$\left[\left(\frac{50,000-1,000}{5}\right)-\frac{25,000}{10}\right]$ = ₹ 7,300

PBT = ₹ 7,700

Tax @ 30% = ₹ 2310 .....(ii)

Incremental CFAT (i + ii) = 12,690

Question – 28

A company has an old machine having book value zero – which can be sold for ₹ 50,000. The company is thinking to choose one from following two alternatives:

(i) To incur additional cost of ₹ 10,00,000 to upgrade the old existing machine.

(ii) To replace old machine with a new machine costing ₹ 20,00,000 plus installation cost ₹ 50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil.

The expected after tax profits for the above three alternatives are as under :

Year	Old existing Machine (₹)	Upgraded Machine (₹)	New Machine (₹)
1	5,00,000	5,50,000	6,00,000
2	5,40,000	5,90,000	6,40,000
3	5,80,000	6,10,000	6,90,000
4	6,20,000	6,50,000	7,40,000
5	6,60,000	7,00,000	8,00,000

The tax rate is 40 per cent.

The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent.

P.V.F. of 15%, 5 = 0.870, 0.756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

(SM TYK – 23)

Solution:

Option 1: Upgraded Machine

Calculation of NPV

	1	2	3	4	5
Upgrade					
PAT	5,50,000	5,90,000	6,10,000	6,50,000	7,00,000
(+) Depreciation	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
CFAT	7,50,000	7,90,000	8,10,000	8,50,000	9,00,000
(-) CFAT (old)	5,00,000	5,40,000	5,80,000	6,20,000	6,60,000
Incremental CFAT	2,50,000	2,50,000	2,30,000	2,30,000	2,40,000
(×) PVF	0.870	0.756	0.658	0.572	0.497

PVCI = 8,08,680

(-) PVCO = 10,00,000

NPV = (1,91,320)

Option 2: New Machine

	1	2	3	4	5
New Machine					
PAT	6,00,000	6,40,000	6,90,000	7,40,000	8,00,000
(+) Depreciation $\frac{20,50,000}{5}$	4,10,000	4,10,000	4,10,000	4,10,000	4,10,000
CFAT	10,10,000	10,50,000	11,00,000	11,50,000	12,10,000
(-) CFAT (old)	5,00,000	5,40,000	5,80,000	6,20,000	6,60,000
Incremental CFAT	5,10,000	5,10,000	5,20,000	5,30,000	5,50,000
(×) PVF	0.870	0.756	0.658	0.572	0.497

Working Note 1:

Sale of old machine

Sale consideration = 50,000

(-) B.V. = 0

Capital gain = 50,000

Tax @ 40%	= 20,000
	= 30,000
PVCI	= 17,47,930
(-) PVCO	= 20,20,000 [20,50,000 – 30,000]
NPV	= (2,72,070)

Since NPV is negative in both option, hence old machine without up gradation is better

Question – 29

A machine used on a production line must be replaced at least every four years. Costs incurred to run the machine according to its age are:

Age of the Machine (years)					
	0	1	2	3	4
Purchase price (in ₹)	60,000				
Maintenance (in ₹)		16,000	18,000	20,000	20,000
Repair (in ₹)		0	4,000	8,000	16,000
Scrap Value (in ₹)		32,000	24,000	16,000	8,000

Future replacement will be with identical machine with same cost. Revenue is unaffected by the age of the machine. Ignoring inflation and tax, determine the optimum replacement cycle. PV factors of the cost of capital of 15% for the respective four years are 0.8696, 0.7561, 0.6575 and 0.5718.

(SM TYK – 26)

Solution:

Working Notes

First of all, we shall calculate cash flows for each replacement cycle as follows:

One year replacement cycle ₹

Year	Replacement Cost	Maintenance & Repair	Residual Value	Net Cash Flow
0	(60,000)	-	-	(60,000)
1	-	(16,000)	32,000	16,000

Two years replacement cycle ₹

Year	Replacement Cost	Maintenance & Repair	Residual Value	Net Cash Flow
0	(60,000)	-	-	(60,000)
1	-	(16,000)	-	(16,000)
2	-	(22,000)	24,000	2,000

Three years replacement cycle ₹

Year	Replacement Cost	Maintenance & Repair	Residual Value	Net Cash Flow
0	(60,000)	-	-	(60,000)
1	-	(16,000)	-	(16,000)
2	-	(22,000)	-	(22,000)
3	-	(28,000)	16,000	(12,000)

Four years replacement cycle ₹

Year	Replacement Cost	Maintenance & Repair	Residual Value	Net Cash Flow
0	(60,000)	-	-	(60,000)
1	-	(16,000)	-	(16,000)
2	-	(22,000)	-	(22,000)
3	-	(28,000)	-	(28,000)
4	-	(36,000)	8,000	(28,000)

Now we shall calculate NPV for each replacement cycles

		1 Year		2 Years		3 Years		4 Years	
Year	PVF @ 15%	Cash Flows	PV	Cash Flows	PV	Cash Flows	PV	Cash Flows	PV
0	1	-60,000	-60,000	-60,000	-60,000	-60,000	-60,000	-60,000	-60,000
1	0.8696	16,000	13,914	-16,000	-13,914	-16,000	-13,914	-16,000	-13,914
2	0.7561	-	-	2,000	1,512	-22,000	-16,634	-22,000	-16,634
3	0.6575	-	-	-	0	-12,000	-7,890	-28,000	-18,410
4	0.5718	-	-	-	0		0	-28,000	-16,010
			-46,086		-72,402		-98,438		-1,24,968

Replacement Cycle		EAC (₹)
1 Year	$\frac{46,086}{0.8696}$	52,997
2 Years	$\frac{72,402}{1.6257}$	44,536
3 Years	$\frac{98,438}{2.2832}$	43,114

4 Years	$\frac{1,24,968}{2.855}$	43,772

Since EAC is least in case of replacement cycle of 3 years hence machine should be replaced after every three years.

Note: Alternatively, Answer can also be computed by excluding initial outflow as there will be no change in final decision.

Question – 30

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

(SM TYK – 25)

Solution:

Calculation of NPV

	Year	PVF (10%)	Replace New		Replace on year	
			Amount	P.V.	Amount	P.V.
Cash outflows						
Cost of new machine	0	1.000	1,50,000	1,50,000	-	-
	1	0.909	-	-	1,50,000	1,36,350
Sale of old machine	0	1.000	(80,000)	(80,000)	-	-
	1	0.909	-	-	(70,000)	(63,630)
Total (A)				**70,000**		**72,720**
Cash inflows						
CFAT	1-3	2.487	80,000	1,98,960	-	-
	1	0.909	-	-	40,000	36,360
	2-4	2.261	-	-	80,000	1,80,880
Total (B)				**1,98,960**		**2,17,240**
NPV (B-A)				1,28,960		1,44,520

Machine should be replaced in year 1 due higher NPV.

Question – 31

X Ltd. is a taxi operator. Each taxi cost to company ₹ 4,00,000 and has a useful life of 3 years. The taxi's operating cost for each of 3 years and salvage value at the end of year is as follows:

	Year 1	Year 2	Year 3
Operating Cost	₹ 1,80,000	₹ 2,10,000	₹ 2,38,000
Resale Value	₹ 2,80,000	₹ 2,30,000	₹ 1,68,000

You are required to determine the optimal replacement period of taxi if cost of capital of X Ltd. is 10%.

Solution:

NPV if taxi is kept for 1 Year

= – ₹ 4,00,000 + ₹ 1,00,000 (0.909)

= – ₹ 3,09,100

NPV if taxi is kept for 2 Year

= – ₹ 4,00,000 – ₹ 1,80,000 × 0.909 + ₹ 20,000 × 0.826

= – ₹ 5,47,100

NPV if taxi is kept for 3 Year

= – ₹ 4,00,000 – ₹ 1,80,000 × 0.909 – ₹ 2,10,000 × 0.826 – ₹ 70,000 × 0.751

= – ₹ 7,89,650

Since above NPV figures relate to different periods, there are not comparable. to make them comparable we shall use concept of EAC as follows:

EAC of 1 year

$$\frac{3,09,100}{0.909} = ₹\ 3,40,044$$

EAC of 2 year

$$\frac{5,47,100}{1,735} = ₹\ 3,15,331$$

EAC of 3 year

$$\frac{7,89,650}{2,486} = ₹\ 3,17,639$$

Since lowest EAC incur if taxi for 2 year; Hence the optimum replacement cycle to replace taxi in 2 years.

Question – 32

Trouble Free Solutions (TFS) is an authorized service center of a reputed domestic air conditioner manufacturing company. All complaints/service related matters of Air conditioner are attended by this service center. The service center employs a large number of mechanics, each of whom is provided with a motor bike to attend the complaints. Each mechanic travels approximately 40,000 kms per annum. TFS decides to continue its present policy of always buying a new bike for its mechanics but wonders whether the present policy of replacing the bike every three year is optimal or not. It is of believe that as new models are entering into market on yearly basis, it wishes to consider whether a replacement of either one year or two years would be better option than present three year period. The fleet of bike is due for replacement shortly in near future.

The purchase price of latest model bike is ₹ 55,000. Resale value of used bike at current prices in market is as follows:

Period	**₹**
1 Year old	35,000
2 Year old	21,000
3 Year old	9,000

Running and Maintenance expenses (excluding depreciation) are as follows:

Year	Road Taxes Insurance etc. (₹)	Petrol Repair Maintenance etc. (₹)
1	3,000	30,000
2	3,000	35,000
3	3,000	43,000

Using opportunity cost of capital as 10% you are required to determine optimal replacement period of bike.

(SM TYK – 27)

Solution:

NPV if Bike is kept for 1 Year

= – ₹ 55,000 + ₹ 2,000 (0.909)

= – ₹ 53,182

NPV if Bike is kept for 2 Year

= – ₹ 55,000 – ₹ 33,000 × 0.909 – ₹ 17,000 × 0.826

= – ₹ 99,039

NPV if Bike is kept for 3 Year

= – ₹ 55,000 – ₹ 33,000 × 0.909 – ₹ 38,000 × 0.826 – ₹ 37,000 × 0.751

= – ₹ 1,44,172

EAC of 1 year

$\frac{53,182}{0.909}$ = ₹ 58,506

EAC of 2 year

$\frac{99,039}{1,735}$ = ₹ 57,083

EAC of 3 year

$\frac{1,44,172}{2,486}$ = ₹ 57,993

Thus, from above table it is clear that EAC is least in case of 2 years, hence bike should be replaced every two years.

Question – 33

A & Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Co. currently pays no taxes. The replacement machine costs ₹ 90,000 now and requires maintenance of ₹ 10,000 at the end of every year for eight years. At the end of eight 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:

Year	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 A & Co. is 15%.

Required:

When should the company replace the machine?

(Notes: Present value of an annuity of Re. 1 per period for 8 years at interest rate of 15% : 4.4873; present value of Re. 1 to be received after 8 years at interest rate of 15% : 0.3269).

(SM TYK – 22)

Solution:

A & Co.

Equivalent cost of (EAC) of new machine

		₹
(i)	Cost of new machine now	90,000
	Add: PV of annual repairs @ ₹ 10,000 per annum for 8 years (₹ 10,000 × 4.4873)	44,873
		1,34,873
	Less: PV of salvage value at the end of 8 years (₹ 20,000 × 0.3269)	6,538
		1,28,335
	Equivalent annual cost (EAC) (₹ 1,28,355/4.4873)	28,600

PV of cost of replacing the old machine in each of 4 years with new machine

Scenario	Year	Cash Flow	PV @ 15%	PV
		₹		₹

Replace Immediately	0	(28,600)	1.00	(28,600)
		40,000	1.00	40,000
				11,400
Replace in one year	1	(28,600)	0.870	(24,882)
	1	(10,000)	0.870	(8,700)
	1	25,000	0.870	21,750
				(11,832)
Replace in two years	1	(10,000)	0.870	(8,700)
	2	(28,600)	0.756	(21,622)
	2	(20,000)	0.756	(15,120)
	2	15,000	0.756	11,340
				(34,102)
Replace in three years	1	(10,000)	0.870	(8,700)
	2	(20,000)	0.756	(15,120)
	3	(28,600)	0.658	(18,819)
	3	(30,000)	0.658	(19,740)
	3	10,000	0.658	6,580
				(55,799)
Replace in 4 years	1	(10,000)	0.870	(8,700)
	2	(20,000)	0.756	(15,120)
	3	(30,000)	0.658	(19,740)
	4	(28,600)	0.572	(16,359)
	4	(40,000)	0.572	(22,880)
				(82,799)

Advice: The company should replace the old machine immediately because the PV of cost of replacing the old machine with new machine is least.

RESIDUAL

Question – 34

Jumble Consultancy Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows:

Cash Flow in ₹	-15,000	-10,000	-4,000	0	15,000	10,000	5,000	1,000
Utilities	-100	-60	-3	0	40	30	20	10

The distribution of cash flows of project A and Project B are as follows:

Project A

Cash Flow (₹)	-15,000	-10,000	15,000	10,000	5,000
Probability	0.10	0.20	0.40	0.20	0.10

Project B