Solution Q-1

Cumulative cash flow, discounted and non-discounted are calculated as shown in the following table:

(in Lakh)

	Pay Back Period		Discounted Pay Back Period @ 15%	
Year	CF	CCF	CF	CCF
1	90	90	78.26	78.26
2	120	210	90.74	169.00
3	380	590	249.86	418.85
4	420	1010	240.14	658.99
5	310	1320	154.12	813.12
6	240	1560	103.76	916.87
7	60	1620	22.56	939.43

(Non Discounted):

Formula:

$$P = E + \frac{B}{C}$$

where

P = Payback period

E = No. of years immediately preceding the year of final recovery

B = Balance amount to be recovered

C = Cash flow during the year of final recovery.

$$P = 2 + \frac{330 - 210}{380}$$

$$= 2 + \frac{120}{380}$$

$$P = 2 \text{ Year } 3 \text{ months}$$

PBP for discounted:

$$P = 2 + \frac{330 - 169}{250}$$

↳ approx

$$P = 2 + \frac{161}{250}$$

$$P = 2 \text{ years } 6 \text{ months}$$

Qu-2 (Practice)

Initial Investment = Rs 10,00,000

Years	CF (Rs '000)	CCF	DCF	Discounted CCF (Rs '000)
1	150	150	136.36	136.36
2	200	350	165.29	301.65
3	350	700	262.96	564.61
4	450	1150	307.36	871.97
5	220	1370	136.60	1008.57

PBP ⇒

$$P = E + \frac{B}{C}$$

$$= 3 + \frac{1000 - 700}{450}$$

$$= 3 + \frac{300}{450}$$

$$= 3.66 \text{ Years}$$

Discounted Pay Back

$$P = E + \frac{B}{C}$$

$$= 4 + \frac{1000 - 871.97}{136.60}$$

$$= 4 + \frac{128.03}{136.60}$$

$$= 4.937 \text{ Years}$$

Sol-3 Initial Investment = Rs 10 00 000/-

Years	Cash Flow (Rs)	PV Discounted cash Flow @ 12%	CCF (Rs)
1	150 000	133928.57	133928.60
2	200 000	159438.78	293367.35
3	300 000	213534.07	506901.42
4	450 000	285983.14	792884.56
5	500 000	283713.43	1076597.98
6	400 000	202652.45	1279250.43
		TPV 1279250.43	

a) Discounted Pay Back Period $= E + \frac{B}{C}$

$= 4 + \frac{10\,00\,000 - 792884.56}{283713.43}$

$= 4 + \frac{207115.44}{283713.43}$

DPBP = 4.73 Years
(Discounted)

b) NPV = TPV − Initial Investment

= 1279250.43 − 10 00 000

NPV = Rs 279250.43

c) PI = $\frac{\text{PV of all future cash inflows}}{\text{Initial outlays}}$

= $\frac{1279250.43}{10\,00\,000}$

PI = 1.279

Sol.-4 Project cost = Rs 2,00,000

Year	CF (Rs)	Disc CF @ 14%	CCF (Rs)
1	300000	263157.89	263157.89
2	420000	323176.36	586,334.26
3	500000	337485.76	923820.01
4	750000	442060.21	1367880.22
5	800000	415494.93	1783375.15
6	600000	273351.93	2056727.08
7	250000	99909.33	2156636.41
	TPV	2156636.41	

a) Discounted PBP = $E + \frac{B}{C}$

$= 5 + \frac{(2000000 - 1783375.15)}{273351.93}$

$= 5 + \frac{216624.85}{273351.93}$

$= 5.79$ Years

b) NPV = TPV − Initial Inv.

= 2156636.41 − 2000000

NPV = Rs 156636.41

c) PI = $\frac{\text{PV of all future cash inflows}}{\text{Initial cash outlay}}$

$= \frac{2156636.41}{2000000}$

PI = 1.07

Solutions: Initial Investment = Rs 15 crore

Project A

a) Pay Back Period (2 is cross)

Years	CF	CCF
1	4	4
2	4	8
3	3	11
4	4	15
5	5	20
6	4	24
7	2	26

$P = E + \frac{B}{C}$

$= 3 + \frac{15-11}{4}$

$= 4$ Years

Discounted

DCF	CCF
3.51	3.51
3.08	6.59
2.02	8.61
2.37	10.98
2.60	13.58
1.82	15.40
.80	16.20

(b) Discounted Pay Back

$P = E + \frac{B}{C}$

$= 5 + \frac{15-13.58}{1.82}$

$= 5 + \frac{1.42}{1.82}$

$P = 5.78$ Years

Project B

Years	CF	CCF
1	3	3
2	4	7
3	4	11
4	5	16
5	6	22
6	3	25
7	2	27

(a) $P = E + \frac{B}{C}$

$= 3 + \frac{15-11}{5}$

$= 3 + \frac{4}{5}$

$= 3.8$ Years

Discounted

Years	DCF	CCF
1	2.63	2.63
2	3.08	5.71
3	2.70	8.41
4	2.96	11.37
5	3.12	14.49
6	1.37	15.85
7	.80	16.65

(b) $P = E + \frac{B}{C}$

$= 5 + \frac{15-14.49}{1.37}$

$= 5 + \frac{.51}{1.37}$

$= 5.37$ Years

(c) **Net present value:-**

NPV = Total present value of Future Cash flows − Initial Investment.

Project A

(Rs in crore)

Disc. Rate = 14%

Years	Cash flow	PV
1	4	3.51
2	4	3.08
3	3	2.02
4	4	2.37
5	5	2.60
6	4	1.82
7	2	.80
		16.20

NPV = 16.20 − 15
= 1.20 crore

Project B:-

Years	CF	PV
1	3	2.63
2	4	3.08
3	4	2.70
4	5	2.96
5	6	3.12
6	3	1.37
7	2	.80
		16.65

NPV = 16.65 − 15
= Rs 1.65 Crore

(D) Profitability Index of each Project (PI)

$$PI = \frac{\text{Present Value of all Future Cash Inflows}}{\text{Initial cash outflow}}$$

$$PI = \frac{\sum_{t=1} \left\{ \frac{C_t}{(1+r)^t} \right\}}{C_0}$$

Project A

$$PI = \frac{\frac{4}{(1.14)^1} + \frac{4}{(1.14)^2} + \frac{3}{(1.14)^3} + \frac{4}{(1.14)^4} + \frac{5}{(1.14)^5} + \frac{4}{(1.14)^6} + \frac{2}{(1.14)^7}}{15}$$

$$= \frac{3.51 + 3.08 + 2.02 + 2.37 + 2.60 + 1.82 + .80}{15}$$

$$= \frac{16.20}{15}$$

$$\boxed{PI = 1.08}$$

Project-B

$$PI = \frac{\frac{3}{(1.14)} + \frac{4}{(1.14)^2} + \frac{4}{(1.14)^3} + \frac{5}{(1.14)^4} + \frac{5}{(1.14)^5} + \frac{3}{(1.14)^6} + \frac{2}{(1.14)^7}}{15}$$

$$= \frac{2.63 + 3.08 + 2.70 + 2.96 + 3.12 + 1.37 + .80}{15}$$

$$= \frac{16.65}{15}$$

$$= 1.11$$

$$\boxed{PI = 1.11}$$

(c) **IRR**

IRR is the discount rate which makes its NPV equal to zero.

for Project A :-

at 14%

NPV = 1.20

so IRR will be more than 14%.

at 16% & at 17%

Yr.	CF	DCF @16%	CF	DCF @17%
0	-15	-		
1	4	3.45	4	3.42
2	4	2.97	4	2.92
3	13	1.92	3	1.87
4	4	2.20	4	2.13
5	5	2.38	5	2.28
6	4	1.64	4	1.56
7	2	.70	2	.67
		15.26		14.85

at 16% NPV = TPV − IO
= 15.26 − 15
= .26

at 17% NPV = TPV − IO
= 14.85 − 15
= −.15

IRR = LDR% + (LDPV − OI) / (LDPV − HDPV) × DIF

= 16 + .26/.41 × 1

= 16.68%

OI = original investment

DIF = Diff. of low & high discounting factor

LDPV = PV at lower rate

HDPV = PV at higher rate

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For Project B

14% to 16% NPV is positive

So at 17%

Yr	CF	DCF	at 18% DCF
1	3	2.564	2.542
2	4	2.922	2.873
3	4	2.497	2.435
4	5	2.668	2.579
5	6	2.737	2.623
6	3	1.1703	1.111
7	2	.666	.628
		15.224	14.790

NPV = TPV − I.O.

= 15.224 − 15

= .224

NP = 14.790 − 15

= −.21

$$IRR = 17 + \frac{.21}{.5} \times 1$$

$$\boxed{IRR = 17.41\%}$$

Sol. Que 6) Initial Investment = Rs 30 crore

Project X:

Years	CF (Rs)	CCF	DCF	Discounted CCF (DF = 11%)
1	500000	500000	450450.45	450450.45
2	700000	1200000	568135.70	1018586.15
3	850000	2050000	621512.67	1640098.83
4	940000	2990000	619207.12	2259305.94
5	1050000	4040000	623123.89	2882429.84
6	900000	4940000	481176.75	3363606.59

a) Pay Back Period (P) $= E + \frac{B}{C}$

$= 4 + \frac{30000000 - 2990000}{1050000}$

$= 4 + \frac{10000}{1050000}$

$= 4 + .010$

$= 4.01$ Years

b) Discounted Payback

$P = E + \frac{B}{C}$

$= 5 + \frac{3000000 - 2883429.84}{481176.75}$

$= 5 + \frac{117570.16}{481176.75}$

$= 5.24$ Years

Project Y

Years	CF (Rs)	CCF	DCF at 11%	CCF
1	500000	5,00,000	4,50,450.45	4,50,450.45
2	650000	11,50,000	527,554.58	9,78005.03
3	850000	20,00,000	6,21,512.67	15,99,517.71
4	1000000	30,00,000	658,730.97	22,58248.68
5	1100000	41,00,000	652,796.46	29,11,045.14
6	700000	48,00,000	374248.59	3285293.73

a) $P = E + \frac{B}{C}$

$= 4 + \frac{0}{1100000}$

$P = 4$ Years

b) Discounted Pay Back $P = E + \frac{B}{C}$

$P = 5 + \frac{3000000 - 2911045.14}{374248.59}$

$= 5 + \frac{88954.86}{374248.59}$

$P = 5.24$ Years

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(c) Net present value of Project X

Years	CF (Rs)	PV (at 11%)
1	500000	450,450.45
2	700000	568,135.70
3	850000	621512.87
4	940000	619,207.12
5	1050000	623,123.89
6	900000	481,176.75
	TPV	33,63,606.59

NPV = TPV − Initial Investment
= 33,63,606.59 − 3000000
NPV = Rs 363.606.59

NPV of Project-Y

Years	CF (Rs)	PV at 11%)
1	5,00,000	450,450.45
2	6,50,000	527553.58
3	8,50,000	621512.87
4	10,00,000	658730.97
5	11,00,000	652796.46
6	7,00,000	374248.59
		TPV = 3285293.73

NPV = 3285293.73 − 3000000
NPV = Rs 285293.74

(b) Profitability Index of Project X :-

$$PI = \frac{\text{Total of all present value of Future Cash Inflows}}{\text{Initial Investment}}$$

$$= \frac{33,63,606.59}{3000000}$$

$$PI = 1.121$$

Project Y :-

$$PI = \frac{32,85,293.73}{30,00,000}$$

$$PI = 1.095$$

or 1.10

(c) Internal Rate of Return (IRR)

Project X:

at the given discount rate PV of cash inflows comes positive.

Year	CF (Rs)	PV at 11% (given)	at 14%	at 15%
1	500000	450450.45	438596.49	434782.61
2	700000	568135.70	538627.27	529300.57
3	850000	621512.67	573725.79	558888.80
4	940000	619207.12	556555.46	537448.05
5	1050000	623123.89	545337.10	522035.57
6	900000	481176.75	410027.89	389094.83
		3363606.59	3062870.10	2971550.43

$$IRR = LDF\% + \left[\frac{LDPV - OI}{LDPV - HDPV} \times DDF\right]$$

where LDF = Discount factor of low trial

DDF = Difference between low discounting factor & high discounting factor

LDPV = PV of cash inflows at low dis factor trial

HDPV = PV of cash inflows at high discounting factor trial

OI = Original Investment.

$$IRR = 11 + \left[\frac{33,63,608.59 - 30,00,000}{33,63,608.59 - 29,71,550.43} \times (15\% - 11\%)\right]$$

$$= 11 + \left[\frac{363606.59}{392056.16} \times (4\%)\right]$$

$$= 11 + 3.71$$

$$\boxed{IRR = 14.71\%}$$

IRR of Project Y

Year	CF (Rs.)	PV at 11%	PV at 13%	PV at 14%
1	500000	450,450.45	442477.88	438596.49
2	650000	527554.58	509045.34	500153.89
3	850000	621512.67	589092.63	573725.79
4	1000000	658730.97	613318.73	592080.28
5	1100000	652796.46	597035.93	571305.53
6	700000	374248.59	336222.97	318910.58
	TPV	3285293.73	3087193.48	2994772.57

$$IRR = LDF\% + \left[\frac{LDPV - OI}{LDPV - HDPV} \times DDF\right]$$

$$= 11 + \left[\frac{3285293.73 - 3000000}{3285293.73 - 2974772.57} \times (14-11)\right]$$

$$= 11 + \left\{\frac{285293.73}{290521.16} \times 3\right\}$$

$$= 11 + 2.946$$

$$\boxed{IRR = 13.95\%}$$

Sol-7 (IRR of one Project)

First, we will calculate the PV of given cash flows at 10% discount rate.

Years	Cash Inflow (Rs)	PV at 10%	at 15% PV
1	70000	63363.36	60869.57
2	70000	57851.24	52930.06
3	70000	52592.04	46026.14
4	70000	47810.94	40022.73
5	70000	43464.49	34802.37
6	80000	45157.91	34586.21
7	100000	51315.81	37593.70
8	150000	69976.11	49035.27
9	100000	42409.76	28426.24
10	40000	15421.73	9887.39
		489636.40	394179.70

at 10% NPV is positive

& also 12%.

$$IRR = LDF\% + \left[\frac{LDPV - OI}{LDPV - HDPV} \times \Delta DF\right]$$

where LDF = Discount factor of Low trial

DDF = Difference between low discounting factor and High discounting factor

LDPV = PV of cash inflows at low discounting factor trial

HDPV = PV of cash inflows at high discounting factor trial

OI = Original Investment

So, IRR

$$= 10 + \left[\frac{489636.40 - 400000}{489636.40 - 394179.66} \times (15-10)\right]$$

$$= 10 + \left[\frac{89636.40}{95456.74} \times 5\right]$$

$$= 10 + 4.69$$

$$= 14.69 \text{ or } \boxed{14.7\%} \text{ IRR}$$

Sol-8 (Practice):- IRR

Investment Req = Rs 1000000 Cost of Capital = 11%

Year	CFI (Rs)	PV @ 11%	PV @ 15%
1	150000	135135.14	130434.78
2	250000	202905.61	189035.92
3	320000	233981.23	210405.19
4	300000	197619.29	171525.97
5	280000	166166.37	139209.49
6	220000	117620.98	95112.07
7	140000	67432.18	52631.19
	TPV =	1120860.81	988354.61

$$IRR = LDF\% + \left[\frac{LDPV - OI}{LDPV - HDPV} \times DF\right]$$

$$= 11 + \left[\frac{1120860.81 - 1000000}{1120860.81 - 988354.61} \times [15 - 11]\right]$$

$$= 11 + \left[\frac{120860.81}{132506.20} \times 4\right]$$

$$= 11 + 3.648$$

$$IRR = 14.648\%$$

Sol-9:- Initial Investment = Rs 500 000

Years	CF (Rs)	PV at 10%
1	100000	90909.09
2	200000	165289.3
3	300000	225394.4
4	100000	68301.35
	TPV	549894.13

NPV = TPV - Initial Investment

= 549894.13 - 500 000

= Rs 49894.13

$$PI = \frac{\text{PV of all Future cash inflows}}{\text{Initial cash outlay}}$$

$$= \frac{549894.13}{500000}$$

$$= 1.099$$

Accept the project as its profitability index is greater than one.

Q.No 10:- Initial Investment = Rs 1500000

Years	CF (Rs)	PV at 11% DF
1	170000	153153.15
2	290000	235370.51
3	370000	270540.81
4	440000	289841.63
5	500000	296725.66
6	380000	203183.52
7	240000	115598.02

TPV = Rs 1564393.30

NPV = TPV − Initial Inv.
= 1564393.30 − 1500000
= 64393.30

Since NPV is positive, the project should be accepted.

$$PI = \frac{\text{PV of all future cash inflows}}{\text{Initial cash outlay}}$$

$$= \frac{15,643930}{1500000}$$

$$= 1.04$$

Since PI is greather than 1, we should accept the project.