1 INVESTMENT DECISIONS, PROJECT PLANNING AND CONTROL

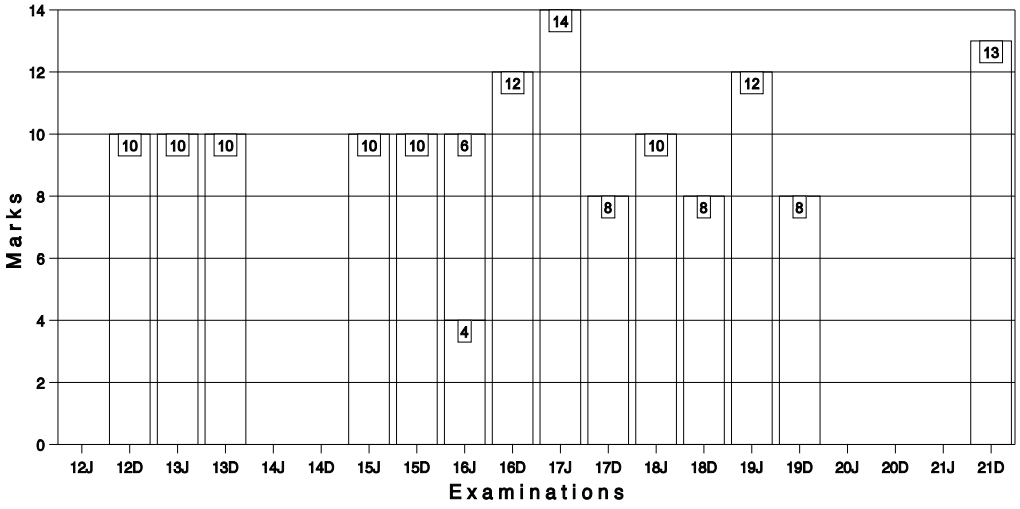
THIS CHAPTER INCLUDES

- Estimation of Project Cash Flow
- Relevant Cost Analysis for Projects
- Project Appraisal Methods – DCF and Non-DCF Techniques
- Capital Rationing
- Social Cost Benefit Analysis

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

Legend

Objective | Short Notes | Distinguish | Descriptive | Practical



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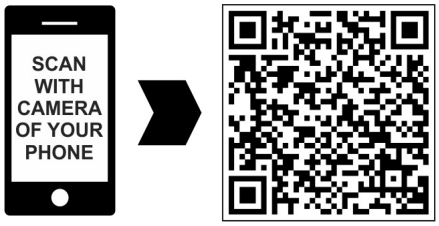

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DESCRIPTIVE QUESTIONS

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*.

—— Space to write important points for revision ——

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

Space to write important points for revision

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 id 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.

Space to write important points for revision

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.

Space to write important points for revision

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

Space to write important points for revision

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.

Space to write important points for revision

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

Space to write important points for revision

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%	4.014	12% is the project's cost of capital.

× .65 = 7.8% years 1 to 5		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.

Space to write important points for revision

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.

Space to write important points for revision

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.

Space to write important points for revision

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.

Space to write important points for revision

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.

Space to write important points for revision

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

Space to write important points for revision

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: Annuity Factors

End of Year / Rate	1	2	3	4	5	4yrs	5yrs
4%	0.962	0.925	0.890	0.855	0.822	3.632	4.454
4.8%	0.954	0.910	0.869	0.829	0.791	3.562	4.353
6%	0.943	0.890	0.840	0.792	0.747	3.465	4.212
7.2%	0.933	0.870	0.812	0.757	0.706	3.372	4.078
8.5%	0.922	0.849	0.783	0.722	0.665	3.276	3.941
10%	0.909	0.826	0.751	0.683	0.621	3.169	3.791
12%	0.893	0.797	0.712	0.636	0.567	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.

Space to write important points for revision

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

Space to write important points for revision

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

Space to write important points for revision

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.

Space to write important points for revision