3. ADVANCED CONCEPTS IN INVESTMENT DECISIONS

NO. OF PROBLEMS IN 41.5 E OF CA INTER: CLASSROOM - 9, ASSIGNMENT – 9

NO. OF PROBLEMS IN 42E OF CA INTER: CLASSROOM - 12, ASSIGNMENT – 11

NO. OF PROBLEMS IN 42.5E (2nd Version) OF CA INTER: CLASSROOM - 9, ASSIGNMENT – 8

SIGNIFICANCE OF EACH PROBLEM COVERED IN THIS CHAPTER

Problem No. in this Material	Problem No. in NEW SM	Problem No. in OLD SM	Problem No. in OLD PM	RTP	MTP	Previous Exams	Remarks
CRD 1	-	-	-	-	-	-	
CRD 2	-	-	-	-	-	M19 – 8M	
CRD 3	-	-	-	-	-	-	
CRD 4	ILL-9	ILL-9	-	-	-	-	
CRD 5	-	-	-	M14	-	-	
CRD 6	-	-	-	-	-	-	
CRD 7	-	-	-	-	-	N13 - 8M	
CRD 8	-	-	-	N15	-	-	
CRD 9	-	-	17	-	-	-	
ASG 1	-	-	18	-	-	-	
ASG 2	-	-	-	-	-	-	
ASG 3	-	-	-	-	-	-	
ASG 4	ILL-10	ILL-10	-	-	-	-	
ASG 5	-	-	-	-	-	-	
ASG 6	-	-	-	-	-	-	
ASG 7	-	-	-	-	-	-	
ASG 8	-	-	-	-	-	-	RK
P 1	-	-	-	-	-	-	RST
P 2	-	-	-	-	-	-	RST
P 3	EX (7.11)	EX (6.9)	-	-	-	-	

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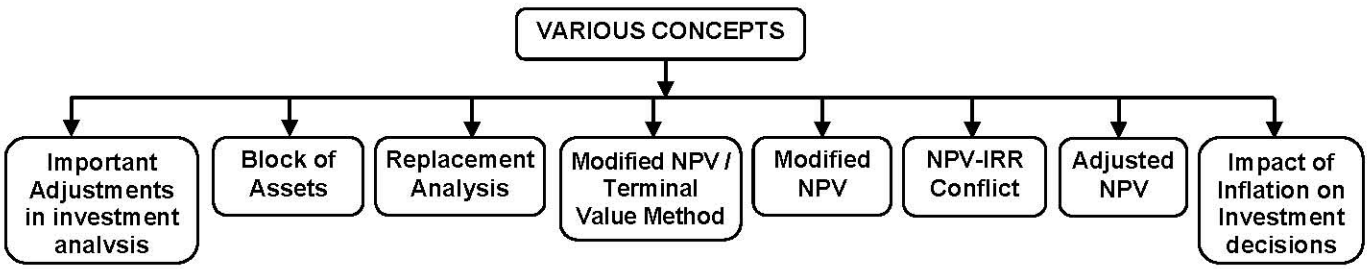

MODEL 1 - REPLACEMENT DECISIONS

REPLACEMENT DECISIONS:

a) In some of the capital budgeting decisions, an existing asset is to be replaced by a new one due to expiry of economic life of the asset is known as Replacement Decision.

b) The purpose of replacement decision is to improve operating efficiency and to reduce cost.

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PROBLEM 1: (PRINTED SOLUTION AVAILABLE) An existing company has a machine which has been in operation for 2 years; its remaining estimated useful life is 10 years, with no salvage value at the end. Its current market value is Rs.1,00,000. The management is considering a proposal to purchase an improved model of a similar machine, which gives increased output. The relevant particulars are as follows:

Particulars	Existing machine	New machine
Purchase price	Rs. 2,40,000	Rs. 4,00,000
Estimated life	12 years	10 years
Salvage value	Nil	Nil
Annual operating hours	2,000	2,000
Selling price per unit	Rs.10	Rs. 10
Output per hour	15 units	30 units
Material cost per unit	Rs. 2	Rs. 2
Labour cost per hour	20	40
Consumable stores per year	2,000	5,000
Repairs and maintenance per year	9,000	6,000
Working capital	25,000	40,000

The company follows straight-line method of depreciation and is subject to 50% tax. Should the existing machine be replaced? Assume that the company's required rate of return is 15%.

(A) (ANS.: INCREMENTAL NPV = RS. 2,90,795; SINCE INCREMENTAL NPV IS POSITIVE, IT IS ADVISABLE TO ACCEPT AND REPLACE THE EXISTING MACHINE) (SOLVE PROBLEM NO. 1 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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PROBLEM 2: (PRINTED SOLUTION AVAILABLE) Aar Cee Manufacturing Co. is considering a proposal to replace one of its existing machines by the CNC machine. In this connection, the following information is available:

The existing machine was bought 3 years ago for Rs.15,40,000. It was depreciated on straight line basis and has a remaining useful life of 7 years. It's annual maintenance cost is expected to increase by Rs.40,000 from the sixth year of its installation. It's present realisable value is Rs.6,50,000.

The purchase price of CNC machine is Rs.27,00,000 and installation expenses of Rs.95,000 will be incurred. Subsidy equal to 15% of the purchase price will be received at the end of first year of its installation. It is subject to same rate of depreciation. It's realisable value after 7 years is Rs.5,70,000. With the CNC machine annual cash operating costs are expected to decrease by Rs.2,16,000. In addition, CNC machine would increase productivity on account of which net cash revenue would increase by Rs.2,76,000 per annum.

The tax rate applicable to firm is 30% and cost of capital is 11%

Required:

Advise the firm whether to replace the existing machine with CNC machine on the basis of net present value.

The present value factor at 11% are as follows :

Year	1	2	3	4	5	6	7
PVF @ 11%	0.901	0.812	0.731	0.659	0.593	0.535	0.482

(M19(O) – 8M)(NPV = Rs. 4,80,076, Replacement decision can be accepted)

Note:_____

MODEL 2 - MODIFIED NPV / TERMINAL VALUE METHOD

a) The other variant of NPV technique is TVM. In this case, a new dimension is added to the NPV technique. In NPV technique, future cash flows are discounted to make them comparable.

b) In the TV technique, the future cash flows are first compounded at the expected rate of interest for the period from their occurrence till the end of the economic life of the project.

c) The compounded values are then discounted at an appropriate discount rate to find out the present value. This present value is compared with the initial outflow to decide about the suitability of the proposal.

ASSUMPTION: The TV technique is based on the assumption that all future cash inflows are reinvested elsewhere at the then prevailing rate of interest until the end of the economic life of the project.

PROBLEM 3:

Cost of machine	Rs. 10,000
Estimate life of machine	3 years
Cash inflows	Rs. 6,000 every year for 3 years
Cost of capital "r"	15%

Expected interest rates, at which cash inflows shall be re-invested:

Year ending	1	2	3
Percentage	12%	10%	9%

State whether the project should be accepted under terminal value method.

(B) (ANS.: MODIFIED NPV RS. 3,242) (SOLVE PROBLEM NO. 2 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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MODEL 3 - MODIFIED IRR

a) There are several limitations attached with the concept of conventional IRR. The MIRR addresses some of these deficiencies, e.g. it eliminates multiple IRR rates, it addresses the reinvestment rate issue and produces results which are consistent with the NPV method.

b) Under this method, all cash flows, apart from the initial investment, are brought to the terminal value using an appropriate discount rate (usually the cost of capital). This results in a single stream of cash inflow in the terminal year.

c) The MIRR is obtained by assuming a single outflow in the year ZERO and the terminal cash inflow as mentioned above. The discount rate which equates the present value of the terminal cash inflows to the year ZERO cash outflow is called MIRR.

PROBLEM 4: (PRINTED SOLUTION AVAILABLE) An investment of Rs.1,36,000 yields the following cash inflows (Profits Before Depreciation but After Tax). Determine Modified Internal Rate of Return (MIRR) considering 8% cost of capital.

Year	1	2	3	4	5
Rs.	30,000	40,000	60,000	30,000	20,000

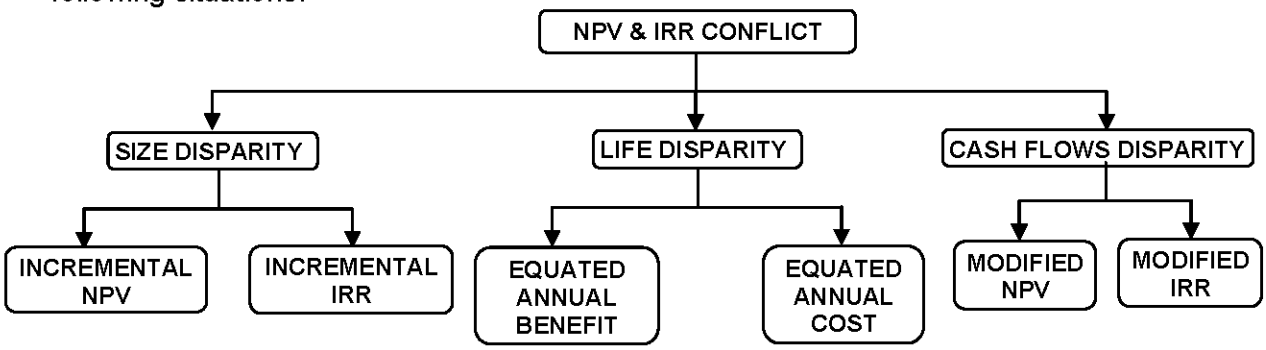
(B) (NEW SM, OLD SM) (ANS.: MODIFIED IRR = 9% (APPROX.))

(SOLVE PROBLEM NO. 3 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

MODEL 4 - NPV & IRR CONFLICT

- There is no ranking conflict between NPV&IRR in case of mutually independent projects.
- The ranking conflict between NPV & IRR in case of mutually exclusive projects is arises in the following situations.



MODEL 5.1 - SCALE OR SIZE DISPARITY

PROBLEM 5: Gamma Limited is considering building an assembly plant and the company has two options, out of which it wishes to choose the best plant. The projected output is 10,000 units per month. The following data is available:

Particulars	Amount (Rs.)	
	Plant A	Plant B
Initial Cost	60,00,000	44,00,000
Direct Labour Cost p.a. (1st Shift)	30,00,000	15,00,000
(Second Shift)	-	19,00,000
Overhead (per year)	5,00,000	4,20,000

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Both the plants have an expected life of 10 years after which there will be no salvage value. The cost of capital is 10 percent. The present value of an ordinary annuity of Re. 1 for 10 years @ 10 percent is 6.1446. Ignore effect of taxation.

You are required to determine the desirable choice?

(B) (RTP M14) (ANS.: PRESENT VALUE OF NET SAVING FOR PLANT A RS 19,66,272, ADDITIONAL OUTLAY FOR USING PLANT A 16,00,000, NET SAVING FOR THE COMPANY IN CHOOSING PLANT A = RS. 19,66,272 -RS. 16,00,000 = RS. 3,66,272. HENCE, PLANT A SHOULD BE IMPLEMENTED) (SOLVE PROBLEM NO. 4 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

MODEL 4.2 - LIFE DISPARITY OR PROPOSALS WITH UNEQUAL LIVES

PROBLEM 6: R Ltd. is considering modernizing its production facilities and it has two proposals under consideration. Which project should be accepted basing on annualized NPV at given discounting rate of 12%.

Particulars	Project A	Project B
NPV	6.497	5.156
Life	6 Years	3 Years

(B) (ANS.: PROJECT A: 1.580, PROJECT B: 2.146, PROJECT B IS ACCEPTED)

(SOLVE PROBLEM NO. 5 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

PROBLEM 7: The following data related to two machines, which machine should be bought?

Particulars	Project A	Project B
PV of cash outflow	11,23,310	10,34,000
Life	3 Years	2 Years

Year	t_1	t_2	t_3
$PVIF_{0.10.t}$	0.9091	0.8264	0.7513
$PVIFA_{0.10.2}$ =1.7355			
$PVIFA_{0.10.3}$ =2.4868			

(A) (N13 - 8M) (ANS.: EQUIVALENT PRESENT VALUE OF NET CASH OUTFLOW OF MACHINE A: RS. 4,51,673; MACHINE B: RS.5,95,622, SINCE EQUIVALENT PRESENT VALUE OF NET CASH OUTFLOW IS LESS, IT IS BENEFICIAL TO PURCHASE MACHINE A) (SOLVE PROBLEM NO. 6 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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PROBLEM 8: (PRINTED SOLUTION AVAILABLE) BT Pathology Lab Ltd. is using a X-ray machines which reached at the end of their useful lives. Following new X-ray machines of two different brands with same features are available for the purchase.

Brand	Cost of Machine	Life of Machine	Maintenance Cost			Rate of Depreciation
			Year 1-5	Year 6-10	Year 11-15	
XYZ	Rs.6,00,000	15 years	Rs.20,000	Rs.28,000	Rs.39,000	4%
ABC	Rs.4,50,000	10 years	Rs.31,000	Rs.53,000	--	6%

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Residual Value of both of above machines shall be dropped by 1/3 of Purchase Price in the first year and thereafter shall be depreciated at the rate mentioned above.

Alternatively, the machine of Brand ABC can also be taken on rent to be returned back to the owner after use on the following terms and conditions:

- Annual Rent shall be paid in the beginning of each year and for first year it shall be Rs. 1,02,000.
- Annual Rent for the subsequent 4 years shall be Rs.1,02,500.
- Annual Rent for the final 5 years shall be Rs.1,09,950.
- The Rent Agreement can be terminated by BT Labs by making a payment of Rs.1,00,000 as penalty. This penalty would be reduced by Rs.10,000 each year of the period of rental agreement.

You are required to:

a) Advise which brand of X-ray machine should be acquired assuming that the use of machine shall be continued for a period of 20 years.

b) Which of the option is most economical if machine is likely to be used for a period of 5 years?

The cost of capital of BT Labs is 12%.

(B) (RTP N15)(RTP M19) (ANS.: A) MACHINE XYZ SHOULD BE PURCHASED B) MACHINE ABC SHOULD BE TAKEN ON RENT)

(SOLVE PROBLEM NO. 7 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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MODEL 4.3 - CASH FLOW DISPARITY

PROBLEM 9: (PRINTED SOLUTION AVAILABLE) A firm can make investment in either of the following two projects. The firm anticipates its cost of capital to be 10% and the net (after tax) cash flows of the projects for five years are as follows:

	Figures in (Rs. Rs.000)					
Year	0	1	2	3	4	5
Project-A	(500)	85	200	240	220	70
Project-B	(500)	480	100	70	30	20

The discount factors are as under:

Year	0	1	2	3	4	5
PVF (10%)	1	0.91	0.83	0.75	0.68	0.62
PVF (20%)	1	0.83	0.69	0.58	0.48	0.41

Required:

a) Calculate the NPV and IRR of each project.

b) State with reasons which project you would recommend. *(A) (OLD PM)*

(ANS.: A) NPV FOR PROJECT A IS RS.116.35 & PROJECT B IS RS.105.1, IRR FOR PROJECT A IS 18.66%, & PROJECT B IS 24.10%, B) AS PER OBJECTIVE OF F.M, IT IS BENEFICIAL TO SELECT THE PROJECT BEING PREFERRED BY NPV. I.E., PROJECT A)

(SOLVE PROBLEM NO. 8 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:_____

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PRINTED SOLUTIONS TO SOME SELECTIVE PROBLEMS

PROBLEM NUMBERS TO WHICH SOLUTIONS ARE PROVIDED: 1, 2, 4, 8, 9

PROBLEM NO.1

Step: 1: NSP of existing machine as on today

Particulars	Amount (Rs.)
a) GSP	1,00,000
b) WDV (2,40,000 - 40,000)	(2,00,000)
c) Capital Loss	1,00,000
d) Tax shield	(50,000)
NSP	**1,50,000**

Step: 2: Estimation of PV of incremental cash outflow

Particulars	Amount (Rs.)
a) Cost of new machine	4,00,000
b) NSP of existing machine	(1,50,000)
	2,50,000
c) Incremental working capital	15,000
d) PV of Incremental cash outflows	**2,65,000**

Step: 3: Computation of Depreciation p.a

Depreciation p.a = Cost - Scrap / Life

New Machine = 4,00,000 - 0 / 10

= 40,000

Existing Machine = 2,00,000 - 0 / 10

= 20,000

Incremental depreciation = 20,000 (40,000,- 20,000)

Step 4: Computation of PV of Incremental Operating cash inflows

	Particulars	Existing Machine	New Machine
a)	Operating hours	2,000	2,000
b)	Output per hour	15	30
c)	Total output (a x b)	30,000	60,000
d)	Selling Price per unit	10	10
e)	Total Sales Revenue	3,00,000	6,00,000
f)	Material Cost	(60,000) (30,000 x 2)	(1,20,000) (60,000 x 2)
g)	Labour Cost	(40,000) (20,000 x 2)	(80,000) (40,000 x 2)
h)	Consumable Stores	(2,000)	(5,000)
i)	Repairs	(9,000)	(6,000)
j)	PBDT (e-f-g-h)	1,89,000	3,89,000

Incremental PBDT	=	2,00,000
Less: Incremental Depreciation	=	20,000
PBT	=	1,80,000
Tax @ 50%	=	(90,000)
PAT	=	90,000
CFAT	=	1,10,000

PV of OPCI = 1,10,000 X PVAF (15%, 10Y)

= 1,10,000 X 5.09 = 5,52,090

Step: 4: PV of TMCI = 0

Step: 5: Estimation of PV of Incremental TMCI

Particulars		Amount
a) GSP / NSP of New Machine	=	0
b) GSP / NSP of Existing Machine	=	0
c) Recovery of Incremental working capital	=	15,000
TMCI		15,000

PV of TMCI = 15,000 x PVF (15% X 10Y)

= 15,000 x 0.247 = Rs. 3705

Step: 6: Computation of Incremental NPV

NPV = Incremental PV of OPCI + Incremental PV TMCI - Incremental PV Cash outflow

= 5,52,090 + 3,705 - 2,65,000 = Rs.2,90,795.

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

PROBLEM NO.2

(a) Present Value of cash outflow:

Particulars	Amount (Rs.)
Purchase price of CNC machine	27,00,000
Add: Installation expenses	95,000
Less: Subsidy (Rs. 27,00,000 × 0.15 × 0.901)	3,64,905

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Less: Sale value of old machine	6,50,000
Less: tax saving due to loss on sale of old machine (10,78,000 – 6,50,000) × 0.30	1,28,400
Total PV of cash outflows	**16,51,695**

Statement showing cash inflows:

Particulars	Year 1 to 2	Year 3 to 7
Increase in revenue	2,76,000	2,76,000
Saving in cash operating cost	2,16,000	2,16,000
Saving in maintenance cost	-	40,000
Less: Incremental Depreciation	1,06,000	1,06,000
Incremental profit before tax	3,86,000	4,26,000
Less: T ax @ 30%	1,15,800	1,27,800
Incremental profit after tax	2,70,200	2,98,200
Add: Incremental depreciation	1,06,000	1,06,000
Incremental cash flow after tax	**3,76,200**	**4,04,200**

Year	CFAT	P V @ 11%	PV of cash flows
1 to 2	3,76,200	1.713	6,44,431
3 to 7	4,04,200	3.000	12,12,600
7th	5,70,000	0.482	**2,74,740**
Total PV of cash Inflows			**21,31,771**
Less PV of cash outflows			16,51,695
NPV			**4,80,076**

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OR

Year	CFAT	P V @ 11%	PV of Cash Flows
1 to 7	3,76,200	4.713	17,73,031
7th	5,70,000	0.482	**2,74,740**
3-7 (Saving in AMC net of taxes) (40000 x 70%)	28,000	3	84,000
Total PV of cash Inflows			**21,31,771**
Less PV of cash outflows			16,51,695
NPV			**4,80,076**

Decision: CNC machine should be purchased as NPV is positive.

Working Notes:

Computation of Depreciation:

Depreciation on existing machine	15,40,000/10 = Rs. 1,54,000
Depreciation on CNC Machine (Rs. 27,00,000 + Rs. 95,000 – Rs. 4,05,000 – Rs. 5,70,000)/7	18,20,000/7 =Rs. 2,60,000
Incremental depreciation	**Rs. 1,06,000**

PROBLEM NO.4

Year- 0, Cash flow- Rs.1,36,000

The MIRR is calculated on the basis of investing the inflows at the cost of capital. The table below shows the valued of the inflows if they are immediately reinvested at 8%.

Year	Cash flow	@ 8% reinvestment rate factor	Amount (Rs.)
1	30,000	1.3605*	40,815
2	40,000	1.2597	50,388
3	60,000	1.1664	69,984
4	30,000	1.0800	32,400
5	20,000	1.000	20,000
			2,13,587

* Investment of Rs. 1 at the end of the year 1 is reinvested for 4 years (at the end of 5 years) shall become 1 $(1.08)^4$ = 1.3605. Similarly, reinvestment rate factor for remaining years shall be calculated. Please note investment at the end of 5th year shall be reinvested for zero year hence reinvestment rate factor shall be 1.00.

The total cash outflow in year 0 (Rs. 1,36,000) is compared with the possible inflow at year 5 and the resulting figure of $\frac{1,36,000}{2,13,587} = 0.6367$ is the discount factor in year 5. By looking at the year 5 row in the present value tables, you will see that this gives a return of 9%. This means that the Rs.2,13,587 received in year 5 is equivalent to Rs.1,36,000 in year 0 if the discount rate is 9%. Alternatively, we can compute MIRR as follows:

Total return = $\frac{2,13,587}{1,36,000} = 1.5705$

MIRR = $\sqrt[5]{1.5705} - 1 = 9\%$

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PROBLEM NO.8

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 XYZ is purchased:

Period	Cash flows (Rs.)	PVF @ 12%	Present Value
0	6,00,00	1.000	6,00,000
1-5	20,000	3.605	72,100
6-10	28,000	2.045	57,260
11-15	39,000	1.161	45,279
15	(64,000)	0.183	(11,712)
			7,62,927

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 = $\frac{\text{Rs.7,62,927}}{6.811}$ = Rs.1,12,014

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

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	4,50,000	1.000	4,50,000
1-5	31,000	3.605	1,11,755
6-10	53,000	2.045	1,08,385
10	(57,000)	0.322	(18,354)
			6,51,786

PVAF for 1-10 years = 5.65

- Equivalent Annual Cost = $\frac{\text{Rs. 6,51,786}}{5.65}$ = Rs.1,15,360

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

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	1,02,000	1.000	1,02,000
1-4	1,02,500	3.037	3,11,293
5-9	1,09,950	2.291	2,51,895
			6,65,188

PVAF for 1-10 years = 5.65

- Equivalent Annual Cost = $\frac{\text{Rs.6,65,188}}{5.65}$ = Rs.1,17,732

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

b) **If machine is used for 5 years:**

W.N.1: Scrap Value of Machine of Brand XYZ

= Rs.6,00,000 - Rs.2,00,000 - Rs.6,00,000 x 0.04 x 4 = Rs.3,04,000

W.N.2: Scrap Value of Machine of Brand ABC

= Rs.4,50,000 - Rs.1,50,000 - Rs.4,50,000 x 0.06 x 4 = Rs.1,92,000

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

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	6,00,000	1.000	6,00,000
1-5	20,000	3.605	75,100
5	(3,04,000)	0.567	(1,72,368)
			4,99,732

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

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	4,50,000	1.000	4,50,000
1-5	31,000	3.605	1,11,755
5	(1,92,000)	0.567	(1,08,864)
			4,52,891

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

Period	Cash Outflows (Rs.)	PVF @ 12%	Present Value
0	1,02,000	1.000	1,02,000
1-4	1,02,500	3.037	3,11,293
5	50,000	0.567	28,350
			4,41,643

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

PROBLEM NO.9

Calculation of NPV and IRR for each project:

Project A (Rs. In thousands)

Year	Cash flows	PVF @ 10%	PV	PVF @ 20%	PV
0	(500)	1	(500)	1	(500)
1	85	0.91	77.35	0.83	70.55
2	200	0.83	166	0.69	138.00
3	240	0.75	180	0.58	139.20
4	220	0.68	149.6	0.48	105.60
5	70	0.62	43.4	0.41	28.70
	NPV		**116.35**		**(17.95)**

NPV of Project A at 10% (cost of capital) Rs.1,16,350.

IRR of Project A may be calculated by Interpolation method as under :

NPV at 20% is = (-) 17.98 (Rs.'000)

NPV at 10% is = + 116.35 (Rs.'000)

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

$$= 10 + \frac{116.35}{116.35 - (-17.95)} \times (20 - 10)\% = 18.66\% \text{ (approx.)}$$

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Project B (Rs. In thousands)

Year	Cash flows	PVF @ 10%	PV	PVF @ 20%	PV
0	(500)	1	(500)	1	(500)
1	480	0.91	436.8	0.83	398.40
2	100	0.83	83	0.69	69.00
3	70	0.75	52.5	0.58	40.60
4	30	0.68	20.4	0.48	14.40
5	20	0.62	12.4	0.41	8.20
		NPV	**105.1**	**NPV**	**30.60**

NPV of Project B at 10% (cost of capital) is Rs 1,05,100.

IRR of Project B may be calculated by Interpolation method as under:

NPV at 10% is = + 105.10 (Rs.'000)

NPV at 20% is = + 30.60 (Rs.'000)

$$IRR = LR + \frac{NPV\ @LR}{NPV\ @LR - NPV\ @HR} \times HR - LR = 10 + \frac{105.10}{105.10 - (30.60)} \times (20 - 10)\% = 24.10\% \text{ (approx.)}$$

a) Ranking of the Projects will be as under:

Particulars	NPV	IRR
Project A	116.35 (I)	18.66% (II)
Project B	105.1 (II)	24.10% (I)

Decision: There is a conflict in ranking. IRR assumes that the project cash flows are reinvested at IRR whereas the cost of capital is 10%. The two projects are mutually exclusive. In the circumstances, the project which yields the larger NPV will earn larger cash flows. Hence the project with larger NPV should be chosen. Thus Project A qualifies for selection.

b) Inconsistency in ranking arises because if NPV criterion is used, Project A is preferable. If IRR criterion is used, Project B is preferable. The inconsistency is due to the difference in the pattern of cash flows.

Where an in consistency is experienced, the projects yielding larger NPV is preferred because of larger cash flows which it generates. IRR criterion is rejected because of the following reasons:

i) IRR assumes that all cash flows are re-invested at IRR.

ii) IRR is a percentage but the magnitude of cash flow is important.

iii) Multiple IRR may arise if the projects have non - conventional cash flows.

ASSIGNMENT PROBLEMS

MODEL 1 - REPLACEMENT DECISIONS

PROBLEM 1: WX Ltd. has a machine which has been in operation for 3 years. Its remaining estimated useful life is 8 years with no salvage value in the end. Its current market value is Rs. 2,00,000. The company is considering a proposal to purchase a new model of machine to replace the existing machine. The relevant information's are as follows:

	Existing Machine	New Machine
Purchase Price	Rs. 3,30,000	Rs. 10,00,000
Estimated life	11 years	8 years
Salvage value	Nil	Rs. 40,000
Annual output	30,000 units	75,000 units
Selling price per unit	Rs. 15	Rs. 15
Annual operating hours	3,000	3,000
Material cost per unit	Rs. 4	Rs. 4
Labour cost per hour	Rs. 40	Rs. 70
Indirect cash cost per annum	Rs. 50,000	Rs. 65,000

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The company follows straight line method of depreciation. The corporate tax rate is 30 percent and WX Ltd. does not make any investment, if it yields less than 12 percent. Present value of annuity of Rs.1 at 12% rate of discount for 8 years is 4.968. Present value of Rs.1 at 12% rate of discount, received at the end of 8th year is 0.404. Ignore capital gain tax.

Advise WX Ltd. whether the existing machine should be replaced or not.

(A) (OLD PM) (ANS.: HENCE, EXISTING MACHINE SHOULD BE REPLACED BECAUSE NPV IS POSITIVE I.E. RS. 7,06,560)

MODEL 2 - MODIFIED NPV / TERMINAL VALUE METHOD

PROBLEM 2: Consider the cash flows of two projects, X and Y:

Year	Project X (Rs.)	Project Y (Rs.)
0	(3,00,000)	(3,00,000)
1	40,000	80,000
2	50,000	70,000
3	60,000	60,000
4	70,000	60,000
5	80,000	50,000
6	90,000	40,000
7	1,00,000	30,000

The cost of capital is 13%. Calculate modified NPV for projects X and Y, assuming re-investment rate of 15%.

(B) (ANS.: MODIFIED NPV OF PROJECT X AND Y IS RS. 3,339.5, RS. (17,753) RESPECTIVELY)

MODEL 3 - MODIFIED IRR

PROBLEM 3: Estimate Modified IRR from the given information.

Initial investment = Rs.1,00,000

Year	1	2	3	4
CFAT	50,000	40,000	30,000	10,000

Assume Reinvestment rate @ 4%. *(B) (ANS.: MIRR: 9%)*

MODEL 4.1 - SCALE OR SIZE DISPARITY

PROBLEM 4: Suppose Project A and Project B are under consideration. The cash flows associated with these projects are as follows:

Year	Project A (Rs)	Project B (Rs)
0	(1,00,000)	(3,00,000)
1	50,000	1,40,000
2	60,000	1,90,000
3	40,000	1,00,000

Assuming Cost of Capital equal to 10% which project should be accepted as per NPV Method and IRR Method. Is there is any ranking conflict between NPV&IRR? Resolve the same.

(B) (NEW SM, OLD SM) (ANS.: NPV OF A: RS. 25,050, B: RS. 59,300, IRR OF A: 24.26%, B: 21.48%)

MODEL 4.2 - LIFE DISPARITY OR PROPOSALS WITH UNEQUAL LIVES

PROBLEM 5: National Electronics Ltd., an electronic goods manufacturing company, is producing a large range of electrical goods. It has under consideration two projects "X" and "Y" each costing Rs.120 lacks. The projects are mutually exclusive and the company is considering the question of selecting one of the two. Cash flows have been worked out for both the projects and the details are given below: "X" has a life of 8 years and "Y" has a life of 6 years. Both will have zero salvage value at the end of their operational lives. The company is already making profits and its tax rate is 50%. The cost of capital of the company is 15%.

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At the end of the year	Net cash inflow		P.V. of rupee at 15%
	Project X	Project Y	
1	25	40	0.870
2	35	60	0.756
3	45	80	0.658
4	65	50	0.572
5	65	30	0.497
6	55	20	0.432
7	35	--	0.376
8	15	--	0.327

The company follows straight line method of depreciating assets. Advise the company regarding the selection of the project using the concept of Annualized NPV. *(B)*

(ANS.: NPV OF PROJECT X =15.4 LAKHS, Y = 17.16 LAKHS SINCE ANNUALIZED NPV MORE, IT IS BENEFICIAL TO SELECT PROJECT Y)

PROBLEM 6: Company UVW has to make a choice between two identical machines, in terms of Capacity, 'A' and 'B'. They have been designed differently, but do exactly the same job.

Machine 'A' costs Rs.7,50,000 and will last for three years. It costs Rs.2,00,000 per year to run. Machine 'B' is an economy model costing only Rs.5,00,000, but will last for only two years. It costs Rs.3,00,000 per year to run.

The cash flows of Machine 'A' and 'B' are real cash flows. The costs are forecasted in rupees of constant purchasing power. Ignore taxes. The opportunity cost of capital is 9%.

Required: Which machine the company UVW should buy? *(A) (OLD PM)*

(ANS.: SINCE EQUIVALENT PRESENT VALUE OF NET CASH OUTFLOW IS LESS IT IS BENEFICIAL TO PURCHASE MACHINE A)

PROBLEM 7: Z Ltd. is using a Scan machines which reached at the end of their useful lives. Following new X-ray machines of two different brands with same features are available for the purchase.

Brand	Cost of Machine	Life of Machine	Maintenance Cost			Rate of Depreciation
			Year 1-5	Year 6-10	Year 11-15	
MNO	10,00,000	15 years	25,000	28,000	32,000	5%
PQR	7,50,000	10 years	40,000	60,000	-	6%

Residual Value for MNO brand shall be dropped by 25% of Purchase Price in the first year, Residual Value for PQR brand shall be dropped by 1/3 of Purchase Price in the first year and thereafter shall be depreciated at the rate mentioned above.

Alternatively, the machine of Brand PQR can also be taken on rent to be returned back to the owner after use on the following terms and conditions:

- Annual Rent shall be paid in the beginning of each year and for first year it shall be Rs. 1,20,000.
- Annual Rent for the subsequent 4 years shall be Rs.1,25,000.
- Annual Rent for the final 5 years shall be Rs.1,50,000.
- The Rent Agreement can be terminated by Z Ltd. by making a payment of Rs. 2,50,000 as penalty. This penalty would be reduced by Rs. 25,000 each year of the period of rental agreement.

You are required to:

a) Advise which brand of Scan machine should be acquired assuming that the use of machine shall be continued for a period of 20 years.

b) Which of the option is most economical if machine is likely to be used for a period of 5 years?

The cost of capital of Z Ltd. is 12%.

(B) (ANS.: A) MACHINE MNO SHOULD BE PURCHASED B) MACHINE PQR SHOULD BE TAKEN ON RENT]

MODEL 4.3 – CASH FLOW DISPARITY

PROBLEM 8: The cash flows of projects C and D are reproduced below:

Project	Cash Flow				NPV at 10%	IRR
	C_0	C_1	C_2	C_3		
C	-10,000	+2,000	+ 4,000	+12,000	+4,139	26.5%
D	-10,000	+10,000	+ 3,000	+3,000	+3,823	37.6%

i) Why there is a conflict of ranking?

ii) Why should you recommend project C in spite of lower internal rate of return?

Time	1	2	3
PVIF 0.10,t	0.9090	0.8264	0.7513
PVIF 0.14,t	0.8772	0.7695	0.6750
PVIF 0.15,t	0.8696	0.7561	0.6575
PVIF 0.30,t	0.7692	0.5917	0.4552
PVIF 0.40,t	0.7143	0.5102	0.3644

(RK) (ANS.: I) SKEWNESS IN CASH FLOWS; PROJECT C NPV IS HIGHER THAN PROJECT D NPV AT LOWER DISCOUNT RATE; PROJECT C NPV WILL FALLS FASTER WHEN DISCOUNT RATE INCREASES DUE TO COMPOUNDING EFFECT; AT BEP DISCOUNT RATE, PROJECT D IS HAVING WITH HIGHER NPV AND IRR; II) PROJECT C SHOULD BE ACCEPTED WHEN OPPORTUNITY COST OF FUNDS IS 10%)

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THE END