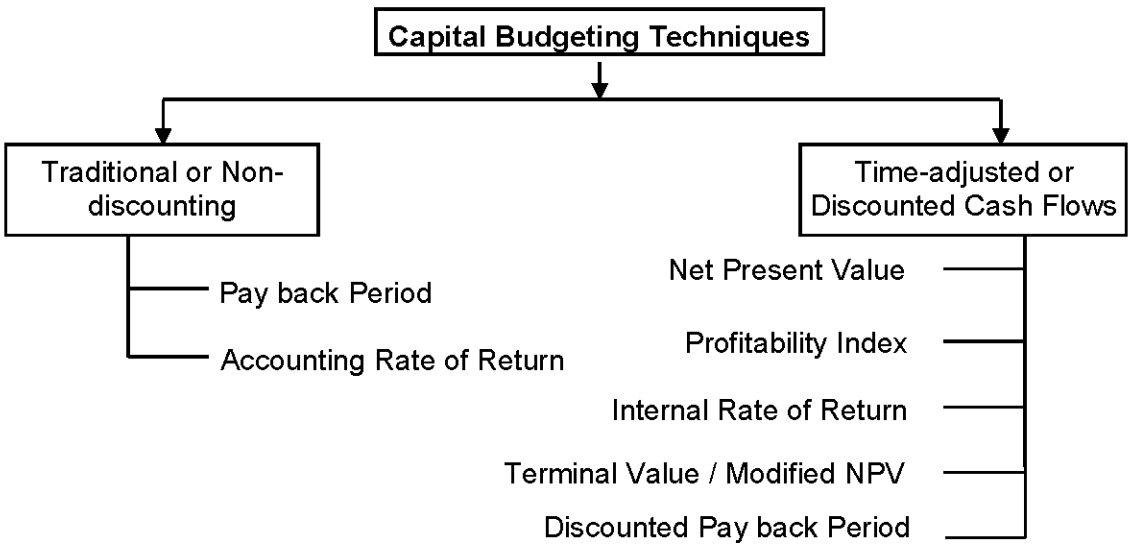
2. INVESTMENT DECISIONS

MODEL - WISE ANALYSIS OF PREVIOUS EXAMINATIONS

No.	Model Name	N-09	M-10	N-10 TO M-11	N-11	M-12	N-12	M-13	N-13	M-14	N-14	M-15	N-15	M-16	N-16
1.	AVERAGE RATE OF RETURN	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.	CALCULATION OF CFAT	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	PAY BACK PERIOD	-	-	-	-	-	-	-	-	-	-	-	8	-	-
4.	NPV	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	EQUIVALENT ANNUAL NPV OF CASH INFLOWS	-	-	8	-	-	-	-	8	-	-	-	-	-	-
6.	EQUIVALENT PRESENT VALUE OF ANNUAL CASH OUTFLOWS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	TERMINAL VALUE METHOD / MODIFIED NPV	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	IRR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	PAYBACK RECIPROCAL														
10.	MODIFIED IRR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	NPV & IRR IN THE SAME PROBLEM	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	PROFITABILITY INDEX	8	-	-	8	-	-	-	-	8	-	-	-	-	-
13.	CAPITAL RATIONING	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.	DISCOUNTED PAY BACK PERIOD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	FINDING OUT MISSING VALUES	-	-	-	-	8	-	-	-	-	-	8	-	8	-
16.	REPLACEMENT DECISIONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.	NPV AND IRR CONFLICT	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18.	COMPREHENSIVE PROBLEMS	8	8	-	-	-	10	9	-	-	-	-	-	-	-

INTRODUCTION: Capital budgeting decisions are related to the allocation of investible funds to different long term assets. Broadly speaking, capital budgeting decision denotes a decision situation where lumpsum funds are invested in the initial stages of a project and the returns are expected over a long period. Although there is no hard and fast rule to define the term long term, yet period involving more than 1 year may be taken as long period for investment decisions. Some of the capital budgeting decisions may be to buy land, building or plants; or to undertake a program on research and development of a product, to diversify into a new product line, promotional campaign etc.

TECHNIQUES OF CAPITAL BUDGETING:



PROBLEMS FOR CLASSROOM DISCUSSION

MODEL 1: ACCOUNTING (BOOK) RATE OF RETURN / AVERAGE RATE OF RETURN METHOD (ARR)

a) The Accounting Rate of Return of an investment measures the average annual net income of the project (incremental income) as a percentage of the investment.

$$\text{Accounting rate of return} = \frac{\text{Average annual net income}}{\text{Investment}} \times 100$$

b) The numerator is the average annual net income generated by the project over its useful life.

c) The denominator can be either the initial investment (including installation cost) or the average investment over the useful life of the project.

d) Average investment means the average amount of fund remained blocked during the lifetime of the project under consideration.

e) Further ARR can be calculated in number of ways as shown in below

VERSION 1: ANNUAL BASIS

$$\text{ARR} = \frac{\text{Profit after Depreciation}}{\text{Investment in the begining of the year}} \times 100$$

VERSION 2: TOTAL INVESTMENT BASIS

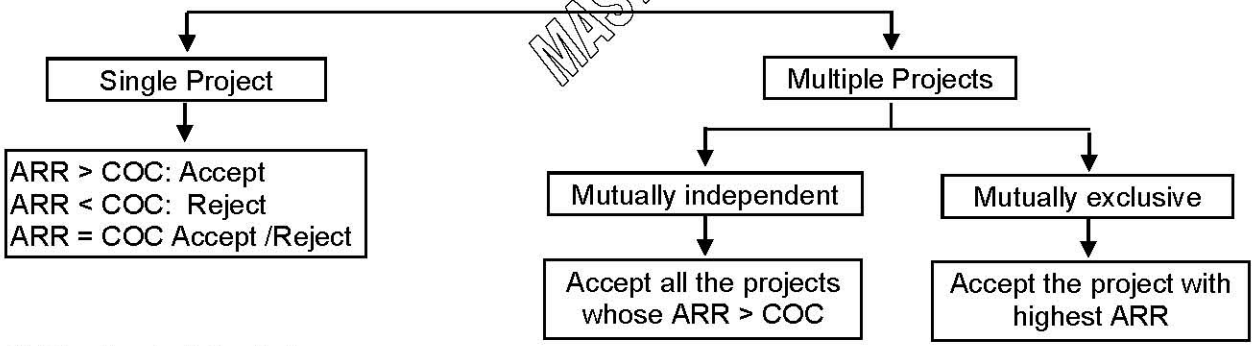
$$\text{ARR} = \frac{\text{Average Annual Profit}}{\text{Investment in the begining}} \times 100$$

VERSION 3: AVERAGE INVESTMENT BASIS

$$\text{ARR} = \frac{\text{Average Annual Profit (after tax)}}{\text{Average investment in the project}} \times 100$$

Where, Average investment = ½ (Initial Cost + Installation Expenses – Salvage value) + Salvage value + Additional Working Capital.

DECISION RULE:



COC = Cost of Capital

PROBLEM 1: A project requires an investment of Rs.10,00,000 yields Profit after Tax and Depreciation as follows:

Year	1	2	3	4	5
Profit After Tax & Depreciation (Rs.)	50,000	75,000	1,25,000	1,30,000	80,000

Suppose further that at the end of 5 years, the plant and machinery of the project can be sold for Rs.80,000. Calculate Average Rate of Return.

(SM)*(Ans.: Average rate of return = 9.2% of Initial investment, 17% of Average investment)*

(Solve Problem No.1 of Assignment Problems as rework)

NOTE: _____

PROBLEM 2: : (PRINTED SOLUTION AVAILABLE) Times Ltd. is going to invest in a project a sum of Rs.3,00,000 having a life span of 3 years . Salvage value of machine is Rs.90,000. The Profit Before Depreciation for each year is Rs.1,50,000.

Requirement:

1. ARR on the basis of
   a) Annual investment
   b) Total investment
   c) Average investment
2. Compute ARR if, additional working capital of Rs.45,000 is required.

(SM) [Ans.: 1(a) ARR on the basis of Annual investment = 37.15%, Total investement 1(b) = 26.67%, Average investment 1(c) = 41.03%, 2)ARR= 33.33%]

NOTE: _____

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MODEL 2: CALCULATION OF CFAT

Cash flow (CFAT) = Profit after Tax (PAT) + Non-cash expenses (N/C Exp.)

PROBLEM 3: Following is the income statement of a project, on the basis of which calculate the annual cash inflows.

Particulars	Rs.	Rs.
Net Sales revenue		4,75,000
- Cost of goods sold	2,00,000	
- General Expenses	1,00,000	
- Depreciation	50,000	3,50,000
Profit before interest and taxes (PBIT)		1,25,000
- Interest		25,000
Profit before tax		1,00,000
-Tax @ 40%		40,000
Profit after tax		60,000

(MAY 03) (Ans.: Annual cash inflow Rs.1,25,000)

(Solve Problem No. 2 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 4: A firm buys an asset costing Rs.1,00,000 and expects operating profits (before depreciation @ 20% WDV and tax @ 30%) of Rs.30,000 p.a. for the next four years after which the asset would be disposed off for Rs.45,000. Find out the cash flows for different years.

(N 99) (Ans.: Cash flows Year 1= Rs. 27,800,Year 2= Rs. 25,800, Year 3= Rs. 24,840, Year 4 = Rs. 24,072, terminal cash flows= Rs. 43,788)

(Solve Problem No.3 of Assignment Problems as rework)

NOTE: _____

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MODEL 3: PAYBACK PERIOD METHOD

The payback period of an investment is the length of time required for the cumulative total net cash flows from the investment to equal the total initial cash outlays. At that point in time, the investor has recovered the money invested in the project.

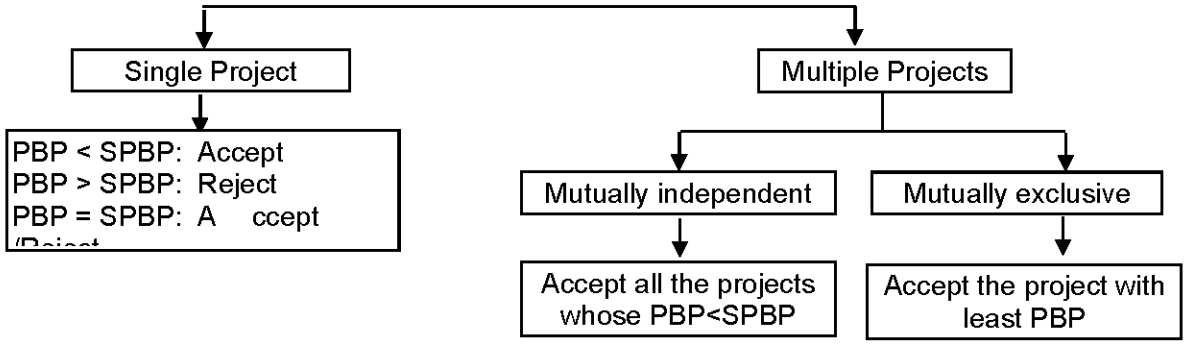
CALCULATION OF PAYBACK PERIOD:

1. When the net cash flows are uniform over the useful life of the project:

$$PBP = \frac{\text{Initial Investment}}{\text{Annual cashinflow}}$$

2. When the annual cash flows are not uniform, the cumulative cash flows from operations must be calculated for each year. The PBP shall be corresponding period when total of cumulative cash inflows is equal to the initial capital investment. However, if exact sum does not match then the period in which it lies should be identified. After that we need to compute the fraction of the year that is needed to complete the total payback.

DECISION RULE:



Where PBP = Payback Period, SPBP= Standard Payback Period

PROBLEM 5: A chemical company is considering investing in a project that costs Rs.5,00,000. The estimated salvage value is zero, tax rate is 55%. The company uses straight line depreciation and the proposed project has cash flows before tax (CFBT) as follows. Determine Payback period.

Year	1	2	3	4	5
CFBT	1,00,000	1,00,000	1,50,000	1,50,000	2,50,000

(Ans.: Pay back period 4.32Yrs)

NOTE: _____

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PROBLEM 6: (PRINTED SOLUTION AVAILABLE) M/s Quality Products are going for a purchase of new machine to increase their installed capacity to meet the growing demand. There are three machines under the consideration of management. The relevant details including estimated yearly expenditure and sales are given below. All sales are on cash basis with corporate tax rate of 40%. Interest on capital may be assumed at 10%. Tell about the most profitable investment on the principle of "pay back method".

Machines	1	2	3
Initial investment (cash outflow)	3,00,000	3,00,000	3,00,000
Expected annual sales	5,00,000	4,00,000	4,50,000
Cost of production:			
Direct material	40,000	50,000	48,000
Direct Labour	50,000	30,000	36,000
Factory overheads	60,000	50,000	58,000
Administrative costs	20,000	10,000	15,000
Selling and distribution costs	10,000	10,000	10,000

The economic life of machine No.1 is 2 years, while it is 3 years for the other two. The scrap values are Rs.40,000, Rs.25,000 and Rs.30,000 respectively.

(Ans.: Machine 1 is preferable, Pay back periods: 1.32Yrs, 1.77Yrs & 1.59 Yrs. Respectively)

(Solve Problem No. 4 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 7: (PRINTED SOLUTION AVAILABLE) Consider the following projects:

Cash flows (Rs.'000)					
Project	**C_0**	**C_1**	**C_2**	**C_3**	**C_4**
A	-1,000	+600	+200	+200	+1,000
B	-1,000	+200	+200	+600	+1,000
C	-300	+100	+100	+100	+600
D	-300	0	0	+300	+600

a) Calculate the payback period for each project.

b) If the standard payback period is 2 year which project will you select? Will your answer be different if the standard payback is 3 years?

[Ans.: a) PBP For A= 3Yrs, B= 3Yrs, C = 3Yrs and D = 3Yrs respectively, b) If it is 2 Yrs then it is advisable to reject all the projects. If it is 3Yrs then the projects can either be accepted or rejected]

NOTE: _____

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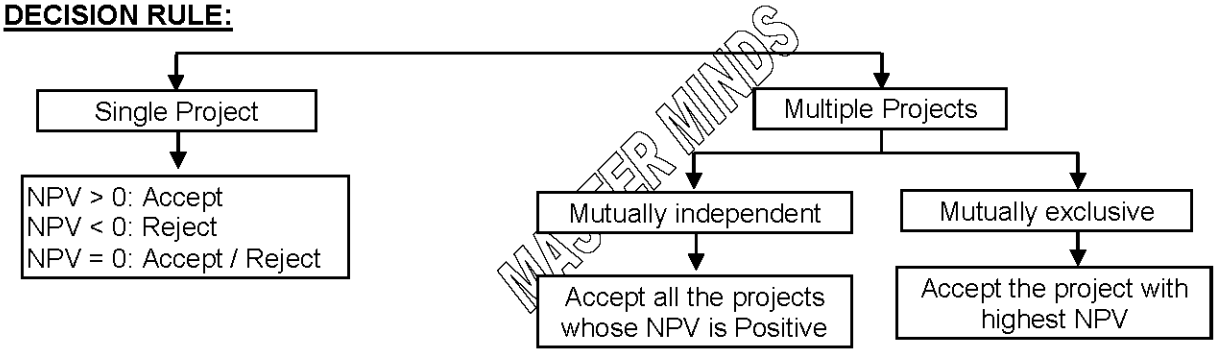
MODEL 4: CALCULATION OF NPV UNDER DIFFERENT CONDITIONS

The Net present value technique is a discounted cash flow method that considers the time value of money in evaluating capital investments. The net present value of a project is the amount, in current value of rupees, the investment earns after paying cost of capital in each period.

CALCULATION OF NPV: NPV = Present value of cash inflows – Present value of cash outflows

DECISION RULE:



PROBLEM 8: A machine costing Rs.110 lacs has a life of 10 years, at the end of which its scrap value is likely to be Rs.10 lacs. The firm's cut-off rate is 12%. The machine is expected to yield an annual profit after tax of Rs.10 lacs, depreciation being reckoned on straight line basis. Ascertain the net present value of the project. *(Ans.: NPV = Rs. 6,22,000)*

NOTE: _____

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PROBLEM 9: Consider the following three investments:

Cash Flows(Rs)			
Projects	**C_0**	**C_1**	**C_2**
X	-2,500	0	+3,305
Y	-2,500	+1,540	+1,540
Z	-2,500	+2,875	0

The discount rate is 12 per cent. Compute the NPV.

(Ans.: NPV for X: Rs. 134, For Y: Rs. 102, For Z: Rs. 67)

(Solve Problem No. 5 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 10: (PRINTED SOLUTION AVAILABLE) ABC Ltd. is a small company that is currently analyzing capital expenditure proposals for the purchase of equipment, the company uses the Net Present Value technique to evaluate projects. The capital budget is limited to Rs.5,00,000 which ABC Ltd. believes is the maximum capital it can raise. The initial investment and projected net cash flows for each project are shown below. The cost of capital of ABC Ltd is 12%. You are required to compute the NPV of the different projects.

	Project A	Project B	Project C	Project D
Initial Investment	200,000	190,000	250,000	210,000
Project Cash Inflows				
Year 1	50,000	40,000	75,000	75,000
2	50,000	50,000	75,000	75,000
3	50,000	70,000	60,000	60,000
4	50,000	75,000	80,000	40,000
5	50,000	75,000	100,000	20,000

(SM) [Ans.: NPV of Project A: Rs.(19,750), Project B: Rs. 25,635, Project C: Rs. 27,050, Project D:Rs.(3,750)]

(Solve Problem No. 6 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 11: (PRINTED SOLUTION AVAILABLE) PR Engineering Ltd. is considering the purchase of a new machine which will carry out some operations which are at present performed by manual labour. The following information related to the two alternative models – 'MX' and 'MY' are available:

	Machine 'MX'	Machine 'MY'
Cost of Machine	Rs.8,00,000	Rs.10,20,000
Expected Life	6 years	6 years
Scrap Value	Rs.20,000	Rs.30,000

Estimated net income before depreciation and tax:

Year	Rs.	Rs.
1	2,50,000	2,70,000
2	2,30,000	3,60,000
3	1,80,000	3,80,000
4	2,00,000	2,80,000
5	1,80,000	2,60,000
6	1,60,000	1,85,000

Corporate tax rate for this company is 30 percent and company's required rate of return on investment proposals is 10%. Depreciation will be charged on straight line basis.

You are required to:

a) Calculate the pay-back period of each proposal.

b) Calculate the Net Present Value of each proposal, if the P.V.factors at 10% are – 0.909, 0.826, 0.751, 0.683, 0.621 and 0.564.

c) Which proposal would you recommend and why?

(N 12-10M)(PM) [Ans.: a) PBP of MX-4.25Y, PBP of MY -3.67Y, b)NPV of MX- Rs.4,807, NPV of MY-Rs.1,12,092, c) Ranking based on PBP Machine MX & MY- II, I respectively, Ranking based on NPV Machine MX & MY- II,I respectively]

(Solve Problem No. 7 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 12: Cello Limited is considering buying a new machine which would have a useful economic life of five years, at a cost of Rs.1,25,000 and a scrap value of Rs.30,000, with 80 percent of the cost being payable at the start of the project and 20 percent at the end of the first year. The machine would produce 50,000 units per annum of a new project with an estimated selling price of Rs.3 per unit. Direct costs would be Rs.1.75 per unit and annual fixed costs, including depreciation calculated on a straight-line basis, would be Rs.40,000 per annum.

In the first year and the second year, special sales promotion expenditure, not included in the above costs, would be incurred, amounting to Rs.10,000 and Rs.15,000 respectively.

Evaluate the project using the NPV method of investment appraisal, assuming the company's cost of capital to be 10 percent. **(MTP M15)** *(SM, RTP) (Ans.: NPV= Rs. 31,712)*

NOTE: _____

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PROBLEM 13: (PRINTED SOLUTION AVAILABLE) A company wants to invest in a machinery that would cost Rs.50,000 at the beginning of year 1. It is estimated that the net cash inflows from operations will be Rs.18,000 per annum for 3 years, if the company opts to service a part of the machine at the end of year 1 at Rs.10,000. In such a case, the scrap value at the end of year 3 will be Rs.12,500. However, if the company decides not to service the part, then it will have to be replaced at the end of year 2 at Rs.15,400. But in this case, the machine will work for the 4th year also and get operational cash inflow of Rs.18,000 for the 4th year. It will have to be scrapped at the end of year 4 at Rs.9,000. Assuming cost of capital at 10% and ignoring taxes, will you recommend the purchase of this machine based on the Net Present Value of its cash flows? **(N08 7M)**

If the supplier gives a discount of Rs.5,000 for purchase, what would be your decision? (The present value factors at the end of years 0, 1, 2, 3, 4, 5 and 6 are respectively 1, 0.9091, 0.8264, 0.7513, 0.6830, 0.6209 and 0.5644).

(N 08-7M) (PM) (Ans.: i. Since NPV is positive in case of option 2, it is beneficial for the company to purchase the machinery and replace the part at the end of year 2. ii. Since supplier is providing discount for both the options decision making will remain same)

(Solve Problem No. 8 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 14: XYZ Ltd. is planning to introduce a new product with a project life of 8 years. The project is to be set up in Special Economic Zone (SEZ), qualifies for one time (at its starting) tax free subsidy from the State Government of Rs.25,00,000 on capital investment. Initial equipment cost will be Rs.1.75 crores. Additional equipment costing Rs.12,50,000 will be purchased at the end of the third year from the cash inflow of this year. At the end of 8 years, the original equipment will have no resale value, but additional equipment can be sold for Rs.1,25,000. A working capital of Rs.20,00,000 will be needed and it will be released at the end of eighth year. The project will be financed with sufficient amount of equity capital. **(N 07 8M)**

The sales volumes over eight years have been estimated as follows:

Year	1	2	3	4 – 5	6 - 8
Units	72,000	1,08,000	2,60,000	2,70,000	1,80,000

A sales price of Rs.120 per unit is expected and variable expenses will amount to 60% of sales revenue. Fixed cash operating costs will amount Rs.18,00,000 per year. The loss of any year will be set off from the profits of subsequent two years. The company is subject to 30 percent tax rate and considers 12 percent to be an appropriate after tax cost of capital for this project. The company follows straight line method of depreciation.

Required: Calculate the Net Present Value of the project and advise the management to take appropriate decision.

The PV factors at 12% are

Year	1	2	3	4	5	6	7	8
PVF	0.893	0.797	0.712	0.636	0.567	0.507	0.452	0.404

(N 07-8M)(PM) (Ans.: NPV=Rs.1,01,32,933)

(Solve Problem No. 9 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 15: X Ltd. an existing profit-making company, is planning to introduce a new product with a projected life of 8 years Initial equipment cost will be Rs.120 lakhs and additional equipment costing Rs.10 lakhs will be needed at the beginning of third year. At the end of the 8 years, the original equipment will have resale value equivalent to the cost of removal, but the additional equipment would be sold for Rs.1 lakh. Working capital of Rs.15 lakhs will be needed. The 100% capacity of the plant is of 4,00,000 units per annum, but the production and sales-volume expected are as under:

Year	Capacity in percentage
1	20
2	30
3 – 5	75
6 – 8	50

A sale price of Rs.100 per unit with a profit volume ratio of 60% is likely to be obtained. Fixed Operating Cash Cost is likely to be Rs.16 lakhs per annum. In addition to this the advertisement expenditure will have to be incurred as under:

Year	1	2	3 – 5	6 – 8
Expenditure in Rs. lakhs each year	30	15	10	4

The company is subjected to 50% tax, straight-line method of depreciation, (permissible for tax purposes also) and taking 12% as appropriate after tax cost of Capital, should the project be accepted? *(PM)(Ans.: NPV= Rs.1,30,24,450 as NPV is positive accept the project)*

NOTE: _____

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PROBLEM 16: (PRINTED SOLUTION AVAILABLE) Swastik Ltd. has two divisions, which are periodically assisted by visiting teams of consultants. The management is worried about the steady increase of expenses in this regard over the years. An analysis of last year's expenses reveals the following:

Consultants Remuneration	2,50,000
Travel and conveyance	1,50,000
Accommodation exp.	6,00,000
Boarding Charges	2,00,000
Special Allowances	50,000

The management estimates accommodation expenses to increase by Rs.2,00,000/- annually. As part of cost reduction drive, Swastik Ltd. is proposing to construct a consultancy center to take care of the accommodation requirements of the consultants. This center will additionally save the company Rs.50,000/- in boarding charges and Rs.2,00,000/- in the cost of Executive Training Programs hitherto conducted outside the company's premises, every year.

The details regarding the construction and maintenance of the new center is:

a) Land at a cost of Rs.8,00,000/- already owned by the company, will be used.
b) Construction cost Rs.15,00,000/- including special furnishings.
c) Cost of annual maintenance: Rs.1,50,000/-
d) Construction cost will be written off over 5 years, being the useful life.

Assume that the write-off of construction cost as aforesaid will be accepted for tax purposes. Is the proposal feasible? Cost of capital - 10%, Tax rate – 50%. *(Ans.: NPV= Rs.14,60,100)*

NOTE: _____

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PROBLEM 17: 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: **(RTP M-14)**

Particulars	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

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:

a) What would be the desirable choice?

b) What other important elements are to be considered before the final decision is taken?

(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.)

NOTE: _____

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PROBLEM 18: (PRINTED SOLUTION AVAILABLE) A chemical company is presently paying an outside firm Rs.1 per gallon to dispose off the waste material resulting form its manufacturing operations. At normal operating capacity, the waste is about 50,000 gallons per year. After spending Rs.60,000 on research, the company discovered that the waste could be sold for Rs.10 per gallon if it was processed further. Additional processing would, however, require an investment of Rs.6,00,000 in new equipment, which would have an estimated life of 10 years with no salvage value. Depreciation would be calculated by straight line method. Except of the costs incurred in advertising Rs.20,000 per year; no change in the present selling and administrative expenses is expected, if the new product is sold, The details of additional processing costs are as follows:

a) Variable : Rs.5 per gallon of waste put into process.

b) Fixed (excluding depreciation) : Rs.30,000 per year.

In costing the new product, general administrative overheads will be allocated at the rate of Rs.2 per gallon. There will be no losses in processing, and it is assumed that the total waste processed in a given year will be sold in that very year. Estimates indicate that 40,000 gallons of the product could be sold each year. The management when confronted with the choice of disposing off the waste or processing it further and selling it, seeks your advice. Which alternative would you recommend? Assume that the firm's cost of capital is 15% and it pays on an average 35% tax on its income. *(Ans.: NPV=RS.1,25,246)*

(Solve Problem No. 10 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 19: Elite Cooker Company is evaluating three investment situations: (1) Produce a new line of aluminum skillets, (2) Expand its existing cooker line to include several new sizes, and (3) develop a new, higher-quality line of cookers. If only the project in question is undertaken, the expected present values and the amounts of investment required are:

Project	Investment required (Rs.)	Present value of Future Cash-Flows (Rs.)
1	2,00,000	2,90,000
2	1,15,000	1,85,000
3	2,70,000	4,00,000

If projects 1 and 2 are jointly undertaken, there will be no economies; the investments required and present values will simply be the sum of the parts. With projects 1 and 3, economies are possible in investment because one of the machines acquired can be used in both the production processes. The total investment required for projects 1 and 3 combined is Rs.4,40,000. If projects 2 and 3 are undertaken, there are economies to be achieved in marketing and producing the products but not in investment. The expected present value of future cash flows for projects 2 and 3 is Rs.6,20,000. If all the three projects are undertaken simultaneously, the economies noted will still hold. However, a Rs.1,25,000 extension on the plant will be necessary, as space is not available for all the three projects. Which project or projects should be chosen?

(SM)(RTP) (Ans.: Since Combination 5 has highest NPV it has to be selected i.e. accept the projects 1&3.)

NOTE: _____

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PROBLEM 20: (PRINTED SOLUTION AVAILABLE) A large profit making company is considering the installation of a machine to process the waste produced by one of its existing manufacturing process to be converted into a marketable product. At present, the waste is removed by a contractor for disposal on payment by the company of Rs.50 lakhs per annum for the next four years. The contract can be terminated upon installation of the aforesaid machine on payment of a compensation of Rs.30 lakhs before the processing operation starts. This compensation is not allowed as deduction for tax purposes.

The machine required for carrying out the processing will cost Rs.200 lakhs to be financed by a loan repayable in 4 equal installments commencing from the end of year1.The interest rate is 16% per annum. At the end of the 4th year, the machine can be sold for Rs.20 lakhs and the cost of dismantling and removal will be Rs.15 lakhs.

Sales and direct costs of the product emerging from waste processing for 4 years are estimated as under:

(Rs. In lakhs)

Year	1	2	3	4
Sales	322	322	418	418
Material consumption	30	40	85	85
Wages	75	75	85	100
Other expenses	40	45	54	70
Factory overheads	55	60	110	145
Depreciation(as per income tax rules)	50	38	28	21

Initial stock of materials required before commencement of the processing operations is Rs.20 lakhs at the start of year 1. The stock levels of materials to be maintained at the end of year 1, 2 and 3 will be Rs.55 lakhs and the stocks at the end of year 4 will be nil. The storage of materials will utilise space which would otherwise have been rented out for Rs.10 lakhs per annum. Labour costs include wages of 40 workers, whose transfer to this process will reduce idle time payments of Rs.15 lakhs in the year 1 and Rs.10 lakhs in the year 2. Factory overheads include apportionment of general factory overheads except to the extent of insurance charges of Rs.30 lakhs per annum payable on this venture. The company's tax rate is 50%.

Year	1	2	3	4
Present value factors	0.870	0.756	0.658	0.572

Advise the management on the desirability of installing the machine for processing the waste. All calculations should form part of the answer. *(PM)(Ans.: NPV = Rs. 105.218 lakhs)*

NOTE: _____

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MODEL 5: EQUIVALENT ANNUAL NPV OF CASH INFLOWS (ANNUALIZED NPV)

PROBLEM 21: 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%.

At the end of the year	Net cash inflow		Present value 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 N.P.V.

(Ans.: NPV of project X =15.4 lakhs , Y= 17.16 lakhs Since Annualised NPV more, it is beneficial to select project Y)

(Solve Problem No. 11 of Assignment Problems as rework)

NOTE: _____

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MODEL 6: EQUIVALENT PRESENT VALUE OF ANNUAL CASH OUTFLOWS

PROBLEM 22: A company is required to choose between two machines A and B. The two machines are designed differently, but have identical capacity and do exactly the same job. Machine A costs Rs.6,00,000 and will last for 3 years. It costs Rs.1,20,000 per year to run. Machine B is an 'economy' model costing Rs.4,00,000 but will last only for two years, and costs Rs.1,80,000 per year to run. These are real cash flows. The costs are forecasted in rupees of constant purchasing power. Opportunity cost of capital is 10%. Which machine company should buy? Ignore tax. **(N 10 8M, M09 7M)**

(PM) (Ans.: equivalent cash outflow of machine A= Rs.3,61,255, machine B= Rs.4,10,415The Company should buy machine A as equivalent cash outflow is less than machine B.)

(Solve Problem No. 12 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 23: (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%

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%.

(RTP N 15) *[Ans.: a) Machine XYZ should be purchased, b) Machine ABC should be taken on rent]*

(Solve Problem No. 13, 14 of Assignment Problems as rework)

NOTE: _____

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MODEL 7: TERMINAL VALUE METHOD / MODIFIED NPV

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. 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. 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 24:

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.

(Ans.: Modified NPV Rs.3,242)

(Solve Problem No. 15 of Assignment Problems as rework)

NOTE: _____

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MODEL 8: CALCULATION OF IRR

INTERNAL RATE OF RETURN:

a) **Internal rate of return** for an investment proposal is the discount rate that equates the present value of the expected net cash flows with the initial cash outflow.

b) The IRR of a proposal is defined as the discount rate which produces a zero NPV i.e. the IRR is the discount rate which will equate the present value of cash inflows with the present value of cash outflows

c) This IRR is then compared to a criterion rate of return that can be the organization's desired rate of return for evaluating capital investments.

OTHER NAMES:

a) Yield on investment,
b) Marginal efficiency of capital,
c) Rate of return over cost,
d) Time adjusted rate of internal return,
e) Productivity of capital,
f) Marginal rate of return.

CALCULATION OF IRR: The procedure for computing Internal Rate Of Return may vary with the pattern of net cash flows over the useful life of an investment.

1. **SCENARIO I: FOR AN INVESTMENT WITH SINGLE CASH FLOW**

   Step 1: Future Value = PV X FVF (FVF = FV/PV)

   Step 2: Trace the rate of interest corresponding to x number of years

2. **SCENARIO II: FOR AN INVESTMENT WITH UNIFORM CASH FLOWS OVER ITS LIFE**

   Step 1: Here we got multiple inflows.

   We know that, at IRR, NPV is zero.

   Present value of inflows = PV of outflows.

   Periodic cash flow X PVAF = PV of outflows.

   PVAF = PV of out flows / Periodic cash flow.

   Step 2: Trace the interest rate using PVAF table.

3. **SCENARIO III: FOR AN INVESTMENT WITH NOT UNIFORM CASH FLOWS OVER ITS LIFE.** There are 2 methods for calculation of IRR:

   a) **Trail & Error method:**

   - Assume one guess rate and calculate NPV at that first guess rate.
   - Assume another guess rate. Calculate NPV at the 2nd guess rate. (If NPV becomes Zero in step a itself, no need to come to step b)
   - Continue till you get NPV = 0.
   - The only problem with this method is that it is based on trail and error approach.

   b) **Interpolation:**

   Let LR = Lower rate,

   HR = Higher rate.

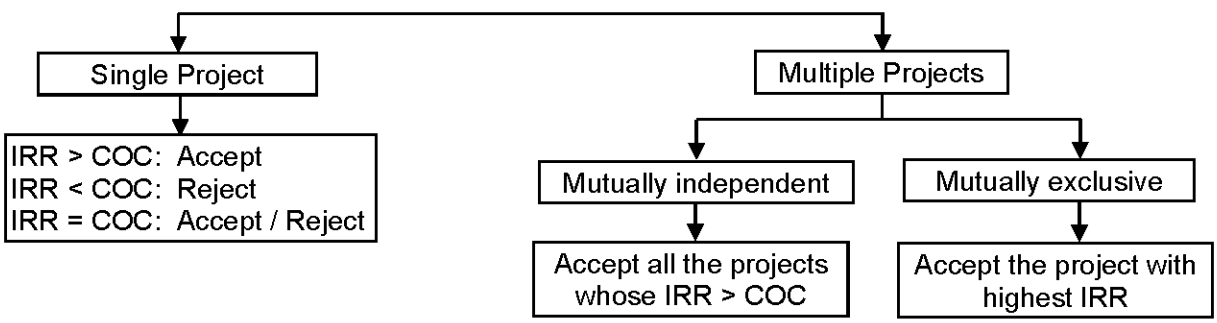
   It is preferable to take HR in such a way that NPV is negative. Using interpolation,

   $$IRR = LR + \frac{NPV \text{ at } LR}{NPV \text{ at } LR - NPV \text{ at } HR} X (HR - LR)$$

4. **SCENARIO IV: FOR AN INVESTMENT WITH INFINITE UNIFORM CASH FLOWS OVER ITS LIFE (PERPETUITY)**

   IRR = Perpetuity / Initial outlay X 100.

DECISION RULE:



Where, COC = Cost of capital

PROBLEM 25: Computation of IRR in four situations.

1. Find the IRR of a project with a cash outflow of Rs.5,000 in year 0 and a cash receipt one year later of Rs.5,850.
2. Find the IRR of a project with a cash outflow of Rs.20,000 in year 0 and a cash inflow two years later of Rs. 25,992.
3. Find the IRR of a project with a cash outflow of Rs.4,42,000 and a three year annuity in flow of Rs.200,000.
4. Find the IRR of the project whose cash flow is given below:

Year	0	1	2	3
Cash flows	(718)	250	575	100

5. Find the IRR of a project with a cash outflow in year 0 of Rs.50,000 and which produces cash inflows in perpetuity of Rs.8,750. *(Ans.: IRR In situation 1. 17%, 2. 14%, 3. 17%, 4. 15.289 %, 5. 17.5%)*

(Solve Problem No. 16 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 26: A company proposes to install machine involving a capital cost of Rs.3,60,000. The life of the machine is 5 years and its salvage value at the end of the life is nil. The machine will produce the net operating income after depreciation of Rs.68,000 per annum. The company's tax rate is 45%.

The Net Present Value factors for 5 years are as under:

Discounting rate:	14	15	16	17	18
Cumulative factor:	3.43	3.35	3.27	3.20	3.13

You are required to calculate the Internal Rate of Return of the proposal.

(Ans.: IRR = 15.74%)

(Solve Problem No.17 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 27: (PRINTED SOLUTION AVAILABLE) X Company is evaluating the rate of return on two of its Assets, I and II. The Asset I was purchased a year ago for Rs.4,00,000 and since then it has generated cash inflows of Rs.16,000. Presently, it can be sold for a price of Rs.4,30,000. Asset II was purchased a few years ago and its market price in the beginning and at the end of the year was Rs.2,40,000 and Rs.2,36,000 respectively. The Asset II has generated cash inflows of Rs.34,000. Find out the rate of return on these Assets.

(PM-EXERCISE)(Ans: IRR of asset I = 11.5%, asset II= 12.5%)

(Solve Problem No. 18 of Assignment Problems as rework)

NOTE: _____

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MODEL 9: PAYBACK RECIPROCAL

a) As the name indicates it is the reciprocal of payback period. A major drawback of the payback period method of capital budgeting is that it does not indicate any cut off period for the purpose of investment decision.

b) It is, however, argued that the reciprocal of the payback would be a close approximation of the Internal Rate of Return (later discussed in detail) if the life of the project is at least twice the payback period and the project generates equal amount of the annual cash inflows.

c) In practice, the payback reciprocal is a helpful tool for quickly estimating the rate of return of a project provided its life is at least twice the payback period.

$$\text{Payback reciprocal} = \frac{\text{Average Annual Cash Inflow}}{\text{Initial investment}}$$

d) If a proposal has a payback period of 4 years then its payback period reciprocal is 25%. Higher the payback period reciprocal (and hence lower the payback period), more worth while the proposal is. There is no positive relevance of the payback period reciprocal except that it is in percentage form.

$$\text{Payback period reciprocal} = (1/\text{Payback period}) \times 100.$$

PROBLEM 28: A project costing Rs.5,60,000 is expected to produce annual net cash benefits (CFAT) of Rs.80,000 over a period of 15 years. Estimate the internal rate of return (IRR). Also, find the payback period and obtain the IRR from it. How do you compare this IRR with the one directly estimated? *[Ans.: a. IRR: 11.5%, b. i) PBP: 7Y, ii) PBP Reciprocal: 14.28%]*

(Solve Problem No. 19 of Assignment Problems as rework)

NOTE: _____

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MODEL 10: 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 29: (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

(SM) *(Ans.: Modified IRR = 9.455% (approx.))*

(Solve Problem No. 20 of Assignment Problems as rework)

NOTE: _____

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MODEL 11: CALCULATION OF NPV AND IRR FOR THE SAME PROJECT

NPV VERSUS IRR: The IRR approach calculates implicit rate of interest unique to each project, while the NPV approach solves for the trade - off cash inflows and outflows using a general required rate of return. On the basis of the above discussion of NPV and IRR, a comparison between the two may be attempted as follows:

SUPERIORITY OF IRR OVER NPV: IRR may be considered superior to the NPV for the following reasons:

a) IRR gives percentage return while the NPV gives absolute return.

b) For IRR, the availability of required rate of return is not a pre-requisite while for NPV it is must.

SUPERIORITY OF NPV OVER IRR: The NPV is said to have superiority over IRR for

a) NPV shows expected increase in the wealth of the shareholders.

b) NPV gives clear cut accept-reject decision rule, while the IRR may give multiple results also.

c) NPV of different projects are additive while the IRRs cannot be added.

d) NPV gives better ranking as compared to the IRR.

PROBLEM 30: (PRINTED SOLUTION AVAILABLE) Hindlever Company is considering a new product line to supplement its range line. It is anticipated that the new product line will involve cash investments of Rs.7,00,000 at time 0 and Rs.10,00,000 in year 1. After-Tax cash inflows of Rs.2,50,000 are expected in year 2, Rs.3,00,000 in year 3, Rs.3,50,000 in year 4 and Rs.4,00,000 each year thereafter through year 10. Although the product line might be viable after year 10, the company prefers to be conservative and end all calculations at that time.

a) If the required rate of return is 15 percent, what is the Net Present Value of the project? Is it acceptable?

b) What would be the case if the required rate of return were 10 percent?

c) What is its internal rate of return?

d) What is the project's payback period?

(SM)[Ans.: a) NPV: Rs -1,18,200, Since NPV is negative it is not advisable to accept the proposal
b) NPV: Rs 2,51,450 c)IRR: 13.40% d)PBP: 6Y]

(Solve Problem No. 21, 22 of Assignment Problems as rework)

NOTE: _____

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MODEL 12: PROFITABILITY INDEX METHOD

This technique which is a variant of NPV technique is also known as '*Desirability factor*' or Benefit-cost ratio or Present Value Index. The PI is also based upon the basic concept of discounting the future cash flows and is ascertained by comparing the present value of future cash inflows with the present value of future cash outflows. PI is calculated by dividing the former by the latter.

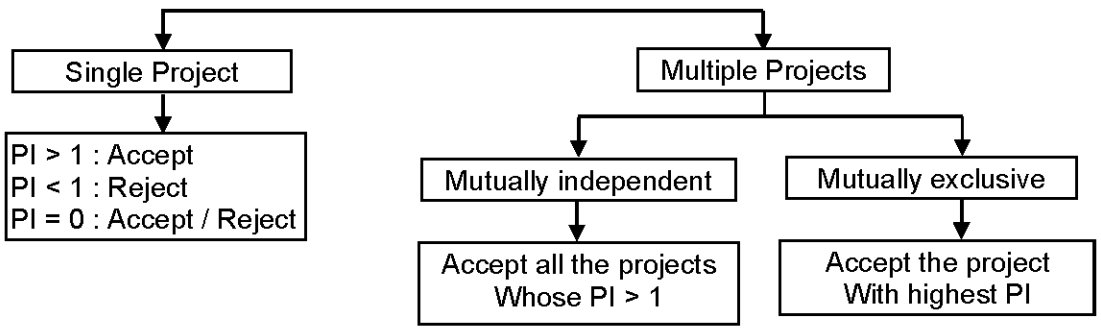
Mathematically:

$$PI = \frac{\text{Sum of discounted cash in flows}}{\text{Initial cash outlay Or Total discounted cash outflow (as the case may)}}$$

or

$$PI = \frac{\text{Total Present Value of cash inflows}}{\text{Total Present Value of cash outflows}} = \sum_{i=1}^{n} \frac{CF_1}{(1+K)^i} \div C_o$$

DECISION RULE:



PROBLEM 31: FH hospital is considering to purchase a CT-Scan machine. Presently the hospital is outsourcing the CT-Scan machine and is earning commission of Rs.15,000 per month (net of tax). The following details are given regarding the machine: **(M14 8M)**

	Rs.
Cost of CT-Scan machine	15,00,000
Operating Cost per annum (excluding depreciation)	2,25,000
Expected revenue per annum	7,90,000
Salvage value of the machine (after 5 years)	3,00,000
Expected life of the machine	5 years

Assuming tax rate @ 30%, whether it would be Profitable for the hospital to purchase the machine?

Give your recommendation under:

i. Net Present Value Method, and

ii. Profitability Index Method

Year	1	2	3	4	5
PV factor	0.893	0.797	0.712	0.636	0.567

(M14-8M) [Ans.: (i) NPV = Rs. (2,93,462.50), (ii) PI = 0.804]

(Solve Problem No. 23, 24 of Assignment Problems as rework)

NOTE: _____

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MODEL 13: CAPITAL RATIONING

PROBLEM 32: Master Minds has a capital budget of Rs.20,00,000 for the year 1999. It has before it the following 6 proposals for which the necessary information is provided here under.

Proposal	Outlay (Rs.)	NPV (Rs)	IRR
A	7,00,000	3,00,000	20.0%
B	2,50,000	1,60,000	17.0%
C	5,00,000	2,00,000	19.0%
D	2,00,000	1,00,000	17.5%
E	5,50,000	4,50,000	18.0%
F	7,50,000	-2,50,000	12.0%

Find out the ranking of the proposals given that:

a) The projects are indivisible, and

b) The projects are divisible

Also evaluate the ranking and make a final selection.

(Ans.: a. A-IV, B-II, C-V, D-III, E-I, b. Investment package with E,B,D,A has more NPV)

(Solve Problem No. 25 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 33: (PRINTED SOLUTION AVAILABLE) Shiva Limited is planning its capital investment program for next year. It has five projects all of which give a positive NPV at the company cut-off rate of 15 percent, the investment outflows and present values being as follows:

Project	Investment	NPV @ 15%
	Rs.'000	**Rs.'000**
A	(50)	15.4
B	(40)	18.7
C	(25)	10.1
D	(30)	11.2
E	(35)	19.3

The company is limited to a capital spending of Rs.1,20,000.

You are required to optimize the returns from a package of projects within the capital spending limit. The projects are independent of each other and are divisible (i.e. part-project is also possible).

(SM)(Ans.: The highest possible amount of NPV is Rs 55,567/- with the available funds of Rs.1,20,000)

(Solve Problem No. 26 of Assignment Problems as rework)

NOTE: _____

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MODEL 14: DISCOUNTED PAY BACK PERIOD

a) Some accountants prefer to calculate payback period after discounting the cash flow by a predetermined rate and the payback period so calculated is called, *'Discounted payback period'.* One of the most popular economic criteria for evaluating capital projects also is the payback period.

b) Payback period is the time required for cumulative cash inflows to recover the cash outflows of the project.

PROBLEM 34: **(PRINTED SOLUTION AVAILABLE)** Consider the following mutually exclusive projects:

Cash flows in Rs.					
Projects	C_0	C_1	C_2	C_3	C_4
A	-10,000	6,000	2,000	2,000	12,000
B	-10,000	2,500	2,500	5,000	7,500
C	-3,500	1,500	2,500	500	5,000
D	-3,000	0	0	3,000	6,000

Required:

i) Calculate the payback period for each project.

ii) If the standard payback period is 2 years, which project will you select? Will your answer differ, if standard payback period is 3 years?

iii) If the cost of capital is 10%, compute the discounted payback period for each project. Which projects will you recommend, if standard discounted payback period is (i) 2 years, (ii) 3 years?

(PM)[Ans.: (i) A= 3y, B=3y, C= 1y and 9.6 m, D= 3y, (ii) project C , All the four projects, (iii) A= 3y and 2 m, B= 3y and 4.6 m, C= 2y and 2.25 m, D=3y and 2.18m, (iii)(i) no projects is acceptable, (iii)(ii) project C is acceptable.]

(Solve Problem No. 27 of Assignment Problems as rework)

NOTE: _____

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MODEL 15: FINDING OUT MISSING VALUES

PROBLEM 35: Following are the data on a capital project of X Ltd.

Particulars	Project M
Annual cost saving	Rs.60,000
Useful life	4 years
Internal rate of return	15%
Profitability index	1.064
Net present value	?
Cost of capital	?
Payback period	?
Salvage value	0

Find the missing values.

(N 98-12M, M 15-8M)(PM) [Ans.: a)NPV= Rs 10,963.20, b) COC= 12%, c) Pay Back period= 2.855 yrs.]

(Solve Problem No. 28 of Assignment Problems as rework)

NOTE: _____

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MODEL 16: REPLACEMENT DECISIONS

PROBLEM 36: 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%.

(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.29 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 37: A machine purchased six years back for Rs.1,50,000 has been depreciated to a book value of Rs.90,000. It originally had a projected life of fifteen years and zero salvage value. A new machine will cost Rs.2,50,000 and result in a reduced operating cost of Rs.30,000 per year for the next nine years. The older machine could be sold for Rs.50,000. The new machine shall also be depreciated on a straight-line method on nine-year life with salvage value of Rs.25,000. The company's tax rate is 50% and cost of capital is 10%.

Determine whether the old machine should be replaced.

Given: Present Value of Rs.1 at 10% on 9th year = 0.424, and Present Value of an annuity of Rs. 1 at 10% for 8 years = 5.335. *(RTP N13) (Ans.: NPV=RS (39,822))*

NOTE: _____

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PROBLEM 38: (PRINTED SOLUTION AVAILABLE) Company Y is operating an elderly machine that is expected to produce a net cash inflow of Rs.40,000 in the coming year and Rs.40,000 next year. Current salvage value is Rs.80,000 and next year's value is Rs.70,000. The machine can be replaced now with a new machine, which costs Rs.1,50,000, but is much more efficient and will provide a cash inflow of Rs.80,000 a year for 3 years . Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 percent. Advise with reasons.

(PM)(Ans.: Since the equivalent annual Cash Inflows of new machine now and next year is more than that Cash Inflows of elderly machine. Therefore it is advised to replace the elderly machine now.)

(Solve Problem No. 30 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 39: (PRINTED SOLUTION AVAILABLE) Lockwood Limited wants to replace its old machine with a new automatic machine. Two models A and B are available at the same cost of Rs.5 lakhs each. Salvage value of the old machine is Rs.1 lakh. The utilities of the existing machine can be used if the company purchases Machine A. Additional cost of utilities to be purchased in that case are Rs.1 lakh. If the company purchases Machine B then all the existing utilities will have to be replaced with new utilities costing Rs.2 lakhs. The salvage value of the old utilities will be Rs.0.20 lakhs. The earnings after taxation are expected to be:

Year	Cash Inflows of		
	A (Rs.)	B (Rs.)	P.V. Factor @ 15%
1	1,00,000	2,00,000	0.870
2	1,50,000	2,10,000	0.756
3	1,80,000	1,80,000	0.658
4	2,00,000	1,70,000	0.572
5	1,70,000	40,000	0.497
Salvage value	50,000	60,000	

The targeted return on capital is 15%. You are required to (i) Compute, for the two machines separately, net present value, discounted payback period and desirability factor and (ii) Advice which of the machines is to be selected? **(RTP N14), (N 05 12M)**

(SM)(Ans.: NPV of Machine A Rs. 42,580 & Machine B Rs.18140, DPBP for Machine A is 4.6 yrs & Machine B is 4.6 yrs, P.I. for Machine A is 1.088 & Machine B is 1.034 Since NPV & P.I. are more in case of Machine A therefore it is better to choose Machine A)

(Solve Problem No. 31,32 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 40: (PRINTED SOLUTION AVAILABLE) Nine Gems Ltd. has just installed Machine-R at a cost of Rs.2,00,000. The machine has a five year life with no residual value. The annual volume of production is estimated at 1,50,000 units which can be sold at Rs.6 per unit. Annual operating costs are estimated at Rs.2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at Rs.3 per unit for the same level of production.

Nine Gems Ltd. has just come across another model called Machine-S capable of giving the same output at an annual operating cost of Rs.1,80,000 (exclusive of depreciation). There will be no change in fixed costs. Capital cost of this machine is Rs.2,50,000 and the estimated life is for five years with nil residual value.

The company has an offer for sale of Machine-R at Rs.1,00,000. But the cost of dismantling and removal will amount to Rs.30,000. As the company has not yet commenced operations, it wants to sell Machine-R and purchase Machine-S.

Nine Gems Ltd. will be a zero-tax company for seven years in view of several incentives and allowances available.

The cost of capital may be assumed at 14%. P.V. factors for five years are as follows:

Year	1	2	3	4	5
P.V. Factor @ 14%	0.877	0.769	0.675	0.592	0.519

a) Advise whether the company should opt for the replacement.

Will there be any change in your view if Machine-R has not been installed but the company is in the process of selecting one or the other machine? Support your view with necessary workings.

(PM - EXERCISE)

[Ans.: a. Incremental NPV is Rs. (1,11,360) & Since NPV is -ve, therefore Machine R has to be continued without replacement, b. NPV for Machine R is Rs.6,58,000 & Machine S is Rs. 6,76,640, Since Machine S has highest NPV, it has to be selected.]

NOTE: _____

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PROBLEM 41: (PRINTED SOLUTION AVAILABLE) MNP Limited is thinking of replacing its existing machine by a new machine which would cost Rs.60 lakhs. The company's current production is 80,000 units, and is expected to increase to 1,00,000 units, if the new machine is bought. The selling price of the product would remain unchanged at Rs.200 per unit. The following is the cost of producing one unit of product using both the existing and new machine: **(RTP M16)**

			Unit Cost
	Existing Machine (80,000 units)	**New Machine (1,00,000 units)**	**Difference**
Materials	75.00	63.75	-11.25
Wages and Salaries	51.25	37.50	-13.75
Supervision	20.00	25.00	5.00
Repairs and Maintenance	11.25	7.50	-3.75
Power and Fuel	15.50	14.25	-1.25
Depreciation	0.25	5.00	4.75
Allocated Corporate Overheads	10.00	12.50	2.50
Total	183.25	165.50	-17.75

The existing machine has an accounting book value of Rs.1,00,000, and it has been fully depreciated for tax purpose. It is estimated that machine will be useful for 5 years. The supplier of the new machine has offered to accept the old machine for Rs.2,50,000. However, the market price of old machine today is Rs.1,50,000 and it is expected to be Rs.35,000 after 5 years. The new machine has a life of 5 years and a salvage value of Rs.2,50,000 at the end of its economic life. Assume corporate Income tax rate at 40%, and depreciation is charged on straight line basis for Income-tax purposes. Further assume that book profit is treated as ordinary income for tax purpose. The opportunity cost of capital of the Company is 15%.

Required:

i) Estimate net present value of the replacement decision.

ii) Estimate the internal rate of return of the replacement decision.

iii) Should Company go ahead with the replacement decision? Suggest.

(PM)[Ans.: i) NPV= Rs.1913.32 /- , ii) IRR= 28.23%, iii) the company should go ahead with replacing the project since it is positive NPV]

NOTE: _____

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MODEL 17: NPV AND IRR CONFLICT

SITUATION 1 - SCALE OR SIZE DISPARITY:

PROBLEM 42: (PRINTED SOLUTION AVAILABLE) 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. *(SM) (Ans.: NPV of A:Rs. 25,050, B: Rs. 59,300, IRR of A: 24.26%, B: 21.48%)*

(Solve Problem No. 33 of Assignment Problems as rework)

NOTE: _____

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SITUATION 2 - LIFE DISPARITY OR PROPOSALS WITH UNEQUAL LIVES:

PROBLEM 43: (PRINTED SOLUTION AVAILABLE) R plc is considering modernizing its production facilities and it has two proposals under consideration. The expected cash flows associated with these projects and their NPV as per discounting rate of 12% and IRR is as follows:

	Cash Flow	
Year	Project A	Project B
0	(40,00,000)	(20,00,000)
1	8,00,000	7,00,000
2	14,00,000	13,00,000
3	13,00,000	12,00,000
4	12,00,000	-
5	11,00,000	-
6	10,00,000	-
NPV @12%	6,49,094	5,15,488
IRR	17.47%	25.20%

Which project should R plc accept? *(SM)(Ans.: Project B have to accept)*

(Solve Problem No. 34 of Assignment Problems as rework)

NOTE: _____

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SITUATION 3 - CASH FLOW DISPARITY OR TIME DISPARITY

PROBLEM 44: (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.

c) Explain the inconsistency in ranking of two projects.

(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. 35 of Assignment Problems as rework)

NOTE: _____

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MODEL 18: COMPREHENSIVE PROBLEMS

PROBLEM 45: (PRINTED SOLUTION AVAILABLE) The management of P Limited is considering selecting a machine out of two mutually exclusive machines. The company's cost of capital is 12 percent and corporate tax rate for the company is 30 percent. Details of the machines are as follows:

	Machine - 1	Machine - 2
Cost of machine	Rs.10,00,000	Rs.15,00,000
Expected life	5Yrs	6Yrs
Annual income before tax and depreciation	Rs.3,45,000	Rs.4,55,000

Depreciation is to be charged on straight line basis.

You are required to:

i. Calculate the discounted pay-back period, net present value and internal rate of return for each machine.

ii. Advise the management of P Limited as to which machine they should take up. **(M10 8M)**

The present value factors of Rs. 1 are as follows:

Year	1	2	3	4	5	6
At 12%	0.893	0.797	0.712	0.636	0.567	0.507
At 13%	0.885	0.783	0.693	0.613	0.543	0.480
At 14%	0.877	0.769	0.675	0.592	0.519	0.456
At 15%	0.870	0.756	0.658	0.572	0.497	0.432
At 16%	0.862	0.743	0.641	0.552	0.476	0.410

(PM) (Ans.: (i) DPBP for Machine-1= 4.49 y, Machine-2 = 5.41y, NPV for Machine-1= Rs 86,909, Machine-2=Rs 1,18,074, IRR for Machine-1= 15.46%, Machine-2= 4.74%, (ii) Since IRR is more & DPBP is low in case of Machine-1 therefore it is better to choose Machine-1)

(Solve Problem No. 36 of Assignment Problems as rework)

NOTE: _____

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PROBLEM 46: (PRINTED SOLUTION AVAILABLE) SS Limited is considering the purchase of a new automatic machine which will carry out some operations which are at present performed by manual labour. NM-A1 and NM-A2, two alternative models are available in the market. The following details are collected:

	Machine	
	NM-A_1	NM-A_2
Cost of machine	Rs.20,00,000	Rs.25,00,000
Estimated working life	5 Years	5 Years
Estimated saving in direct wages per annum	Rs.7,00,000	Rs.9,00,000
Estimated saving in scrap per annum	Rs.60,000	Rs.1,00,000
Estimated additional cost of indirect material per annum	Rs.30,000	Rs.90,000
Estimated additional cost of indirect material per annum	Rs.40,000	Rs.50,000
Estimated additional cost of repairs and maintenance per annum	Rs.45,000	Rs.85,000

Depreciation will be charged on a straight line method. Corporate tax rate is 30 percent and expected rate of return may be 12 percent.

You are required to evaluate the alternatives by calculating the:

i) Pay-back Period

ii) Accounting (Average) Rate of Return; and

iii) Profitability Index or P.V. Index

(P.V. factor for Rs1 @ 12% 0.893; 0.797; 0.712; 0.636; 0.567; 0.507)

(PM)*(Ans.: (i) PBP of NM-A1= 3.50Y, NM-A2= 3.61y, (ii) ARR of NM-A1=17.15%, NM-A2= 15.4%, (iii) PI of NM-A1=1.03, NM-A2= 0.998)*

(Solve Problem No. 37, 38, 39, 40 of Assignment Problems as rework)

NOTE: _____

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ASSIGNMENT PROBLEMS

MODEL 1: AVERAGE RATE OF RETURN

PROBLEM 1: From the following information determine the ARR of the two machines:

	Machine A	Machine B
Original cost	50,000	50,000
Additional investment in net working capital	4,000	14,000
Estimated life in years	5 years	5 years
Estimated salvage value	2,000	2,000
Average income tax rate	40%	40%
Annual estimated income after depreciation and tax:		
1st year	5,000	25,000
2nd year	10,000	20,000
3rd year	15,000	15,000
4th year	20,000	10,000
5th year	25,000	5,000
Total	75,000	75,000

Depreciation has been charged on straight-line basis. *(Ans: ARR of Machine A: 50%, Machine B: 37.5%)*

MODEL 2: CFAT

PROBLEM 2: X Ltd. is manufacturing electronic motors fitted in the desert coolers. Its annual turnover is Rs.30 crore and cash expenses to generate this sale are Rs.25 crore. Tax rate is 30%.

Requirement: Find the cash flows if,

i) There is no depreciation

ii) Depreciation amounted to Rs.1.5 crores per annum *(SM)[Ans.: I)Rs.3.50 crores, II)Rs. 3.95 crores]*

PROBLEM 3: ABC Ltd. is evaluating the purchase of a new project with a depreciable base of Rs.1,00,000, expected economic life of 4 years and change in Earnings Before Taxes and Depreciation of Rs.45,000 in year 1, Rs.30,000 in year 2, Rs.25,000 in year 3 and Rs.35,000 in year 4. Assume straight-line depreciation and a 20% tax rate. You are required to compute relevant cash flows. *(SM)(Y1- Rs.41,000,Y2- Rs.29,000, Y3- Rs.25,000, Y4- Rs.30,000)*

MODEL 3: PAY BACK PERIOD

PROBLEM 4: XYZ Ltd. is analyzing a project expected to generate cash inflows as follows:

Year	Annual cash flows (Rs.)
1	80,000
2	60,000
3	60,000
4	20,000

Requirement:

Payback period, if initial cash outlays are:

a) Rs.2,00,000

b) Rs.2,05,000 *(SM)[Ans.: a) PBP: 3 years, b)PBP:3 1/4 years]*

MODEL 4: NPV

PROBLEM 5: Compute the net present value for a project with a net investment of Rs.1,00,000 and net cash flows year one is Rs.55,000, for year two is Rs.80,000 and for year three is Rs.15,000. Further, the company's cost of capital is 10%?

[PVIF @ 10% for three years are 0.909, 0.826 and 0.751] *(SM)(Ans.: NPV: Rs.27,340)*

PROBLEM 6: Elite Limited is considering three projects A, B and C. The cash flows associated with the projects are given below:

Cash flows associated with the Three Projects (Rs.)					
Project	**C_0**	**C_1**	**C_2**	**C_3**	**C_4**
A	(5,000)	1,000	1,000	3,000	0
B	(1,000)	0	1,000	2,000	3,000
C	(5,000)	1,000	1,000	3,000	5,000

You are required to:

a) Calculate the Payback period of each of the three projects.

b) If the cut-off period is two years, then which projects should be accepted?

c) Projects with positive NPVs if the opportunity cost of capital is 10 percent.

d) "Payback gives too much weight to cash flows that occur after the cut-off date". Is it true or false?

e) "If a firm used a single cut-off period for all projects, it is likely to accept too many short-lived projects." Is it true or false?

(RTP M 15) [Ans.: a) NPV of project A= 3years,B= 2 years,C= 3 years. b) Project B c)NPV of project A= Rs.(1,012),project B=Rs.(3,377) project C= Rs.2,403, d) false, e) true]

PROBLEM 7: For the data given in problem no.34 of classroom discussion problem:

Required: Compute NPV of each project. Which project will you recommend on the NPV criterion? The cost of capital is 10%. What will be the appropriate choice criteria in this case? The PV factors at 10% are:

Year	1	2	3	4
PV factor at 10% (PV/F0.10,t)	0.9091	0.8264	0.7513	0.6830

(PM)(Ans.:NPV of project A= Rs 6,806.2, B= Rs 3,217.75, C= Rs 3,720.3, D= Rs 3,351.9)

PROBLEM 8: A Ltd. is considering the question of taking up a new project which requires an investment of Rs.200 lakhs on machinery and other assets. The project is expected to yield the following gross profits (before depreciation and tax) over the next five years:

Year1	1	2	3	4	5
G.P. (Lakhs)	80	80	90	90	75

The cost of raising the additional capital is 12% and the assets have to be depreciated at 20% on 'written down value' basis. The scrap value at the end of the five-year period may be taken as zero. Income tax applicable to the company is 50%. Calculate the Net Present Value of the project and advise the management whether the project has to be implemented.

(Ans.: NPV = Rs 18.94 Lakhs. Advisable to accept the project)

PROBLEM 9: Sager industries are planning to introduce a new product with a project life of 8 years. The project, to be set up in a backward region, qualifies for a one-time (as its starting) tax-free subsidy from the government of Rs.20 lakhs. Initial equipment cost will be Rs.140 lakhs and additional equipment costing Rs.10 lakhs will be needed at the beginning of the third year. At the end of 8 years the original equipment will have no resale value, but the supplementary equipment can be sold for Rs.1 lakh. A working capital of Rs.15 lakhs will be needed. The sales volumes over the eight-year period have been forecasted as follows:

Year	Units	Lakhs
1	80,000	30
2	1,20,000	15
3-5	3,00,000	10
6-8	2,00,000	4

A sale price of Rs.100 per unit is expected and variable expenses will amount to 40% of sales revenue. Fixed cash operating costs will amount to Rs.16 lakhs per year. In addition, an extensive advertising campaign will be implemented, requiring annual outlays as above. The company is subject to 50% tax rate and considers 12% to be an appropriate after-tax cost of capital for this project. The company follows the straight-line method of depreciation. Should the project be accepted? Assume that the company has enough income from its existing products.

(Ans.: NPV=Rs.142.97 lakhs)

PROBLEM 10: Santosh & Co. is considering setting up a new unit. The following data has been compiled by the company for the purpose of determining the acceptability of the proposal for setting up the new unit.

A. Land:

a) To be paid at the time of purchase (t=0) Rs.2 lakhs

b) 1st, 2nd & 3rd installments at the end of next 3 following years.1 lakh each installment

B. Factory buildings (Total Rs. 20 lakhs)

a) Initial payment on signing of contract Rs.2 lakhs

b) At the end of year 2 Rs.10 lakhs

c) Balance at the end of year 3 Rs.8 lakhs

C. Plant, Machinery & Equipment:

To be paid at the beginning of - Year 4 Rs.15 lakhs

- Year 5 Rs.5 lakhs

D. Extra margin for working capital (at the end of year 5) – Rs.1 Lakh.

E. Operations will begin in the 6th year and will continue for 10 years upto year 15. Assume revenue and costs t the end of each year.

F. Buildings, Plant, Machinery and equipment will be depreciated on straight line method over the 10 years starting form year 6, as under:

a) Buildings @ 5%

b) Plant, machinery and equipment @ 10%

G. Buildings are expected to be sold for Rs.6 lakhs and land for Rs.8 lakhs at the end.

H. Plant, Machinery & Equipment will have a salvage value of Rs.2 lakhs.

I. Cost of Capital is 12%

J. Other operating data:

a) Annual Sales - Rs.30 lakhs

b) Variable costs of operation - Rs.12 lakhs.

c) Fixed costs (excluding depreciation) - Rs.8 lakhs; and Tax rate - 50%.

Advise whether the company should accept the project or reject it on the basis of NPV of the project. *[Ans.: NPV=Rs. (10.6365 lakhs)]*

MODEL 5: EQUIVALENT ANNUAL NPV OF CASH INFLOWS

PROBLEM 11: Suppose there are two Project A and Project B are under consideration. The cash flows associated with these projects are as follows:

Year	Project A	Project B
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.

(SM) (Ans.: NPV of project A=25,050, project B=59,300,IRR of project A=24.26%, project B=21.48%)

MODEL 6: EQUIVALENT PRESENT VALUE OF ANNUAL CASH OUTFLOWS

PROBLEM 12: Company X is forced to choose between two machines A and B. The two machines are designed differently, but have identical capacity and do exactly the same job. Machine A costs Rs.1,50,000 and will last for 3 years. It costs Rs.40,000 per year to run. Machine B is an 'economy' model costing only Rs1,00,000, but will last only for 2 years, and costs Rs.60, 000 per year to run. These are real cash flows. The costs are forecasted in rupees of constant purchasing power. Ignore tax. Opportunity cost of capital is 10 per cent. Which machine company X should buy **(RTP M15)**

(PM) (Ans.: Company X should buy machine A since its equivalent cash out flow is less than machine B)

PROBLEM 13: 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? **(N06 - 8M)(PM)**

(Ans.: Since equivalent present value of net cash outflow is less it is beneficial to purchase machine A)

PROBLEM 14: A company has to replace one of its machines which has become unserviceable. Two options are available:

a) A more expensive machine (EM) with 12 years of life.

b) A less expensive machine (LM) with 6 years of life.

If machine LM is chosen, it will be replaced at the end of 6 years by another LM machine.

The pattern of maintenance, running costs and prices are as under:

	EM	LM
Purchase Price (Rs.)	10,00,000	7,00,000
Scrap Value at the end of life (Rs.)	1,50,000	1,50,000
Overhauling is due at the end of	8th year	4th year
Overhauling costs (Rs.)	2,00,000	1,00,000
Annual Repairs (Rs.)	1,00,000	1,40,000
Cost of Capital - 14%.		

You are required to recommend the machine to be purchased.

(Ans.: Equivalent Present Value of Net Cash Outflow of Machine EM: Rs.2,83,568.9, Machine LM: Rs.3,17,629.2, Since Equivalent Present Value of Net Cash Outflow is less, it is beneficial to purchase Machine EM)

MODEL 7: TERMINAL VALUE METHOD / MODIFIED NPV

PROBLEM 15: Consider the cash flows of two projects, X and Y:

Year	Project X (Rs.)	Project Y (Rs.)
0	(3,00,000)	(300,000)
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	100,000	30,000

The cost of capital is 13%. Calculate modified NPV for projects X and Y, assuming re-investment rate of 15%. *(Ans.: Modified NPV of Project X and Y is Rs.3,339.5, Rs.17,753 Respectively)*

MODEL 8: IRR

PROBLEM 16: A project costs Rs.36,000 and is expected to generate cash inflows of Rs.11,200 annually for 5 years. Calculate the IRR of the project.

PROBLEM 17: The following are two mutually exclusive projects?

Cash Flows (Rs.)					
Project	**C_0**	**C_1**	**C_2**	**C_3**	**C_4**
I	-25,000	+30,000			
II	-25,000	0	0	0	43,750

Assume a 10% opportunity cost of capital. Compute the IRR for each project.

(Ans.:IRR of project I= 20% and project II= 15%).

PROBLEM 18: A company has to select one of the following two projects:

		Project A	Project B
Cost		Rs.11,000	Rs.10,000
Cash Inflows:	Year 1	6,000	1,000
	2	2,000	1,000
	3	1,000	2,000
	4	5,000	10,000

Using the Internal Rate of Return Method suggest which project is preferable.

(Ans.: IRR project A=: 11.782% and project B= 10.22%)

MODEL 9: PAYBACK RECIPROCAL

PROBLEM 19: A project requires an initial investment of Rs.20,000 and it would give annual cash inflow of Rs.4,000. The useful life of the project is estimated to be 5 years. Compute Payback Reciprocal. *(SM)(Ans.: Payback Reciprocal=20%)*

MODEL 10: MODIFIED IRR

PROBLEM 20: 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%. *(Ans.:MIRR: 9%)*

MODEL 11: CALCULATION OF NPV AND IRR FOR THE SAME PROJECT

PROBLEM 21: A company is considering the proposal of taking up a new project which requires an investment of Rs.400 lakhs on machinery and other assets. The project is expected to yield the following earnings (before depreciation and taxes) over the next five years:

Year	Earnings (Rs. in lakhs)
1	160
2	160
3	180
4	180
5	150

The cost of raising the additional capital is 12% and assets have to be depreciated at 20% on 'Written Down Value' basis. The scrap value at the end of the five years' period may be taken as zero. Income-tax applicable to the company is 50%.

You are required to calculate the net present value of the project and advise the management to take appropriate decision. Also calculate the Internal Rate of Return of the Project.

Note: Present values of Rs.1 at different rates of interest are as follows:

Year	10%	12%	14%	16%
1	0.91	0.89	0.88	0.86
2	0.83	0.80	0.77	0.74
3	0.75	0.71	0.67	0.64
4	0.68	0.64	0.59	0.55
5	0.62	0.57	0.52	0.48

(PM)(Ans: NPV at 12% = Rs 38.62 lakhs, so it is advise to implement project, IRR = 15.61%)

PROBLEM 22:. A sole trader installs plant and machinery in rented premises for the production of luxury article, the demand for which is expected to last only 5 Years. The total capital put in by the sole trader is as under:

Plant and Machinery	Rs.2,70,500
Working Capital	Rs.40,000
Total	Rs.3,10,500

The working capital will be fully realised at the end of the 5th year. The scrap value of the plant expected to be realised at the end of the 5th year is only Rs.5,500. The trader's earnings are expected to be as under:

Years	Cash profit (before depreciation and tax) (Rs.)	Tax payable (Rs.)
1	90,000	20,000
2	1,30,000	.30,000
3	1,70,000	40,000
4	1,16,000	26,000
5	19,500	5,000

Present value factors of various rates of interest are given below:

Years	11%	12%	13%	14%	15%
1	0.909	0.8929	0.8850	0.8770.	0.8696
2	0.8116	0.7972	0.7831	0.7695	0.7561
3	0.7312	0.7118	0.6931	0.6750	0.6575
4	0.6587	0.6355	0.6133	.0.5921	0.5718
5	0.5935	0.5674.	0.5428	0.5194	0.4972

You are required to compute the present value of cash flows discounted at the various rates of interests given above and state the return from the project.

(PM-Exercise)[Ans.: Present value of cash flows *at 11%= Rs.3,34,172, 12%= Rs. 3,25,996, 13%= Rs.3,18,128; 14%= Rs.3,10,543, 15% = Rs.3,03,251, Return of project= 14%]*

MODEL 12: PROFITABILITY INDEX

PROBLEM 23: A hospital is considering to purchase a diagnostic machine costing Rs.80,000. The projected life of the machine is 8 years and has an expected salvage value of Rs.6,000 at the end of 8 years. The annual operating cost of the machine is Rs.7,500. It is expected to generate revenues of Rs.40,000 per year for eight years. Presently, the hospital is outsourcing the diagnostic work and is earning commission income of Rs.12,000 per annum (net of taxes). **(N 09 8M)**

Required: Whether it would be profitable for the hospital to purchase the machine? Give your recommendation under:

(i) Net Present Value method **(ii)** Profitability Index method.

PV factors at 10% are given below:

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467

(*PM)[Ans.: (i) NPV is negative Rs. (5,055.64), (ii) PI is 0.937, It is advisable to the Hospital not to purchase the diagnostic Machine]*

PROBLEM 24: A Ltd. is considering the purchase of a machine which will perform some operations which are at present performed by workers. Machines X and Y are alternative models. The following details are available: **(N 11 8M)**

	Machine X (Rs.)	Machine Y (Rs.)
Cost of machine	1,50,000	2,40,000
Estimated life of machine	5 years	6 years
Estimated cost of maintenance p.a.	7,000	11,000
Estimated cost of indirect material, p.a.	6,000	8,000
Estimated savings in scrap p.a.	10,000	15,000
Estimated cost of supervision p.a.	12,000	16,000
Estimated savings in wages pa.	90,000	1,20,000

Depreciation will be charged on straight line basis. The tax rate is 30%. Evaluate the alternatives according to:

a) Average Rate of Return method, and

b) Present Value Index method assuming cost of capital being 10%.

(The present value of Rs.1.00 @ 10% p.a. for 5 years is 3.79 and for 6 years is 4.354)

(N 11-8M) (PM)[Ans.: a) ARR of X= 42%,Y= 35% , so machine X is better , b)PV index of X =1.5539, Y= 1.4876, so machine X is better.]

MODEL 13: CAPITAL RATIONING

PROBLEM 25: A company is considering three methods of attracting customers to expand its business:

a) Advertisement campaign.

b) Display of neon signs.

c) Direct delivery service.

The initial outlays for each alternative are: A-Rs.1,00,000, B-Rs.1,50,000, C-Rs.1,50,000. If A is carried out, but not B, it has an NPV of Rs.1,25,000. If B is done, but not A, has an NPV of Rs.45,000. However, if both are done, their NPV's are Rs.2,00,000. The NPV of the delivery system, C, is Rs.90,000. Its NPV is not dependent on whether A or B is adopted, and the NPV of A or B does not depend on whether C is adopted. Which of the investments should be made by the company.

a) If the firm has no budget constraint,

b) If the budgeted amount is only Rs.2,50,000.

[Ans.: (a) since all the projects have positive NPV it is better to select all projects i.e A,B,C(b)select projects A&C)

PROBLEM 26: S Ltd. has Rs.10,00,000 allocated for capital budgeting purposes. The following proposals and associated profitability indexes have been determined.

Project	Amount in (Rs.)	Profitability index
1	3,00,000	1.22
2	1,50,000	0.95
3	3,50,000	1.20
4	4,50,000	1.18
5	2,00,000	1.20
6	4,00,000	1.05

Which of the above investments should be undertaken? Assume that projects are indivisible and there is no alternative use of the money allocated for capital budgeting.

(PM-Exercise) (Ans.: Projects 3, 4 and 5)

MODEL 14: DISCOUNTED PAYBACK PERIOD

PROBLEM 27: B&K Manufacturing Company uses Discounted Payback Period to evaluate investments in capital assets. The company expects the following annual cash flows from an investment of Rs.35,00,000:

Year	1	2	3	4	5	6	7	8
Cash flows	9,00,000	9,00,000	9,00,000	9,00,000	9,00,000	9,00,000	9,00,000	9,00,000

No salvage value (residual value) is expected. The company's cost of capital is 12%.

(Ans.: Discounted Payback Period: 5.56 years)

MODEL 15: FINDING OUT MISSING VALUES

PROBLEM 28: ANP Ltd. is providing the following information: **(M16, M12 8M)**

Annual cost of saving	Rs.96,000
Useful life	5 years
Salvage value	zero
Internal rate of return	15%
Profitability index	1.05

Table of discount factor:

Discount factor	Years					
	1	2	3	4	5	Total
15%	0.870	0.756	0.658	0.572	0.497	3.353
14%	0.877	0.769	0.675	0.592	0.519	3.432
13%	0.886	0.783	0.693	0.614	0.544	3.52

You are required to find out:

i) Cost of the project

ii) Payback period

iii) Net present value of cash inflow

iv) Cost of capital

(PM)[Ans: i)cost of project = Rs. 3,21,888, ii)PBP= 3.353 y, iii)NPV= Rs 16,094.40, iv) Cost of capital =13%]

MODEL 16: REPLACEMENT DECISIONS

PROBLEM 29: 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
Cost of machine	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

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.

(PM) *(Ans.: Hence, existing machine should be replaced because NPV is positive i.e. Rs. 7,06,560)*

PROBLEM 30 Company M is operating an elderly machine that is expected to produce a net cash inflow of Rs.50,000 in the coming year and Rs.30,000 next year. Current salvage value is Rs.70,000 and next year's value is Rs.60,000. The machine can be replaced now with a new machine, which costs Rs.1,40,000, but is much more efficient and will provide a cash inflow of Rs.90,000 a year for 3 years . Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 percent. Advise with reasons.

(Ans.: Since the equivalent annual Cash Inflows of new machine now and next year is more than that Cash Inflows of elderly machine. Therefore it is advised to replace the elderly machine now.)

PROBLEM 31: Delhi Machinery Manufacturing Company wants to replace the manual operations by new machine. There are two alternative models X and Y of the new machine. Using Payback period, suggest the most profitable investment. Ignore taxation.

Particulars	Machine X	Machine Y
Original Investment (Rs.)	9,000	18,000
Estimated life of the machine (Years)	4	5
Estimated savings in cost (Rs.)	500	800
Estimated savings in Wages (Rs.)	6,000	8,000
Additional cost of maintenance (Rs.)	800	1,000
Additional cost of supervision (Rs.)	1,200	1,800

(Dec 93 - CS Final) (Ans.: PBP of Machine X=2 years, Machine Y= 3 years)

PROBLEM 32: ABC Company Ltd. has been producing a chemical product by using machine Z for the last two years. Now the management of the company is thinking to replace this machine either by X or by Y machine. The following details are furnished to you:

	Z	X		Y
Book value (Rs.)	1,00,000	-		-
Resale value now (Rs.)	1,10,000	-		-
Purchase price (Rs.)	-	1,80,000		2,00,000
Annual fixed costs (including depreciation) (Rs.)	92,000	1,08,000		1,32,000
Variable running cost per unit (Rs.) (including labour cost)	3	1.50		2.50
Production per hour (units)	8	8		12
You are also provided the following details				
Selling price per unit (Rs.)			20	
Cost of materials per unit (Rs.)			10	
Annual operating hours			2,000	

Working life of each of the three machines (as from now) - 5 years

Salvage value of machines Z is Rs.10,000, X is Rs.15,000 and Y is Rs.18,000

The company charges depreciation using straight line method. It is anticipated that an additional cost of Rs.8,000 per annum would be incurred on special advertising to sell the extra output of machine Y. Assume tax rate of 50% and cost of capital 10%. The present value of Rs.1 to be received at the end of the year at 10% is as under:

Year	1	2	3	4	5
Present value	0.909	0.826	0.751	0.683	0.621

Required: Using NPV method, you are required to analyse the feasibility of the proposal and make recommendations.

(PM) *(N 1999-14) (Ans.: NPV for Z – Rs 9,910, X- Rs.7,445, Y- Rs.24,934, and PI for Z-1.09, X-1.04, Y-1.12, Since the NPV and PI of Y is highest, therefore Z should replace with Y)*

MODEL 17: NPV & IRR CONFLICT

SITUATION 1 - SCALE OR SIZE DISPARITY:

PROBLEM 33: A firm having the minimum required rate of return of 10% is considering two mutually exclusive proposals, X and Y. The relevant data for the proposals are given below. Evaluate the proposal on the basis of NPV and IRR techniques.

Year	0	1	2	3
Cash flows (X) (Rs.)	-10,000	5,000	6,000	4,000
Cash flows (Y) (Rs.)	-30,000	14,000	19,000	10,000

(Ans: Project X-NPV= Rs 2,509, IRR=24.3%, Project Y-NPV= Rs 5,943, IRR= 21.5%)

SITUATION 2 - LIFE DISPARITY OR PROPOSALS WITH UNEQUAL LIVES:

PROBLEM 34: The cash flows of two mutually exclusive Projects are as under:

	t_0	t_1	t_2	t_3	t_4	t_5	t_6
Project Rs. P' (Rs.)	(40,000)	13,000	8,000	14,000	12,000	11,000	15,000
Project Rs. J' (Rs.)	(20,000)	7,000	13,000	12,000	-	-	-

Required:

a) Estimate the net present value (NPV) of the Project Rs.P' and Rs.J' using 15% as the hurdle rate.

b) Estimate the internal rate of return (IRR) of the Project Rs.P' and Rs.J'.

c) Why there is a conflict in the project choice by using NPV and IRR criterion?

d) Which criteria you will use in such a situation? Estimate the value at the criterion. Make a project choice.

The present value interest factor values at different rates of discount are as under:

Rate of discount	t_0	t_1	t_2	t_3	t_4	t_5	T_6
0.15	1.00	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323
0.18	1.00	0.8475	0.7182	0.6086	0.5158	0.4371	0.3704
0.20	1.00	0.8333	0.6944	0.5787	0.4823	0.4019	0.3349
0.24	1.00	0.8065	0.6504	0.5245	0.4230	0.3411	0.2751
0.26	1.00	0.7937	0.6299	0.4999	0.3968	0.3149	0.2499

(PM)(M 04-7M) [Ans.: a) NPV of Project 'P'= Rs. 5,376, Project 'J'= Rs. 3,807.41, b) IRR of Project 'P'=19.73% & Project 'J'= 25.20%]

SITUATION 3 - CASH FLOW DISPARITY OR TIME DISPARITY

PROBLEM 35: The cash flows of projects C and D are reproduced below:

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

a) Why there is a conflict of rankings?

b) Why should you recommend project C inspite of lower internal rate of return?

Time	Period		
	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

(PM) *(Ans.: NPV for Project –C is Rs.4,139 & Project – D is Rs.3,823, IRR for Project –C is 26.5%, Project – & Project – D is 37.6%, As per objective of F.M, it is beneficial to select the project being preferred by NPV. i.e., Project – C)*

MODEL 18: COMPREHENSIVE PROBLEMS

PROBLEM 36: C Ltd. is considering investing in a project. The expected original investment in the project will be Rs.2,00,000, the life of project will be 5 year with no salvage value. The expected net cash inflows after depreciation but before tax during the life of the project will be as following:

Year	1	2	3	4	5
Rs.	85,000	1,00,000	80,000	80,000	40,000

The project will be depreciated at the rate of 20% on original cost. The company is subjected to 30% tax rate. **(M08 8M)**

Required:

i) Calculate payback period and average rate of return (ARR)

ii) Calculate net present value and net present value index, if cost of capital is 10%.

iii) Calculate internal rate of return.

Note: The P.V. factors are:

Year	P.V at 10%	P.V at 37%	P.V at 38%	P.V at 40%
1	0.909	0.730	0.725	0.714
2	0.826	0.533	0.525	0.510
3	0.751	0.389	0.381	0.364
4	0.683	0.284	0.276	0.260
5	0.621	0.207	0.200	0.186

(PM) [Ans: (i) PBP=1.914y, ARR=53.90%, (ii) NPV= Rs 1,61,197.50, PI= 0.81, (iii) IRR:39.9%]

PROBLEM 37: Alpha Company is considering the following investment projects:

Cash Flows (Rs.)

Projects	C_0	C_1	C_2	C_3
A	-10,000	+10,000		
B	-10,000	+7,500	+7,500	
C	-10,000	+2,000	+4,000	+12,000
D	-10,000	+10,000	+3,000	+3,000

a) Rank the projects according to each of the following methods: (i) Payback, (ii) ARR, (iii) IRR and (iv) NPV, assuming discount rates of 10 and 30 percent.

b) Assuming the projects are independent, which one should be accepted? If the projects are mutually exclusive, which project is the best? **(SM)**

Ans:

Ranks					
Projects	PBP	ARR	IRR	NPV@10%	NPV@30%
A	1Y (I)	0 (IV)	0 (IV)	-910 (IV)	-2310 (IV)
B	1.33Y (II)	50% (II)	32% (II)	+3,013 (III)	+208 (II)
C	2.33Y (III)	53% (I)	26.5% (III)	+4,134 (I)	-633 (III)
D	1Y (I)	40% (III)	37.6% (I)	+3,821 (II)	+831 (I)

PROBLEM 38:. The Alpha Co. Ltd, is considering the purchase of a new machine. Two alternative machines A and B have been suggested, each costing Rs.4,00,000. Earnings after taxation but before depreciation are expected to be as follows:

Year	Cash flows	
	Machine A (Rs.)	Machine B (Rs.)
1	40,000	1,20,000
2	1,20,000	1,60,000
3	1,60,000	2,00,000
4	2,40,000	1,20,000
5	1,60,000	80,000
Total	**7,20,000**	**6,80,000**

The company has a target rate of return on capital @ 10 percent and on this basis, you are required.

a) Compare profitability of the machines and state which alternative you consider financially preferable,

b) Compute the payback period for each project and,

c) Compute annual rate of return for each project. ***(PM - EXERCISE)***

[Ans: (a) PV of Machine A = Rs 5,18,920, Machine B = Rs 5,23,080 (b) PBP of Machine A =3years 4 months, Machine B=2years 7.2 month (c)ARR of Machine A =16%, Machine B=14%]

PROBLEM 39: The expected cash flows of three projects are given below. The cost of capital is 10 per cent.

a) Calculate the payback period, net present value, internal rate of return and accounting rate of return of each project.

b) Show the rankings of the projects by each of the four methods.

Period	Project A (Rs)	Project B (Rs)	Project C (Rs)
0	(5,000)	(5,000)	(5,000)
1	900	700	2,000
2	900	800	2,000
3	900	900	2,000
4	900	1,000	1,000
5	900	1,100	
6	900	1,200	
7	900	1,300	
8	900	1,400	
9	900	1,500	
10	900	1,600	

PROBLEM 40: A company has to make a choice between two projects namely A and B. The initial capital outlay of two Projects are Rs. 1,35,000 and Rs. 2,40,000 respectively for A and B. There will be no scrap value at the end of the life of both the projects. The opportunity Cost of Capital of the company is 16%. The annual incomes are as under:

Year	Cash Inflows of		
	Project A (Rs.)	Project B (Rs.)	P.V. Factor @ 16%
1	-	60,000	0.862
2	30,000	84,000	0.743
3	1,32,000	96,000	0.641
4	84,000	1,02,000	0.552
5	84,000	90,000	0.476

You are required to calculate for each project:

i) Discounted payback period **ii)** Profitability index **iii)** Net present value.

[Ans: (i),DPB of Project A=3.61y, Project B=4.19Y,PI of Project A=1.43, Project B=1.15, NPV Of Project A= Rs 58,254: Project B= Rs 34,812]

ABC ANALYSIS

	A Category	B Category	C Category
Classroom Problems	1,3,11,12,13,14,16,17, 19,23,28,29,30,31,35, 36,39,40,41,42, 43,45,46.	4,5,6,7,8,9,10,15,18,2 1,22,26,27,32,33,37, 38,44,	2,20,24,25,34,
Assignment Problems	1,3,8,9,10, 12,14,20, 23,24,25,28,30,31, 32,36, 38,	2,4,6,7, 11,13,15,18, 21,26,27,29,33,34, 35,37,39,40.	5,16,17,19,22

Verified By: Bala Subrahmanyam Sir
Executed By: Dhanalakshmi

THE END