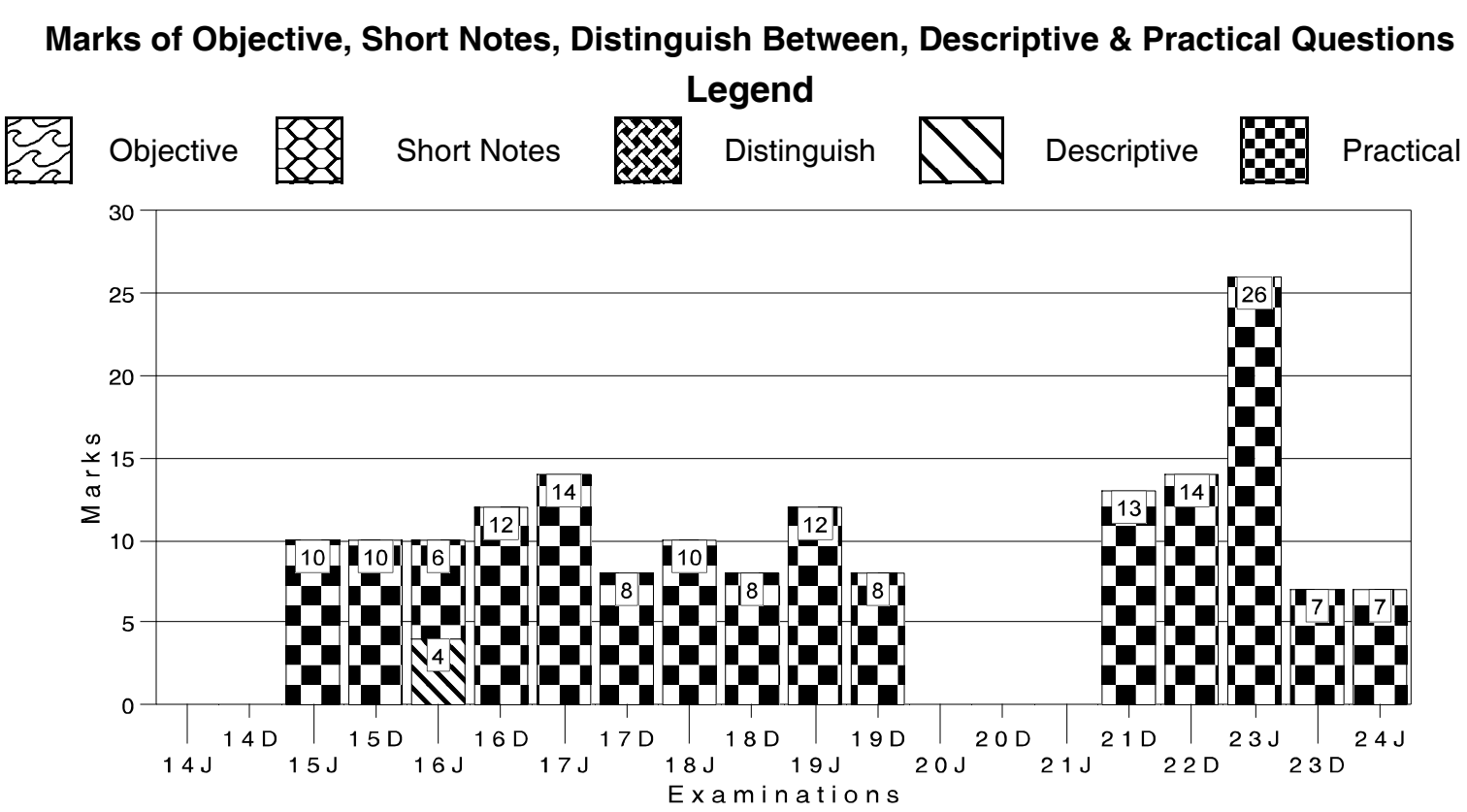
Marks of Objective, Short Notes, Distinguish Between, Descriptive & Practical Questions



1 INVESTMENT DECISIONS, PROJECT PLANNING AND CONTROL

THIS CHAPTER INCLUDES

1. Measuring Cash Flow, Discounted Cash Flow Technique for Project Evaluation
2. NPV and IRR - Conflict and Resolution, The Modified Internal Rate of Return (MIRR), Comparing Projects with Unequal Lives, The Concept of Abandonment Value, Modified Accelerated Cost Recovery System (MACRS)
3. Inflation Adjusted Cash Flow Forecasting in Capital Budgeting
4. Capital Rationing for Divisible and Non-divisible Projects (with Application of Integer Programming)
5. Social Cost Benefit Analysis

CHAPTER AT A GLANCE

Estimation of Project Cash Flow

Financial analysis of long-term investment decisions basically involves estimating cost of the asset / project and benefits receivable therefrom over the economic life of the asset or project. Estimating cost is relatively easier as it is conventionally incurred in the current period only, but estimating benefits is very difficult as it relates to future period involving risk and uncertainty.

Initial Cash Flow

Any long-term investment decision will involve large amount of initial cash outlay. It reflects the cash spent for acquiring the asset, known as initial cash outflow.

Subsequent Cash Flow

In conventional cash flow, cash outflow occurs at the initial period and a series of cash inflows occur in the subsequent periods. On the other hand, non-conventional cash flow involves intermittent cash outflows in the subsequent periods also for major repairing, additional working capital requirement, etc. Therefore, apart from estimating initial cash flow, subsequent cash flows are also required to be estimated.

Terminal Cash Flow

At the end of the economic life of the asset or at the time of termination of the project, usually some additional cash inflows occur in addition to the operating cash inflows, viz., salvage value of the asset, release of working capital (the working capital that is introduced at the beginning will no longer be required at the end of the life of the asset or at the termination of the project). Moreover, tax impact on gain or loss on sale of the asset if the block of asset ceases to exist may also lead to some equivalent cash inflow or outflow.

Non-Discounted Cash Flow

Methods consider the cash flows over the life of the projects similarly. In other words, here it is assumed that cash flows in different time periods do not have any time value and hence are directly additive. These methods are again divided into two groups –

1. Accounting or Average Rate of Return (ARR)
2. Payback Period:
   (a) Traditional Payback Period
   (b) Payback Profitability
   (c) Payback Reciprocal

Discounted Cash Flow

Methods assume that cash flow over different time periods are not directly additive as they involve time value of money.
Depending upon a few other project specific considerations these methods can be as follows:

1. Discounted Pay Back Period
2. Net Present Value (NPV)
3. Profitability Index or Benefit Cost Ratio
4. Adjusted Net Present Value (ANPV)
5. Internal Rate of Return (IRR)
6. Modified NPV
7. Modified IRR

Conflict between NPV and IRR

Though in case of a single independent project application of both NPV and IRR methods always choose the same project, while evaluating mutually exclusive projects, the results sometimes lead to conflict. In other words, the project which is acceptable under NPV may not be so under IRR and *vice-versa*.
Such conflict may arise because of three reasons:

(a) Difference in the timing of cash flow or cash flow pattern of alternative projects, known as time disparity in cash flow.
(b) Difference in the life expectancy of the alternative projects known as life disparity.
(c) Difference in the investment size (size of cash outflow) of the alternative projects known as scale or size disparity.

DESCRIPTIVE QUESTIONS

2016 - June [8] Answer the following:

(d) What are the situations in which Net Present Value (NPV) and Internal Rate of Return (IRR) give conflicting results? **(4 marks)**

Answer:
NPV and IRR may give conflicting results in the evaluation of different projects, in the following situations:

(i) **Initial Investment Disparity:** i.e. Different project sizes,
(ii) **Project Life Disparity:** i.e. Difference in project lives,
(iii) **Outflow Patterns:** i.e. when cash outflows arise at different points of time during the Project Life, rather than as Initial Investment (Time 0) only.
(iv) **Cash Flow Disparity:** when there is a huge difference between initial CFAT and later years' CFAT. A project with heavy initial CFAT than compared to later years will have higher IRR and *vice-versa*.

PRACTICAL QUESTIONS

2012 - Dec [3] (a) A Company has developed a new toy which has been estimated to have a life cycle of 3 years. To manufacture the toy, the company will have to purchase a semi-automatic injection moulding machine at a cost of ₹ 8,60,000. The machine will have to be scrapped after 3 years at a salvage value of ₹ 1,10,000. Variable cost of producing the toy would be 40% of the sales price.

Fixed expenses, apart from depreciation will be ₹ 50,000 per year. Besides, advertising and selling expenses will have to be incurred at the rate of ₹ 1,00,000 in the first year, ₹ 1,50,000 in the second year and ₹ 50,000 in the third year. The following projection of sales have been made after evaluating the consumer demand:

Probability	Estimated Sales in year (₹ lakhs)		
	Year 1	Year 2	Year 3
0.3	12	25	10
0.6	7	17	15
0.1	2	9	4

The Company is subject to corporate tax rate of 30% and its cost of capital is 15%.

Prepare a schedule computing the probable sales of the new toy and estimated cash flows in each of the three years. Also determine net present value (NPV) of the proposal. Ignore tax on salvage value.
The present value of ₹ 1 earned at the year end discounted at 15%—

Year 1	Year 2	Year 3
0.87	0.756	0.658

(10 marks)

Answer:
Schedule showing Sales:

(Amount in ₹ lakh)

Probability	**Year 1**		**Year 2**		**Year 3**	
0.3	x 12	3.6	x 25	7.5	x 10	3
0.6	x 7	4.2	x 17	10.2	x 15	9
0.1	x 2	0.2	x 9	0.9	x 4	0.4
		8		18.6		12.4

Determination of estimated cash flow: **₹ (lakh)**

	Year 1	**Year 2**	**Year 3**
Probable Sales revenue	8.00	18.60	12.40
Less : Variable cost @ 40%	3.20	7.44	4.96
	4.80	11.16	7.44
Less : Depreciation ₹ (8,60,000 – 1,10,000) / 3	2.50	2.50	2.50
Fixed cost	0.50	0.50	0.50
	1.80	8.16	4.44
Less : Advt. & Sales Exp.	1.00	1.50	0.50
Earning before Tax	0.80	6.66	3.94

Tax @ 30%	0.24	2.00	1.18
Earning after Tax	0.56	4.66	2.76
Total Cash flow after tax (add back Depreciation)	3.06	7.16	5.26
Add : salvage value	—	—	1.10
	3.06	7.16	6.36

Determination of NPV	**CFAT**	**PV factor**	**Total PV**
Year 1	3.06	0.870	2.662
2	7.16	0.756	5.413
3	6.36	0.658	4.185
			12.26
Less : Cash outflow (Investment)			8.60
NPV			3.66

2013 - June [3] (a) VEDAVYAS Ltd. is considering two mutually exclusive projects M and project N. The Finance Director thinks that the project with the higher NPV should be chosen, whereas the Managing Director thinks that the one with the higher IRR should be undertaken, especially as both projects have the same initial outlay and length of life. The company anticipates a cost of capital of 10% and the net after-tax cash flow of the projects are as follows:

Year	0	1	2	3	4	5
Cash flows (₹)						
Project M	(4,00,000)	70,000	1,60,000	1,80,000	1,50,000	40,000
Project N	(4,00,000)	4,36,000	20,000	20,000	8,000	6,000

You are required to:

(i) Calculate the NPV and IRR of each project.

(ii) State with reasons, which project you would recommend.

(iii) Explain the inconsistency in the ranking of the two projects.

Present value Table is given:

Year	0	1	2	3	4	5
PVIF at 10%	1.000	0.909	0.826	0.751	0.683	0.621
PVIF at 20%	1.000	0.833	0.694	0.579	0.482	0.402

((3 + 4) + 2 + 1 = 10 marks)

Answer :

(i) **Calculation of NPV and IRR**

NPV of project M:

Year	Cash Flows	Discount factor (10%)	Discounted values (₹)	Discount factor(20%)	Discounted values (₹)
0	(4,00,000)	1.000	(4,00,000)	1.000	(4,00,000)
1	70,000	0.909	63,630	0.833	58,310
2	1,60,000	0.826	1,32,160	0.694	1,11,040
3	1,80,000	0.751	1,35,180	0.579	1,04,220
4	1,50,000	0.683	1,02,450	0.482	72,300
5	40,000	0.621	24,840	0.402	16,080
NPV			58,260		(38,050)

IRR of Project M:

At 20% NPV is (–) 38,050 and at 10% NPV is 58,260

$$\therefore \text{IRR} = 10 + \frac{58260}{58260 + 38050} \times 10 = 10 + \frac{58260}{96310} \times 10 = 10 + 6.05 = 16.05\%$$

NPV of Project N:

Year	Cash Flows (₹)	Discount factor (10%)	Discounted Values (₹)	Discount factor (20%)	Discounted values (₹)
0	(4,00,000)	1.000	(4,00,000)	1.000	(4,00,000)
1	4,36,000	0.909	3,96,324	0.833	3,63,188
2	20,000	0.826	16,520	0.694	13,880
3	20,000	0.751	15,020	0.579	11,580

4	8,000	0.683	5,464	0.482	3,856
5	6,000	0.621	3,726	0.402	2,412
NPV			37,054		(5,084)

IRR of Project M: 18.79%

(ii) Both the projects are acceptable because they generate the positive NPV at the company's cost of capital at 10%. However, the company will have to select PROJECT M because it has higher NPV. If the company follows IRR method, then PROJECT N should be selected because of higher internal rate of return (IRR). But when NPV and IRR give contradictory results, a project with higher NPV is generally preferred because of high return in absolute terms. Hence, Project M should be selected.

(iii) The inconsistency in the ranking of the projects arises because of the difference in the pattern of the cash flows. Project N generated the major cash flow in the first year itself.

2013 - Dec [10] (c) Nava Ratna Ltd. has just installed MACHINE R at a cost of ₹ 2,00,000. This machine has 5 years life with no residual value. The annual volume of production is estimated at 1,50,000 units, which can be sold at ₹ 6 per unit. Annual operating costs are estimated at ₹ 2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at ₹ 3 per unit for the same level of production.

The company has just come across another model called MACHINE S, capable of giving the same output at an annual operating costs of ₹ 1,80,000 (excluding depreciation). There will be no change in fixed costs. Capital cost of this machine is ₹ 2,50,000 and the estimated life is 5 years with no residual value.

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

Nava Ratna Ltd. will be a zero-tax company for 7 years in view of several incentives and allowances available. The cost of capital may be assumed as 14%.

Required:

(i) Advise the company whether it should opt for replacement.

(ii) What would be your advice, if MACHINE R has not been installed but the company is in the process of selecting one or the other machine?

[Given: PVIF for 1-5 years = 0.877, 0.769, 0.675, 0.592, 0.519]

(10 marks)

Answer:

Replacement of Machine R: Incremental cash outflow:

Cash outflow of Machine S	₹ 2,50,000
Less: Sale value of Machine R (₹ 1,00,000 - 30,000)	₹ 70,000
Net outflow	₹ 1,80,000

Incremental cash flow from Machine S:

Annual cash flow from Machine S:

[(1,50,000 × 6) - 1,80,000 - (1,50,000 × 3)] Annual ₹ 2,70,000

Cash flow from Machine R:

[(1,50,000 × 6) - 2,00,000 - (1,50,000 × 3)] ₹ 2,50,000

Net inflow ₹ 20,000

Present value of Incremental cash inflow:

= 20,000 × (0.877 + 0.769 + 0.675 + 0.592 + 0.519) = ₹ 68,640 NPV of Machine S = 68,640 - 1,80,000 = ₹ (-) 1,11,360.

[₹ 2,00,000 Spent on Machine R is a sunk cost and hence it is not relevant for deciding the replacement]

Decision: NPV of Machine S is negative. Replacement is not advised. If it selects one of the two, independent NPV is to be calculated for this decision.

Independent evaluation of Machine R & Machine S:

(All in ₹)

Particulars	**Machine R**	**Machine S**
Units produced	1,50,000	1,50,000
Selling Price @ ₹ 6	9,00,000	9,00,000
Less: Operating cost (Exclusive of depreciation)	2,00,000	1,80,000
Contribution	7,00,000	7,20,000
Less: Fixed cost	4,50,000	4,50,000

Annual cash flow	2,50,000	2,70,000
PV of cash flows for 5 years, i.e., [Sum of PVIF for 14%,5]		
3.432 × 2,50,000	8,58,000	
3.432 × 2,70,000		9,26,640
Cash out flow	2,00,000	2,50,000
NPV	6,58,000	6,76,640

Decision: Choose Machine S as NPV of S is higher than that of R.

2015 - June [5] (a) A Ltd. company has undertaken market research at a cost of ₹ 4 Lakhs in order to forecast the future Cash Flows of an Investment Project with an expected life of four years as follows:

Year	**1**	**2**	**3**	**4**
Sales revenue	₹ 25,00,000	₹ 51,40,000	₹ 1,37,80,000	₹ 9,06,000
Costs	₹ 10,00,000	₹ 20,00,000	₹ 50,00,000	₹ 35,00,000

These forecast Cash Flows are before considering inflation of 4.7% p.a. The Capital Cost of the project, payable at the start of first year will be ₹ 40 Lakhs. The Investment Project will have zero scrap value at the end of the fourth year. The level of working capital investment at the start of each year is expected to be 10% of the sales revenue in that year.

Capital allowances would be available on the Capital Cost of the Investment Project on a 25% reducing balances basis. A Ltd. pays tax on Profit at an annual rate of 30% per year with tax being paid one year in arrears.

A Ltd. has a nominal (money terms) after tax Cost of Capital of 12% per year.

Discount Factor at 12% is as under:

Year	**1**	**2**	**3**	**4**	**5**
Discount Factor	0.893	0.797	0.712	0.636	0.567

Calculate the net Present Value of the Investment Project in nominal terms and comment on its financial acceptability. **(10 marks)**

Answer:

Calculation of Net Present value of the investment project using a nominal terms approach. **(₹ In '000')**

Year	1	2	3	4	5
Sales Revenue	2617.50	5634.52	15815.74	1088.72	-
Less: Costs	1047.00	2192.42	5738.66	4205.86	-
Net Revenue	1570.5	3442.10	10077.08	-3117.14	-
Less: Tax Payable	-	(471.16)	(1032.64)	-3023.12	-
Capital Allowance	-	300.00	225.00	168.76	506.3
After Tax Cash Flow	1570.50	3270.94	9269.44	-5971.5	506.3
Less: Working Capital	-301.72	(1018.12)	1472.70	108.87	-
Project Cash Flow	1268.78	2252.82	10742.14	(5862.63)	506.3
Discount Factor 12%	0.893	0.797	0.712	0.636	0.567
Present Value of Cash Flow	1133.02	1795.5	7648.4	(3728.63)	287.1

(₹ In '000')

P. V. of Future Cash Flow	7135.34
Less: Initial Investment	(4000.00)
Less: Working Capital	(261.76)
NPV	2873.58

The net present value is ₹ 2873.58. So the investment is financially acceptable.

Working Notes:

1. **(₹ In '000')**

Year	1	2	3	4
Sales Revenue	2500	5140	13780	906
Inflated sales (by 4.7%)	2617.5	5634.52	15815.74	1088.7

Inflated costs have been calculated accordingly although the normal discount rate is 12% and general rate of inflation is 4.7%.

2. Capital Allowance

Cost of project = ₹ 40,00,000
Tax @ 30% = ₹ 12,00,000
12,00,000 × 25% = 3,00,000
(12,00,000 - 3,00,000) × 25% = 2,25,000
(9,00,000 - 2,25,000) × 25% = 1,68,750
12,00,000 - 3,00,000 - 2,25,000 - 1,68,750 = 5,06,250

3. Working Capital

10% of Incremental Sales.

(2617.50 - 5634.52) × 10%	=	(301.72)
(5634.52 - 15815.74) × 10%	=	(1018.12)
(15815.74 - 1088.72) × 10%	=	1472.70
(1088.72 - 0) × 10%	=	108.87
		261.76

2015 - Dec [5] (a) A company is considering which of two mutually exclusive projects it should undertake. The Finance Director thinks that the project with the higher Net Present Value (NPV) should be chosen whereas the Managing Director thinks that the one with the higher Internal Rate of Return (IRR) should be undertaken especially as both projects have the same initial outlay and length of life. The company anticipates cost of capital of 10% and the net after tax cash flows of the projects are as follows:

Year end	0	1	2	3	4	5
Cash flows (000) Project X	(200)	35	80	90	75	20
Project Y	(200)	218	10	10	4	3

(i) Calculate the NPV of each project **(4 marks)**

(ii) Which project do you think will have a higher internal rate of return (IRR)? Why? **(2 marks)**

(iii) Under what circumstances will NPV and IRR give different ranking of projects? Why? **(2 marks)**

(iv) Which project would you recommend? Why? **(2 marks)**

Answer:

(a) (i) **Calculation of the NPV**

Project X

Years	Cash Flows	Discount Factor @10%	Discounted values
0	(200)	1.00	(200)
1	35	0.91	31.85
2	80	0.83	66.4
3	90	0.75	67.5
4	75	0.68	51
5	20	0.62	12.4
NPV			**29.15**

Project Y

Years	Cash Flows	Discount Factor @10%	Discounted values
0	(200)	1	(200)
1	218	0.91	198.38
2	10	0.83	8.30
3	10	0.75	7.50
4	4	0.68	2.72
5	3	0.62	1.86
	NPV		**18.76**

(ii) Project Y will have a higher IRR since Y has very high initial cash inflow.

Project Y has a payback of less than 2 years. Whereas project X has smaller cash flows which are never in bulk. Hence Y will have a much higher IRR.

IRR assumes that cash flows are reinvested at IRR rates. Whereas NPV assumes investment only at the discount rate.

(iii) IRR and NPV can give different ranking if, projects compared have uneven cash inflows – the one with higher initial inflows has a higher IRR. When there are initial as well as intervening cash outlays (for e.g. heavy repairs, etc.), so that in the intervening period within the life of the project net cash flows are negative and positives we have a multiple IRR situation. Whereas the NPV is unique.

(iv) Project X can be recommended if the project has to run through completion and must exist for 5 years, since the net wealth added is higher.

Project Y can be recommended if there is any other investment opportunity for the cash flows generated in the 1st year such that total NPV during the full 5 years is higher than project X.

2016 - June [3] (b) A company is considering a proposal of installing a drying equipment. The equipment would involve a cash outlay of ₹ 6,00,000 and net working capital of ₹ 80,000. The expected life of the project is 5 years without any salvage value. Assume that the company is allowed to charge depreciation on straight line basis for income tax purpose. The estimated before-tax cash inflows (₹'000) are given below:

Year-end	1	2	3	4	5
Before-tax cash inflows	240	275	210	180	160

The applicable income-tax rate of the company is 35%. If the company's cost of capital is 12%, calculate the equipment's discounted payback period, and net present value. **(6 marks)**

Answer:

Statement showing the calculation of present value of CFAT: [₹ 000]

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5
Cash flows before tax	240	275	210	180	160
Less: Tax @ 35%	(84)	(96.25)	(73.5)	(63)	(56)
After tax cash flows	156	178.75	136.5	117	104
Add: tax saving on depreciation	42	42	42	42	42
Net cash flow after tax	198	220.75	178.5	159	146
Release of working capital	–	–	–	–	80

CFAT for last year	–	–	–	–	226
PVF at 12%	0.8929	0.7972	0.7118	0.6355	0.5674
PV	176.79	175.98	127.06	101.04	128.23
Cumulative discounted cash flows	176.79	352.77	479.83	580.87	709.10
NPV = ₹ 709.10 – ₹ 680 = ₹ 29.10 thousand					

Discounted payback period = 4 Years + (₹ 6,80,000 – 5,80,870) / ₹ 1,28,230 = 4.773 years

2016 - Dec [5] (a) An eatery is located in its own premises at Street A in a city. The Management is planning a relocation to a nearby new location, College Road, also owned by it so that it can attract new clients. Two years ago, the College Road location was considered and ₹ 2,00,000 was paid to a consultant for site study. Due to metro rail construction, the idea had to be abandoned. Now the road is fit for easy access. Until now, the College Road premises could not be let out and was idle. But now, it can be let out on an annual year end lease rental of ₹ 1,20,000. On similar terms, Street A premises would fetch ₹ 2,50,000. The eatery would have to spend ₹ 10,00,000 on initial refurbishment if it relocates. This will entail a bank loan at 12% interest. 25% of its new sales would be from the old customers at the Street A premises who represented 25% of the Street A sales value. Other information is given below:

Figures (₹/annum) (valid for the next 5 years)	Street A (same as per existing values)	College Road
Sales	15,00,000	21,00,000
Variable Cost	10,00,000	11,00,000
Contribution	5,00,000	10,00,000
Fixed Cost (excluding depreciation)	1,50,000	2,40,000
Depreciation	30,000	2,00,000

(i) Depreciation is on straight line basis over 5 years. Assume that the life of the project is 5 years from now in both the premises.

(ii) Income Tax rate applicable is 35% and taxes are payable at the end of the year.
(iii) Cash flows from operations arise at the end of the year.
(iv) There is no salvage value in both the cases at the end of the project life.
(v) Both the sites are meant for long term usage. There is no sale of the premises envisaged.
(vi) Weighted average cost of capital until this project begins is 10%.
(vii) The Bank loan has to be repaid in equal instalments of principal at the end of each year together with the applicable interest on the outstanding principal.
(viii) Assume no time lag between the capital expenditure and the commencement of operation.
(ix) Use P.V. factors as given in the table.
(x) Show calculations to the nearest rupee.
(xi) The cost - revenue structure is different in both the locations and the above table is applicable for all customers in a location.
(xii) No significant changes in the working capital requirement.

You are required to present a statement showing the evaluation on an incremental basis, of relocating to the new premises, showing the rationale behind the cash flows you consider and those that you do not, for the evaluation. Recommend from a financial perspective using the NPV method, whether the eatery should relocate to the College Road premises.

(12 marks)

Answer:

₹

	College Road			Street A		
	25%	**75%**	**Total (Amount in Rupees)**	**25%**	**75%**	**Total (Amount in Rupees)**
Sales Value	5,25,000	15,75,000	21,00,000	3,75,000	11,25,000	15,00,000
Variable Cost	2,75,000	8,25,000	11,00,000	2,50,000	7,50,000	10,00,000
Contribution	2,50,000	7,50,000	10,00,000	1,25,000	3,75,000	5,00,000

Fixed Cost (excluding depreciation)	-	2,40,000	2,40,000	-	1,50,000	1,50,000
Profit (before depreciation)	2,50,000	5,10,000	7,60,000	1,25,000	2,25,000	3,50,000
Depreciation			2,00,000			30,000
Profit			5,60,000			3,20,000

Statement showing relevant cash flows for NPV method

Items of Cash Flow	Amount (in Rupees)	Working Note
Cash profits from operations (year end 1 to 5)	+ 2,66,500	(From existing customers + 1,25,000; from new customers + 2,85,000) Alternatively, difference in the total profit columns since cost revenue structures are different. Hence, ₹ 4,10,000 before tax, i.e., ₹ 2,66,500 after 35% tax.
Lease Rental of Street A premises	+ 84,500	Opportunity cost of Street A premises = ₹ 2,50,000 less amount that would have been gained by rent of College Road ₹ 1,20,000 = Opportunity loss, i.e., ₹ 1,30,000 is the opportunity gain, less 35% taxes.
Tax shield on Depreciation	+ 59,500	Depreciation (new) = ₹ 2,00,000 *less:* Old = ₹ 30,000; Net = ₹ 1,70,000; Tax Shield 35% = 35% × ₹ 1,70,000
Total inflows from the project	+ 4,10,500	
P.V. factor at 12% × .65 = 7.8% years 1 to 5	4.014	12% is the project's cost of capital. Average thus far should not be taken, since this project involves this cost.

		Cost after tax = 65% of 12%. This is the minimum return that the project should fetch for acceptance.
Present value of inflows	+ 16,47,747	
Initial Outlay = Present value of outflows	- 10,00,000	Occurs at end of year zero or beginning of year 1. Hence discount rate = 1
Net Present Value	+ 6,47,747	
Decision: It is recommended to relocate to the new premises.		
Cash flows not considered in the evaluation :		
Consultant's fee	2,00,000	Sunk cost. It has been incurred irrespective of the project and hence not considered.
Bank Interest		Not considered since it does not arise from the project. It is a financing decision. The specific cost of financing is considered in the cut off rate used for the NPV.
Bank Loan – Repayment	2,00,000	Not a project outflow.

2017 - June [2] (a) A Ltd. is considering replacement of an existing machine or to spend money on overhauling it. A Ltd. currently pays no taxes. The replacement machine costs ₹ 50,000 now and requires maintenance of ₹ 5,000 at the end of every year for 5 years. At the end of 5 years, it would have a salvage value of ₹ 10,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows:

Year	Maintenance (₹)	Salvage (₹)
Present	0	20,000
1	5,000	12,500
2	10,000	7,500
3	15,000	0

The cost of capital of A Ltd. is 15%.

End of year	1	2	3	4	5	6
Present value factor @ 15%	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323

When should the company replace the machine? **(8 marks)**

Answer:

A & Co. Equivalent cost of (EAC) of new machine

	Particulars	**Amount** (₹)
(i)	Cost of new machine now	50,000
	Add: P.V. of annual repairs @ ₹ 5,000 per annum for 5 years (₹ 5,000 × 3.3522)	16,761
		66,761
	Less: P.V. of salvage value at the end of 5 years (₹ 10,000 × 0.4972)	4,972
		61,789
	Equivalent annual cost (EAC) (₹ 61,789 / 3.3522)	18,432

Equivalent Cost (EAC) of keeping the old machine

Present value	**I Year**	**II Year**	**III Year**
(P.V.)	**(₹)**	**(₹)**	**(₹)**
Value Present	20,000	12,500	7,500

Add: P.V. of annual maintenance (Annual Maintenance/1.15)	4,348	8,696	13,043
Total	24,348	21,196	20,543
Less: P.V. of salvage value at the end of the year (P.V./1.15)	10,870	6,522	Nil
	13,478	14,674	20,543
	1.15	1.15	1.15
Equivalent Annual Cost (EAC)	15,500	16,875	23,625

Advice: The company should replace the old machine after 2 years because the Equivalent Annual Cost (EAC) of the new machine at ₹ 18,432 is lower than the cost of using the existing machine in third year.

2017 - June [5] (b) ABC Ltd. has a capital budget of ₹ 2 crore for the year. From the following information relating to six independent proposals, select the projects if (i) the projects are divisible and (ii) projects are indivisible in order to maximise the NPV.

Proposal	Investment (₹)	NPV (₹)
I	8,500,000.00	5,000,000.00
II	3,500,000.00	2,600,000.00
III	6,000,000.00	2,000,000.00
IV	4,000,000.00	2,500,000.00
V	6,000,000.00	5,000,000.00
VI	8,000,000.00	(2,500,000.00)

(6 marks)

Answer:

(i) If the projects are divisible

Projects are ranked according to PI and arranged in descending order.

Proposal	Investment	NPV	PV of Inflows	PI	Rank
I	85,00,000	50,00,000	1,35,00,000	1.59	4
II	35,00,000	26,00,000	61,00,000	1.74	2
III	60,00,000	20,00,000	80,00,000	1.33	5
IV	40,00,000	25,00,000	65,00,000	1.63	3
V	60,00,000	50,00,000	1,10,00,000	1.83	1

Proposal	Investment	Cum Investment
V	60,00,000	60,00,000
II	35,00,000	95,00,000
IV	40,00,000	1,35,00,000
I	85,00,000	2,20,00,000
III	60,00,000	2,80,00,000

Only 65,00,000 can be invested in project I. NPV of the project = 65/85×50,00,000 = 38,23,529

So the selected projects are V, II, IV and part of I.

(ii) If the projects are indivisible (by trial and error method)

Feasible Sets	Investments	NPV
V,II,I	1,80,00,000	1,26,00,000
V,IV,I	1,85,00,000	1,25,00,000
V, II, IV, III	1,95,00,000	1,21,00,000
I, II, IV	1,60,00,000	1,01,00,000
V, IV, III	1,60,00,000	95,00,000

Project V, II and I provides the maximum NPV may be undertaken.

2017 - Dec [5] (a) A manufacturing company has an old machine having no book value which can be sold now for ₹ 1,00,000. It can be used for another five years after which it will have to be condemned without any sale value. The company is examining the following options:

Option I: To upgrade the existing machine at a cost of ₹ 20 lacs and continue operations for a further 5 years at the end of which the ₹ 20 lacs would have also fully been depreciated equally over the next 5 years and will fetch a sale value of ₹ 50,000 at the end of the 5th year.

Option II: To replace the old machine with a new one costing ₹ 40 lacs which will have a useful life of 5 years, during which it will be fully depreciated equally. At the end of the 5th year, this machine will have a resale value of ₹ 10 lacs.

The following figures are the after-tax cash profits in rupees without the depreciation shield and the salvage values for the existing situation and the fresh options:

End of year	Existing Machine	Upgraded Machine	New Machine
1	10,00,000	11,00,000	12,00,000
2	10,80,000	11,80,000	12,80,000
3	11,20,000	12,20,000	13,80,000
4	12,00,000	13,00,000	14,80,000
5	13,00,000	14,00,000	16,00,000

The hurdle rate used for evaluation is 15%.

Consider that the salvage values and profits will be subjected to tax at the normal tax rate of 40%.

Present an incremental analysis of options I and II and state which is better. Evaluate the better option above over continuing with the old machine without upgrading. **(8 marks)**

Answer:

Option I vs Option II - Incremental Analysis

End of Year	Operating Profits	PV factor	PV of cash profits (₹)
0		1	
1	1,00,000	0.870	87,000
2	1,00,000	0.756	75,600
3	1,60,000	0.658	1,05,280
4	1,80,000	0.572	1,02,960
5	2,00,000	0.497	99,400
Total		**3.353**	**4,70,240**

New Machine Vs Upgraded Machine

Operating Profits		₹ 4,70,240
Depreciation shield	(8,00,000 - 4,00,000) × 40% = 160000 with annuity factor 3.353 = 3.353 × 1,60,000	₹ 5,36,480
Salvage value	(10,00,000 - 50,000) × 60% = 5,70,000 @ PVF 0.497	₹ 2,83,290
Incremental cost of new machine	20,00,000 with PV factor 1	₹ (20,00,000)
Sale value of old machine	60% × 1 lac, PV 1	₹ 60,000
Decrease in NPV with new machine		₹ 6,49,990
Decision: Continue with the upgraded machine, Option 1		

Analysis: Continue without upgrade Vs Upgrade old machine

		₹
Increase in operating profits	1,00,000 × annuity factor 5 years = 1,00,000 × 3.353	3,35,300
Depreciation shield	4,00,000 × 40% × 3.353	5,36,480

Salvage value at yr 5 end	50,000 × 60% × 0.497	14,910
Sub Total - Incremental benefits over upgrade		8,86,690
Incremental cost of upgrade	20,00,000 × 1	(20,00,000)
Net disadvantage of upgrade		11,13,310
Conclusion: Do not upgrade. Continue with the old machine as it is.		

2018 - June [2] (a) Electronics Pvt. Ltd. is considering a proposal to replace one of its machines. In this connection, the following information is available :
The existing machine was purchased 3 years ago for ₹ 20 Lakh. It was depreciated 20 per cent per annum on reducing balance basis. It has remaining useful life of 5 years, but its maintenance cost is expected to increase by ₹ 1 Lakh per year from the end of sixth year of its installation. Its present realizable value is ₹ 12 Lakh. The company has several machines having 20% depreciation.
The new machine costs ₹ 30 Lakh and is subject to the same rate and basis of depreciation. On sale after 5 years, it is expected to realize ₹ 18 Lakh. With the new machine, the annual pre-tax operating costs (excluding depreciation) are expected to decrease by ₹ 2 Lakh. In addition, the machine would increase productivity on account of which net pre-tax revenues would increase by ₹ 3 Lakh annually (reckoned at year end). The tax rate applicable to the company is 40% and the cost of capital is 10 per cent.
Advise the company on the choice of the machine from a financial perspective on the basis of NPV.
PV Factors (10%)

Year	1	2	3	4	5
PV Factor	0.909	0.826	0.751	0.683	0.621

Present an incremental analysis of using the existing machine versus replacing the machine with a new one. Present annual discounted cash flows in your answers with separate calculation showing annual discounted cash flows on account of incremental depreciation without netting off capital asset outflows or inflows. Calculations are to be presented to the nearest rupee. P.V. factors with above decimal places should be used. **(10 marks)**

Answer:

(i)

	Existing Machine (₹)	(Amount in ₹)
Cost	20,00,000	
Depreciation 20%, year 1	4,00,000	
	16,00,000	
Depreciation 20%, year 2	3,20,000	
WDV	12,80,000	
Depreciation 20%, year 3	2,56,000	
WDV at Y_0 =	10,24,000	

(ii) Base for incremental depreciation

Cost of New Machine	30,00,000
Less: WDV of existing machine	10,24,000
Difference	19,76,000

Depreciation at end of the Year		PV	Disc. Values
Year 1	3,95,200	0.909	3,59,237
Year 2	3,16,160	0.826	2,61,148
Year 3	2,52,928	0.751	1,89,949
Year 4	2,02,342	0.683	1,38,200
Year 5	1,61,874	0.621	1,00,524
			10,49,058
Tax Shield 40%			4,19,623

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Expenses				(1,00,000)	(1,00,000)	(1,00,000)
Revenue		3,00,000	3,00,000	3,00,000	3,00,000	3,00,000
Net Revenue		3,00,000	3,00,000	2,00,000	2,00,000	2,00,000
Net Revenue after Tax		1,80,000	1,80,000	1,20,000	1,20,000	1,20,000
Cost of New Machine	(30,00,000)					
Resale – Old Machine	12,00,000					

Resale – New Machine						18,00,000
Cash Flows other than Depreciation	(18,00,000)	1,80,000	1,80,000	1,20,000	1,20,000	19,20,000
PV Factor	1	0.909	0.826	0.751	0.683	0.621
Discount Annual C/F	(18,00,000)	1,63,620	1,48,680	90,120	81,960	11,92,320
						(1,23,300)

∴ PV of Cash Flows (Other than Depreciation) (1,23,300)
Depreciation Impact + 4,19,623
Net Impact + 2,96,323
Hence, it is beneficial to go in for the new machine.

2018 - Dec [7] (a) Saptarshi Ltd. has just installed Machine - M at a cost of ₹ 2,10,000. The machine has a five year life with no residual value. The annual volume of production is estimated at 150000 units, which can be sold at ₹ 6 per unit in the first two years and at ₹ 7,8 and 9 in the third, fourth and fifth years. The first year's operating costs are estimated at ₹ 2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at ₹ 3 per unit for the same level of production. The second year's cost will be the same as in the first year. Thereafter, costs (operating and fixed) will increase over the first year's cost by 10%, 20% and 25% respectively in the third, fourth and fifth years.

Saptarshi Ltd. has just come across another model called Machine-N capable of giving the same output at the same fixed and operating costs as in the first year of Machine-M. There will be no change over the first year's costs in the next four years also. Capital cost of this machine is ₹ 2,50,000 and the estimated life is five years with nil residual value.

The company has an offer for sale of Machine - M at ₹ 1,10,000. But the cost of dismantling and removal will amount to ₹ 40,000. As the company has not yet commenced operations, it wants to sell Machine - M and purchase Machine - N.

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

The cost of capital is 15%.

(i) Advise whether the company should opt for the replacement. Present calculations of discounted annual cash flows to the nearest rupee without netting off.

(ii) Will there be any change in your view, if machine-M has not been installed, but the company is in the process of selecting one or the other machine?

Support your view with necessary workings. Cash flows of revenue and cost may be taken at year ends. **(8 marks)**

Answer:

(i)

Replacement :		₹
Cash outflow on Machine – N		2,50,000
Less : Sale value of Machine- M	1,10,000	
Less : Cost of Dismantling and Removal =	40,000	70,000
Net outflow =		1,80,000

P.V. of incremental cash inflows = (From (ii) workings below) 13,32,200 (N) – 11,34,308 (M) = 197892

NPV of Machine – N = 1,97,892 – 1,80,000 = 17,892

₹ 2,10,000 spent on Machine – M is a sunk cost and hence not relevant for deciding the replacement.

Decision: Since NPV of Machine – N is positive, replacement is advised.

(ii) **Independent evaluation :**

Machine - M

	Total Cost (Op + Fixed)	**Sale Value**	**Net C/1**	**PV**	**Total Inflow**
Y1	6,50,000	9,00,000	2,50,000	0.870	2,17,500
Y2	6,50,000	9,00,000	2,50,000	0.756	1,89,000
Y3	7,15,000	10,50,000	3,35,000	0.658	2.20,430
Y4	7,80,000	12,00,000	4,20,000	0.572	2,40,240

Y5	8,12,500	13,50,000	5,37,500	0.497	2.67,138
					11,34,308
					2,10,000
Less: Cash outflow					
				NPV =	9,24,308
Machine - N					
Y1	6,50,000	9,00,000	2,50,000	0.870	2,17,500
Y2	6,50,000	9,00,000	2,50,000	0.756	1,89,000
Y3	6,50,000	10,50,000	4,00,000	0.658	2,63,200
Y4	6,50,000	12,00,000	5,50,000	0.572	3,14,600
Y5	6,50,000	13,50,000	7,00,000	0.497	3,47,900
					13,32,200
Less: Cash outflow					2,50,000
				NPV =	10,82,200

Since the NPV of Machine – N is higher than that of Machine – M, the choice should fall on Machine – N.

Note : As the company is a zero tax company depreciation and the tax effect on the same are not relevant for consideration.

2019 - June [4] (a) EC Limited is considering a new project with initial investment. It is estimated that IRR of the project is 16% having an estimated life of 5 years. The Finance Manager has studied that project with sensitivity analysis and informs that annual fixed cost sensitivity is 7.8416%, whereas cost of capital (discount rate) sensitivity is 60%.

Other information available are:

Profit Volume Ratio (P/V)is	70%
Variable cost	₹ 60 per unit
Annual Cash Flow (year end)	₹ 57,500

Ignore depreciation on initial investment and taxes.
Calculate:

(i) Initial investment of the project
(ii) Net Present Value of the project
(iii) Annual Fixed Cost
(iv) Estimated annual sales units
(v) Break Even Units **(8 marks)**

Answer:

(i) **Initial Investment**
At IRR of 16%, NPV = 0, Hence,
Initial Cost of Investment = PVIFA (16%, 5) × Cash Flow (Annual)
= 3.274 × ₹ 57,500
= ₹ 1,88,255

(ii) **Net Present Value (NPV)**
Let Cost of capital be x, then, (16-x)/x = 60%; x= 10%
Thus, NPV of the project = [Annual Cash Flow x PVIFA (10%, 5)] - Initial Investment
= (₹ 57,500 × 3.791) - ₹ 1,88,255
= ₹ 29,727.50

(iii) **Annual Fixed Cost**
Let change in the Fixed Cost which makes NPV zero is X. Then,
₹ 29,727.50 - 3.791 X = 0
Thus X = ₹ 7,841.60
Let original Fixed Cost be Y. Then,
Y x 7.8416% = ₹ 7,841.60
Y = ₹ 1,00,000
Thus, Fixed Cost = ₹ 1,00,000

(iv) **Estimated Annual Units of sales**
Selling Price per unit = ₹ 60/(100% - 70%) = ₹ 200
(Annual Cash Flow + Fixed Cost)/ P/V Ratio = Sales Value
(₹ 57,500 + ₹ 1,00,000)/0.70 = ₹ 2,25,000
Sales in Units = ₹ 2,25,000/ ₹ 200 = 1,125 units.

(v) **Break Even Units**
Fixed Cost/ Contribution per Unit = 1,00,000/140 = 714.285 units

2019 - June [8] Answer the following question:

(e) How would you choose indivisible projects under capital rationing? Can there be a situation where a project with lower NPV is chosen while discarding a project with higher NPV? Explain.

PV Factor Table:

Rate \ End of Year	1	2	3	4	5
4%	0.962	0.925	0.890	0.855	0.822
4.8%	0.954	0.910	0.869	0.829	0.791
6%	0.943	0.890	0.840	0.792	0.747
7.2%	0.933	0.870	0.812	0.757	0.706
8.5%	0.922	0.849	0.783	0.722	0.665
10%	0.909	0.826	0.751	0.683	0.621
12%	0.893	0.797	0.712	0.636	0.567

Annuity Factors

4yrs	5yrs
3.632	4.454
3.562	4.353
3.465	4.212
3.372	4.078
3.276	3.941
3.169	3.791
3.038	3.605

$e^{.0225}$	1.0228	$e^{-0.0225}$	0.978
$e^{0.025}$	1.02532	$e^{-0.25}$	0.975
$e^{0.225}$	1.2523	$e^{-0.225}$	0.799
$e^{0.25}$	1.2840	$e^{-0.025}$	0.779
$e^{0.5}$	1.6458	$e^{-0.5}$	0.608

Annuity factors for 5 years:

Rate	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%
Factor	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127

(4 marks)

Answer:

Capital Rationing: This refers to prioritizing the projects based on NPV. The available capital is limited and therefore all projects with positive NPV cannot be selected. Hence, projects are arranged in the order of NPV (descending

order) and the cumulative project cost is tabulated. When available capital is exhausted, the process of selection has to stop. But in the case of indivisible project, i.e. part project cannot be undertaken and therefore, we may have unutilized capital. Therefore, we may leave out the last one and choose the combination which maximizes the NPV. While doing so, we may have a situation where the project with better NPV is not selected since its selection would involve under utilization of capital. For example, consider the following table:

Project	Capital Outlay	NPV (₹ lacs)	Cumulative outlay
A	200	+250	200
B	225	+200	425
C	400	+180	825
D	175	+100	600

Suppose that available capital is ₹ 600 lacs. If we stop with B, since funds will be insufficient for C, we are not utilizing ₹ 175 lacs of capital. Hence, we can go for D, which has lesser NPV. The project is indivisible. Hence we cannot go for part of C which yields proportional NPV.

2019 - Dec [6] (a) A company has to replace its machine with either machine EM or LM. The following details are given:

Particulars	EM	LM
Purchase price (₹)	20,00,000	10,00,000
Scrap value at the end of its life (₹)	3,00,000	3,00,000
Life (no. of years)	12	6
Overhauling due at the end of year	8	4
Overhauling cost (₹)	4,00,000	2,00,000
Annual repair cost (₹)	2,00,000	2,80,000

If LM is chosen, it has to be replaced by another LM machine at the end of the 6th year at ₹12,00,000. Ignore depreciation and taxes. Use a discount rate of 10% p.a. with annual rests. Present annual pre-discounted cash flows for each machine, then apply the PV or annuity factors and show computations to the nearest rupee.

Compare the equivalent annual cash flows for the machines.

Which machine should the company choose based on NPV? **(8 marks)**

Answer:

EM:

Year	Cash flows	Factor	PV
0	– 20,00,000	1	– 20,00,000
1-12	– 2,00,000	6.814	– 13,62,800
8	– 4,00,000	0.467	– 1,86,800
12	+ 3,00,000	0.319	+ 95,700
NPV			**– 34,53,900**

LM:

Year	Cash flows	Factor	PV
0	– 10,00,000	1	– 10,00,000
1-12	– 2,80,000	6.814	– 19,07,920
4	– 2,00,000	0.683	– 1,36,600
10	– 2,00,000	0.386	– 77,200
6	+ 3,00,000	0.564	– 5,07,600
	– 12,00,000		
12	+ 3,00,000	0.319	+ 95,700
NPV			**– 35,33,620**

Equivalent annual cash flows EM: – 34,53,900/12 = – 2,87,825

LM: – 35,33,620/12 = – 2,94,468

EM is better

2021 - Dec [14] If an equipment costs ₹ 20,00,000 and lasts 8 years, what should be the minimum pre-discounted equal annual cash inflow for it to be worthwhile to purchase the equipment ? Assume that the cost of capital is 14% and that there is no salvage value.? **(1 mark) [Sec. B - SAQ]**

Answer:

₹ 4,31,128

2021 - Dec [1] XYZ Ltd. is a company that has been a market leader for a considerable period of time. It makes strategic improvements to existing products or transforms products through latest technology and has been able to be sufficiently above competition. It has a wide range of products which are all profitable.

One of its products 'X' is in the maturity stage of its lifecycle and XYZ has identified a start-up (SU) which has successfully improved upon the product and has made it viable and attractive as value for money. XYZ is keen to buy up the know-how of SU at 50 lacs (to be paid at the beginning of year 1) and release the product as its own upgraded version of X. This cost will be amortised equally over five years at year-ends. If it does not act now, competition is sure to do it and XYZ may lose out on its market position. However, XYZ has a team to evaluate the financials using appropriate capital budgeting techniques and present an analysis before it takes a deliberate decision to phase out X or sustain its improved version. The following information is available:

SU recommends an intermediary process to be done before the finishing stage of X to transform it into its new version. The machinery available to fulfill the estimated demand has to be purchased at ₹ 100 crores. A further sum of ₹ 20 crores will have to be spent for its transport and installation at the beginning of year 1. The new machine will last for five years after which there is no significant residual value. It may be depreciated accordingly, equally over five years.

The old version of X will also be made in addition to the new one. The contribution from the new version's sales will be ₹ 60 lacs per annum before tax. However, sales of the old version will decline resulting in a loss of the usual annual contribution by ₹ 18 lacs, of which ₹ 6 lacs can be attributed to shifting of sales to the new version instead of the old and the remaining due to the normal fall in demand due to its lifecycle stage.

In order to make this new machine functional, it has to be installed in a portion of the land in the factory which was until now fetching an annual lease rent of ₹ 2,00,000 before tax. This lease will have to be cancelled at no penalty cost and used for the new machine.

Due to the increased production and sales, working capital will have to be introduced to the extent of ₹ 30 lacs at the beginning of the first year and this will be released at the end of five years.

It is the policy of XYZ to adhere to its target capital structure in the long term to evaluate projects. Finance is also raised in the same manner. Accordingly, 60% of the cost is funded by equity capital which costs 12% p.a. and 40% is funded by debt which costs 10 % before taxes (30 % tax rate). Interest amounts on debts are to be paid at the end of each year and the principal is returned in one full repayment after 5 years.

XYZ requires you to evaluate whether the purchase of the new machine is justified considering its Net Present Value (NPV).

(i) Calculate the NPV and advise XYZ if it should go in for the new version of X.(Write only the NPV value and your advice in the answer box on the computer screen.)
Suggested Rough Work: (Use '+' for inflows and '-'or '( )' for outflows. Display ₹ in lacs up to two decimals. Use PV factors up to 3 decimals.

(ii) Compute the discount rate to be applied to the cash flows for evaluation of the proposal with a brief reasoning for your choice.

(iii) Identify cash flows that you will consider irrelevant in determining the NPV under i) and briefly state why you consider them irrelevant.

(12 marks) [Sec. C Case Study Question]

Answer:

(i) Net Present Value(NPV) = 4.71 lacs
Advice : XYZ should not go in for the new version.

(ii) The Cost of capital is 10 % after tax, computed as follows:
K_e = Cost of equity = 12 %.
K_d = After tax cost of debt = 10% (1-0.3) = 10% x 0.7 = 7 %
Weighted average cost of capital is the discount factor rate to be used in the capital budgeting decision. This works out to 60% K_e + 40 % K_d = 0.6 x 12 + 0.4 x 7 = 10%. We are not evaluating whether to borrow or use own funds. Viability of an investment is concerned only with the

cash flows that a project brings to its equity and debt funders. Hence principal and interest cash flows, which are part of financing decision, will not figure in the choice of discount rate. Since cash flows are after tax, we compute the after tax cost of capital, which is cost of equity (no tax element) and cost of debt (after tax) in the given ratio.

(iii) **Irrelevant cash flows:** Interest and principal costs of financing Contribution lost on old X due to its stage in lifecycle ₹ 12 lacs.
Gain in contribution is 60 lacs. Less loss in old version of X due to new X = 6 lacs. Net gain is ₹ 60 – 6 = 54 lacs. Gain after tax = 0.7 x 54 = 37.8 lacs. The other 12 lacs of loss in contribution of old X is irrelevant cash flow since this loss exists in the old and new versions of X.
Cost of the machine = 100 + transport + installation = 100 + 20 = 120 lacs. Depreciation per annum = 24 lacs.
Tax benefit on depreciation = 0.3 x 24 = + 7.2 lacs.
₹ 50 lacs for know how is amortised at ₹ 10 lacs every year end. Tax benefit = 3 lacs p.a. Interest outflows and principal repayment should not be considered in the capital budgeting decision as they do not arise out of the deployment of the machine. That is a financing decision and not an investment decision. Only cash flows relating to the investment decision are to be considered for NPV. However, the cost of raising the funds will be the long term target cost of capital since the marginal cost of capital may give misleading decisions on investments by choosing the lower than best investment proposals. Moreover, financing the project is from debt and equity. Cash flows that have to be considered are those that accrue to debt and equity. Hence interest is not part of the cash flows for evaluation.

2022 - Dec [2] (b) AGRON LTD. is Contemplating whether to replace an existing machine or to spend money on overhauling it. Agron Ltd. currently pays no taxes. The replacement machine costs ₹ 1,00,000 now and requires maintenance of ₹ 10,000 at the end of every year for 8 years. At the end of 8 years, it would have a salvage value of ₹ 20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows:

Years	Maintenance (₹)	Salvage (₹)
Present	0	40,000
1	10,000	25,000
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The Opportunity Cost of Capital for AGRON LTD. is 10%.
[Given PVIF]:

End of Year	1	2	3	4	5	6	7	8
Present value factor @ 10%	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665

PVI FA (10%, 8 yrs.) = 5.3349 (Ignore Taxation)

Required:

When should the AGRON Ltd. replace the Machine?

(3 + 2 + 1 = 6 marks)

Answer:

Equivalent Annual Cost of New Machine

Particulars	₹
Cost of New Machine	1,00,000
Add: P.V. of Annual Repairs Maintenance 10,000 × 5.3349	53,349
Less: P.V. of Salvage Value at the end of 8 years (20,000 × 0.4665).	9,330
Equivalent Annual Cost	₹ 26,996

Equivalent Annual Cost of (EAC) of keeping the existing Machine

Year	1	2	3	4
P. V. of Salvage Value of Old Machine	40,000	25,000	15,000	10,000
Add: P. V. of Annual Maintenance Cost Annual Cost ÷ 1.10	9,091	18,181	27,273	36,364

Less: P. V. of Salvage Value at the end of the year (P.V. ÷ 1.10)	22,727	13,636	9,091	0
	26,364	29,545	33,182	46,364
Equivalent Annual Cost:	29,000	32,500	36,500	51,000

Recommendation:

The Company should replace the old Machine now, since the Equivalent Annual Cost of new machine at ₹ 26,996 is lower than the cost of using the existing Machine in the First year, Second year, third and Fourth year.

2022 - Dec [6] (a) Bitrin Ltd. had only one Water Pollution Control Machine in this type of block of asset, with no book value under the provisions of the Income Tax Act, 1961 as it was subject to rate of depreciation of 100% in the very first year of installation. Due to funds crunch Bitrin Ltd. decided to sell the machine which can be sold in the market, of any one for ₹ 5,00,000 easily.

Understanding this from a reliable source **Cetna Ltd.** came forward to buy the machine for ₹ 5,00,000 and lease it to Bitrin Ltd. for lease rental of ₹90,000 p.a. for 5 years. Bitrin Ltd. decided to invest the next sale proceed in a risk free deposit, fetching yearly interest of 8.75% to generate some cash flow. It also decided to relook the entire issue afresh after the said period of 5 years.

Another company, Delta Ltd. also approached Bitrin Ltd., proposing to sell a similar machine for ₹4,00,000 to the latter and undertook to buy it back at the end of 5 years for ₹1,00,000 provided the maintenance were entrusted to Delta Ltd. for yearly charge of ₹15,000. Bitrin Ltd. would utilize the net sale proceeds of the old machine to fund this machine also this offer.

The marginal rate of tax of Bitrin Ltd. is 34% and its weighted average cost of capital is 12%.

Discounting factor @ 12%

Year	**1**	**2**	**3**	**4**	**5**
	0.893	0.797	0.712	0.636	0.567

Required:

Which Company's proposal you should recommend to accept to the Company (Bitrin Ltd.)? **(1+ 3 +1+2+1= 8 marks)**

Answer:

First Option

	Amount (in ₹)
Sale Proceeds	5,00,000
Tax @ 34%	1,70,000
Net Proceeds	3,30,000
Interest @ 8.75% p.a.	28,875

NPV of this option

	Year					
	0	**1**	**2**	**3**	**4**	**5**
Interest on net proceeds (₹)		28,875	28,875	28,875	28,875	28,875
Tax @ 34% (₹)		-9,818	-9,818	-9,818	-9,818	-9,818
Lease Rent (₹)		-90,000	-90,000	-90,000	-90,000	-90,000
Tax @ 34% (₹)		30,600	30,600	30,600	30,600	30,600
Terminal Cash Flow (₹)						3,30,000
Cash Flow (₹)		-40343	-40343	-40343	-40343	2,89,657
PV Factor		0.893	0.797	0.712	0.636	0.567
PV of cash flows		-36,026	-32,153	-28,724	-25,658	1,64,236

NPV = ₹ 41,675

Second Option

Particulars	**Amount (in ₹)**
Cost of New Machine	4,00,000
Net Sale proceeds of old machine	3,30,000
Investment in Cash	70,000

NPV of this option

	Year					
	0	**1**	**2**	**3**	**4**	**5**
Payment for new machine (₹)	-70,000					
Tax Saving (₹ 4,00,000*34%)		1,36,000				
Maintenance (₹)		-15,000	-15,000	-15,000	-15,000	-15,000
Tax Saving on above @ 34% (₹)		5,100	5,100	5,100	5,100	5,100
Terminal Cash Flow (₹)						1,00,000
Tax on above @ 34% (₹)						-34,000
Cash Flow (₹)	-70,000	1,26,100	-9,900	-9,900	-9,900	56,100
PV Factor	1	0.893	0.797	0.712	0.636	0.567
PV of Cash Flows (₹)	-70,000	1,12,607	-7,890	-7,049	-6,296	31,809
NPV = ₹ 53,181						

The second alternative is recommended

2023 - June [2] (a) SRISTI Ltd., a manufacturing company, has a machine Z which is ten years old and is badly in need of an overhaul. The overhaul will have the following costs:

		₹
(i)	Motor and Generator	17,50,000
(ii)	Electronic equipments	5,00,000
(iii)	Painting and other parts	2,50,000

These expenses can be capitalised and depreciated for tax purposes over the next five years with no salvage value on a straight line basis. Post overhaul, the operating costs would be as follows in the first year:

	₹
Fuel	17,50,000
Labour and Benefits	15,00,000
Maintenance	7,50,000
Others	5,00,000

These costs increase at 5% p.a. with inflation.
Machine Z has zero book value with old parts (i) to (iii) but can be sold as it is for ₹ 2,00,000 and the difference between these values will be charged to tax at 25% which is also the corporate tax rate, expected to be valid for the next five years.
Installation of a brand new set of parts instead of overhaul of items (i) to (iii) above would mean a cost of ₹ 40,00,000 with depreciation similar to overhauling. This replacement will result in the following costs from the first year with annual increase of 5%:

	₹
Fuel	20,00,000
Labour and Benefits	12,00,000
Maintenance	5,00,000
Others	3,00,000

Overhauling or replacement will be done within a month and will not impact the annual production.
There is no scrap value expected after the end of five years, by when the production will stop whether parts are overhauled or replaced.
The cost of capital for evaluating such decisions at 10% p.a., cash flows and tax savings occur at year ends are considered.

Required:

Analyse the above information to determine the following:

(i) Total Net Present Value (NPV) of the proposal for overhauling of the machine Z,
(ii) Total Net Present Value (NPV) of the proposal for replacing new parts of Machine Z, and
(iii) Advise the company as to which proposal (overhauling or replacing parts) will be preferable to the company with reasons.

(Present figure to the nearest Rupee)

[**Given:** PV factors @ 10%]

Year	1	2	3	4	5
PV (10%)	0.909	0.826	0.751	0.683	0.621

(5 + 4 + 1 = 10 marks)

Answer:

(i) Total Net Present Value (NPV) of the proposal for overhauling of the machine Z = ₹ 1,60,31,705

(ii) Total Net Present Value (NPV) of the proposal for replacing new parts of Machine Z = 1,55,54,944

(iii) Advice: Since net present value of cash out flow of replacing parts for machine is lower than the net present value of cash outflow of overhauling machine z, it is better to replace the parts of Machine Z resulting in decline of outflow by ₹ 4,76,761.

2023 - June [8] {C} MUNIT LTD. (ML) manufactures musical instruments. The Company exports around 60 per cent of its output. Customers are dispersed around the Country and there is no concentration in one particular area. MUNIT LTD.'s. turnover has been growing at around 20 per cent per annum over the past 5 years and it now needs to consider extending its premises or moving to a new location. The present premises are rented from the Local Government Authority. The rental agreement is due for renewal on January 1, 2023. The Company Spent ₹ 20 Lakhs on renovations to the property three years ago to provide a more suitable manufacturing environment for its products. The renovations are structural and could not be removed if MUNIT LTD. decides to relocate.

The company is considering three alternatives:

1. Renegotiate the rental agreement and extend the existing premises with the approval of the Land lords;
2. Buy a much larger property which is available a few kilometres from the current premises and which is around 20 years old; or
3. Build a new factory and office premises in an 'enterprise zone' approximately 150 kilometres away.

The information available on these three alternatives is as follows:

Alternative 1: Rent and extend the existing Premises:

The rental terms would be ₹ 30 Lakhs per annum in real terms as at January 1, 2023. Rent will be payable at the end of each of the years 2023-2027. Rates are included with the rental payments. The agreement allows for an increase the annual payments in Line with inflation of 5 per cent per annum. Extensions to the premises would cost ₹ 57 Lakhs (nominal) payable at the end of 2023. The extension costs can be written off, for tax purposes, in the year in which they are incurred. The local Authority (the Land Lord) has indicated it would be willing to purchase the extension from MUNIT Ltd. (ML) at the original nominal Cost at the end of 2027.

Alternative 2: Buy Larger Property:

The purchase costs are ₹ 150 Lakhs payable on January 1, 2023. Rates will be fixed at ₹ 15 Lakhs per annum payable at the end of each year from 2023 to 2032 inclusive. Renovations and Removal costs payable at the end of the first year (2023) are estimated at ₹ 45 Lakhs nominal.

The Company thinks these premises will be large enough until the end of 2032. After that, it may have to sell or move again, as there is no possibility of extending these premises. Depreciation for tax purposes are available on the full purchase cost of new premises at 4 percent straight line. The realizable value of the premises at the end of 10 years is estimated as ₹ 300 Lakhs nominal.

Note: Assume the application of indexation allowance at the time of sale will result in there being no balancing charge or balancing allowance.

Alternative 3: Build new Factory and Office Premises:

The land will Cost ₹ 60 Lakhs which will be paid at January 1, 2023. Building Costs are estimated at ₹ 75 Lakhs to be paid at the end of 2023. While building is in Progress, the Company will remain in its existing premises at an agreed annual rent of ₹ 30 Lakhs payable at January 1, 2023. No Rates will be payable on the new premises for the years 2023 to 2025 inclusive. From 2026 onwards they are expected to be ₹ 9 Lakhs per annum payable at the end of each year. The company estimates that 50% of the work force

will relocate. Removal and relocation costs at the end of 2023 will be ₹ 15 Lakhs. Recruitment and Training Costs of the new staff are estimated as ₹ 21 Lakhs, also payable at the end of 2023. All costs in this alternative are in nominal terms. The cost of the buildings being in an enterprise zone, will attract 100 per cent first year depreciation.

For the purposes of evaluation, a 15 year life of the Land and buildings from the Commencement of the evaluation under this alternatives.

Additional Information:

1. The starting date for the evaluation is January 1, 2023
2. The Company pays tax at 33 per cent. This rate is not expected to change.
3. Tax relief is available on 100 per cent of all expanses and Costs except Land in alternative-3, and building in alternative-2, which attract depreciation as indicated.
4. The Company is quoted on the National Stock Exchange (NSE) and which has a Debt: Equity Ratio of 1: 3. The Cost of Debt before Tax is 10% and the cost of Equity of 15.10%.

Note: (Inflation Index figures are to rounded off to 3 decimal places. Show calculation in ₹ Lakh upto 2 decimal places and use PV factors upto 3 decimal places).

Required:

(i) Evaluate the Total Net-Present value of Cash Out Flows of Alternative-1 (Rent and extend the existing Premises)

(ii) Assess the value of Equivalent Annual Cost of Alternative-2 (Buy larger property locally

(iii) Present the Total Net present value (outflows) of Alternative-3 (Build new factory and office Premises)

(iv) Which alternative (Project) would you recommend for acceptance of the Company (ML) and why?

Given:

PV Factor Table								Annuity Factor Table		
Yr. end Rate	1	2	3	4	5	10	15	5	10	15
12%	0.893	0.797	0.712	0.636	0.567	0.322	0.183	3.605	5.650	6.811
13%	0.885	0.783	0.693	0.613	0.543	0.295	0.160	3.517	5.426	6.462
14%	0.877	0.769	0.675	0.592	0.519	0.270	0.140	3.433	5.216	6.142

(4 + 4 + 6 + 2 = 16 marks)

Answer:

Alternative 1: Rent and Extend the Existing Premises

Annual Rent Payments:

- 2023: 30 Lakhs
- 2024: 31.50 Lakhs
- 2025: 33.08 Lakhs
- 2026: 34.73 Lakhs
- 2027: 36.47 Lakhs

Present Value of Rent Payments:

⇒ PV factors for 12%:
  - Year 1: 0.893
  - Year 2: 0.797
  - Year 3: 0.712
  - Year 4: 0.636
  - Year 5: 0.567

⇒ PV of rent payments:
  - 2023: 30 * 0.893 = 26.79 Lakhs
  - 2024: 31.50 * 0.797 = 25.11 Lakhs
  - 2025: 33.08 * 0.712 = 23.55 Lakhs
  - 2026: 34.73 * 0.636 = 22.10 Lakhs
  - 2027: 36.47 * 0.567 = 20.69 Lakhs

⇒ Total PV of rent payments: 26.79 + 25.11 + 23.55 + 22.10 + 20.69 = 118.24 Lakhs

Present Value of Extension Cost:

- Extension cost: 57 Lakhs
- PV factor for 2023: 0.893
- PV of extension cost: 57 * 0.893 = 50.90 Lakhs

Tax Savings on Extension Cost:

- Tax savings: 57 * 33% = 18.81 Lakhs
- PV of tax savings: 18.81 * 0.893 = 16.80 Lakhs

Buyback of Extension by Landlord:

- Buyback amount: 57 Lakhs
- PV factor for 2027: 0.567
- PV of buyback amount: 57 * 0.567 = 32.32 Lakhs

Net Present Value of Cash Outflows:

- Total PV of rent payments: 118.24 Lakhs
- PV of extension cost: 50.90 Lakhs
- Less PV of tax savings: -16.80 Lakhs
- Less PV of buyback amount: -32.32 Lakhs
- Net NPV: 118.24 + 50.90 - 16.80 - 32.32 = 120.02 Lakhs

Equivalent Annual Cost (EAC):

- NPV: 120.02 Lakhs
- Annuity factor for 5 years at 12%: 3.605
- EAC: 120.02 / 3.605 = 33.30 Lakhs

Alternative 2: Buy Larger Property

Annual Depreciation and Tax Savings:

- Annual depreciation: 150 Lakhs * 4% = 6 Lakhs
- Annual tax savings on depreciation: 6 Lakhs * 33% = 1.98 Lakhs

Present Value of Annual Rates:

- PV factor for 12% (annuity factor for 10 years): 5.650
- Annual rates: 15 Lakhs per annum
- PV of annual rates: 15 Lakhs * 5.650 = 84.75 Lakhs

Present Value of Renovation and Removal Costs:

- Renovation and removal costs: 45 Lakhs
- PV factor for 2023: 0.893
- PV of renovation and removal costs: 45 * 0.893 = 40.19 Lakhs

Present Value of Depreciation Tax Savings:
- PV factor for 12% (annuity factor for 10 years): 5.650
- Annual tax savings on depreciation: 1.98 Lakhs per annum
- PV of tax savings: 1.98 Lakhs * 5.650 = 11.19 Lakhs

Present Value of Realizable Value:
- Realizable value: 300 Lakhs
- PV factor for 10 years: 0.322
- PV of realizable value: 300 * 0.322 = 96.60 Lakhs

Net Present Value of Cash Outflows:
- Purchase cost: 150 Lakhs
- PV of annual rates: 84.75 Lakhs
- PV of renovation and removal costs: 40.19 Lakhs
- Less PV of tax savings on depreciation: -11.19 Lakhs
- Less PV of realizable value: -96.60 Lakhs
- Net NPV: 150 + 84.75 + 40.19 - 11.19 - 96.60 = 167.15 Lakhs

Equivalent Annual Cost (EAC):
- NPV: 167.15 Lakhs
- Annuity factor for 10 years at 12%: 5.650
- EAC: 167.15 / 5.650 = 29.59 Lakhs

Alternative 3: Build New Factory and Office Premises

Present Value of Initial Costs:
- Land cost: 60 Lakhs (already in present value)
- Building costs: 75 Lakhs payable at the end of 2023
- Rent for existing premises: 30 Lakhs payable on January 1, 2023 (already in present value)
- PV factor for 2023: 0.893
- PV of building costs: 75 * 0.893 = 66.98 Lakhs
- PV of removal and relocation costs: 15 * 0.893 = 13.40 Lakhs
- PV of recruitment and training costs: 21 * 0.893 = 18.75 Lakhs

Tax Impact on Building Costs:
- Tax savings on building costs: 75 * 33% = 24.75 Lakhs
- PV of tax savings: 24.75 * 0.893 = 22.10 Lakhs

Present Value of Rates:

- Rates are 9 Lakhs per annum from 2026 onwards for 12 years (2026-2037)
- PV factor for annuity (12 years from year 4): 3.206 (from annuity table 6.811 - 3.605)
- Annual rates: 9 Lakhs per annum
- PV of rates: 9 Lakhs * 3.206 = 28.85 Lakhs

Net Present Value of Cash Outflows:

- Land cost: 60 Lakhs
- PV of building costs: 66.98 Lakhs
- Rent for existing premises: 30 Lakhs
- PV of removal and relocation costs: 13.40 Lakhs
- PV of recruitment and training costs: 18.75 Lakhs
- Less PV of tax savings on building costs: -22.10 Lakhs
- PV of rates: 28.85 Lakhs

Net NPV of cash outflows: 60 + 66.98 + 30 + 13.40 + 18.75 - 22.10 + 28.85 = 195.88 Lakhs

Equivalent Annual Cost (EAC):

- NPV: 195.88 Lakhs
- Annuity factor for 15 years at 12%: 6.811
- EAC: 195.88 / 6.811 = 28.76 Lakhs

Summary of Equivalent Annual Costs (EAC):

- Alternative 1 (Rent and extend the existing premises): 33.30 Lakhs
- Alternative 2 (Buy larger property locally): 29.59 Lakhs
- Alternative 3 (Build new factory and office premises): 28.76 Lakhs

Recommendation:

Alternative 3: Build New Factory and Office Premises

Reason:

- Alternative 3 has the lowest Equivalent Annual Cost (EAC) of 28.76 Lakhs.
- This indicates that over the evaluation period, the cost of building and operating the new factory and office premises is the most economical option for MUNIT Ltd.

Conclusion:

- Based on the calculated EACs, Alternative 3 is the most attractive option for MUNIT Ltd. due to its lower cost compared to the other alternatives. Therefore, it is recommended that the company proceed with building the new factory and office premises.

2023 - Dec [2] (a) PRANTICK Ltd. is considering the replacement of its existing machine with a new machine. The purchase price of the new machine is ₹ 36,40,000 and its expected life is 8 years. The company follows straight line method of depreciation on the original investment (Scrap value is not considered for the purpose). The other expenses to be incurred for the New Machine are as under:

(i) Installation charges ₹ 14,000
(ii) Consultant fees paid for his advice to buy new machine ₹ 7,000
(iii) Additional working capital required (will be released after 8 years) ₹ 23,800

The written down value of the existing machine is ₹ 1,06,400 and its cash salvage value is ₹ 17,500. The dismantling of the existing machine would cost ₹ 6,300. The annual earnings (before tax but after depreciation) from the new machine would amount to ₹ 4,41,000. The company's marginal tax rate applicable is 35%. Its cost of capital is 13%.

(Given: PVIF (13%, 8 yrs.) = 0.376 and PVIFA (13%, 8 yrs.) = 4.80) Present figures nearest to rupee.

Required:

(i) Analyse the annual cash savings and present value of cash inflows.
(ii) Advise on the viability of the proposal. **(7 marks)**

Answer:

Annual Cash Savings	= ₹ 7,44,275
Present Value of Cash inflows	= ₹ 36,25,989
NPV of the Proposal	= ₹ (58,811)

Since Net present Value (NPV) of Project is Negative (- ₹ 58,811), it is not viable. So, the replacement of the existing Machine with a new replacement should not be considered.

Calculate the Total Initial Investment:
Purchase price: 36,40,000
Installation charges: 14,000
Consultant fees: 7,000
Additional working capital: 23,800
Total Initial Investment: 36,40,000 + 14,000 + 7,000 + 23,800 = 36,84,800
Determine Annual Cash Savings:
Given annual cash savings: 744,275
Calculate Present Value of Cash Inflows:
Present value of annual cash savings over 8 years is 36,25,989 (given).
Calculate Net Present Value (NPV):
NPV = Present value of cash inflows - Total initial investment
NPV = 36,25,989 - 36,84,800 = -58,811
Advice:
Decision Based on NPV:
Since the NPV is negative (-58,811), the investment is not viable.
Therefore, PRANTICK Ltd. should not replace the existing machine with the new one.

2024 - June [2] (a) BATECH Ltd., is a manufacturer of computers. It wants to introduce Artificial Intelligence (AI) while manufacturing computers. The estimated annual saving from introduction of the Artificial Intelligence is as follows:

(i) Reduction of five employees with annual salaries of ₹ 1,50,000 each
(ii) Reduction of ₹ 1,50,000 in production delays caused by inventory problems
(iii) Reduction in lost sales ₹ 1,25,000 p.a.
(iv) Gain due to timely billing ₹ 1,00,000 p.a.

The purchase price of the system for installation of Artificial Intelligence is ₹ 10,00,000 and installation cost is ₹ 50,000. 80% of the purchase price will be paid in the year of purchase and remaining will be paid in next year.
The estimated life of the system is 5 years and it will be depreciated for Income Tax purposes on a straight line basis. However, the operation of the new system requires two computer specialists with annual salaries of ₹ 2,50,000 per person.

In addition to above, annual maintenance and operating cost for five years are as below:

(Amount in ₹)

Year	1	2	3	4	5
Maintenance & Operating Cost	1,00,000	90,000	80,000	70,000	60,000

Maintenance and operating cost are payable in advance.
The Company's tax rate is 30% and its required rate of return is 15%.
Given: PV Factor:

Year	1	2	3	4	5
$PVIF_{(15\%)}$	0.870	0.756	0.658	0.572	0.497

Required:

(i) Assess the Net Present Value (NPV) of the Project.
(ii) Advise whether the Company should introduce Artificial Intelligence (AI) or not. **(7 marks)**

FOR NOTE