANK II
10%	(10,000) 2,000 4,000 12,000	1.0000 0.9090 0.8264 0.7513	(10,000) 1,818 3,306 9,016	(10,000) 10,000 3,000 3,000	1.0000 0.9090 0.8264 0.7513	(10,000) 9,090 2,479 2,254
			NPV= 4,140 RANK I			NPV= 3,823 RANK II
15%	(10,000) 2,000 4,000 12,000	1.0000 0.8696 0.7561 0.6575	(10,000) 1,739 3,024 7,890	(10,000) 10,000 3,000 3,000	1.0000 0.8696 0.7561 0.6575	(10,000) 8,696 2,268 1,973
			NPV= 2,653			NPV= 2,937

			RANK II			RANK I
30%	(10,000) 2,000 4,000 12,000	1.0000 0.7692 0.5917 0.4552	(10,000) 1,538 2,367 5,462	(10,000) 10,000 3,000 3,000	1.0000 0.7692 0.5917 0.4552	(10,000) 7,692 1,775 1,366
			NPV= (633) RANK II			NPV=833 RANK I
40%	(10,000) 2,000 4,000 12,000	1.0000 0.7143 0.5102 0.3644	(10,000) 1,429 2,041 4,373	(10,000) 10,000 3,000 3,000	1.0000 0.7143 0.5102 0.3644	(10,000) 7,143 1,531 1,093
			NPV=(2,157) RANK II			NPV=(233) RANK I

i) Reason For conflict in Ranking

The conflict in ranking arises because of skew ness in cash flows. The Cash flows of project occur more in later of its life. But in case of project D, the cash flows occur at the beginning of its life.

- At lower discount rate, Project C's NPV will be higher than that of project D
- As the discount rate increases, project C's NPV will fall at a faster rate, due to compounding effect
- After break even discount rate, project D is higher NPV as well as higher IRR.

ii) If the opportunity cost of funds is 10% project C should be accepted because the firm's wealth will increased by RS. 316 (i.e., Rs. Rs. 4,139- Rs. 3,823)

Incremental Analysis:

Project	Cash Flow				NPV at 10%	IRR
	C_0	C_1	C_2	C_3		
C-D	0	-8000	1000	9000	(-8000 x 0.909) + (1,000 x 0.8264) + (9,000 x 0.7513)	(-8000 x 0.88884) + (1,000 x 0.7898) + (9,000 x 0.0.7019)

Therefore, the project C should be accepted, when opportunity cost of funds is 10%.

THE END