5.1 Fundamentals of Replacement Analysis

→ Replacement analysis is carried out when there is a need to replace the current owned equipment or any assets.

→ Concepts of Replacement analysis refers to selection of similar but new assets to replace the existing assets to meet the current and future requirement more economically.

(defender → old asset challenger → new asset)

Reasons for Replacement

(1) Deterioration: loss of value due aging
(2) obsolescence: outdated or no longer used
(3) Inadequacy: lacking the quality
(4) Depletion: Gradual loss of mv
(5) physical impairment: wear and tear due to chemical changes.

Approaches for comparing Defender and Challenger

(a) Cash flow approach
(b) Opportunity cost approach.

(a) Cash flow approach (purna bechekeo kharcha garera naya samman kinne)

→ Treat the proceeds from sale of the old machine as down payment towards purchasing the new machine.

→ Use NPW or AB analysis to decide.

(b) Opportunity cost Approach

→ Treat the proceeds from sale of the old machine as the investment requirement to keep the old machine.

(Bechekeo bhaya ko akune jun paisa cha teitai purano machine ma invest garne)

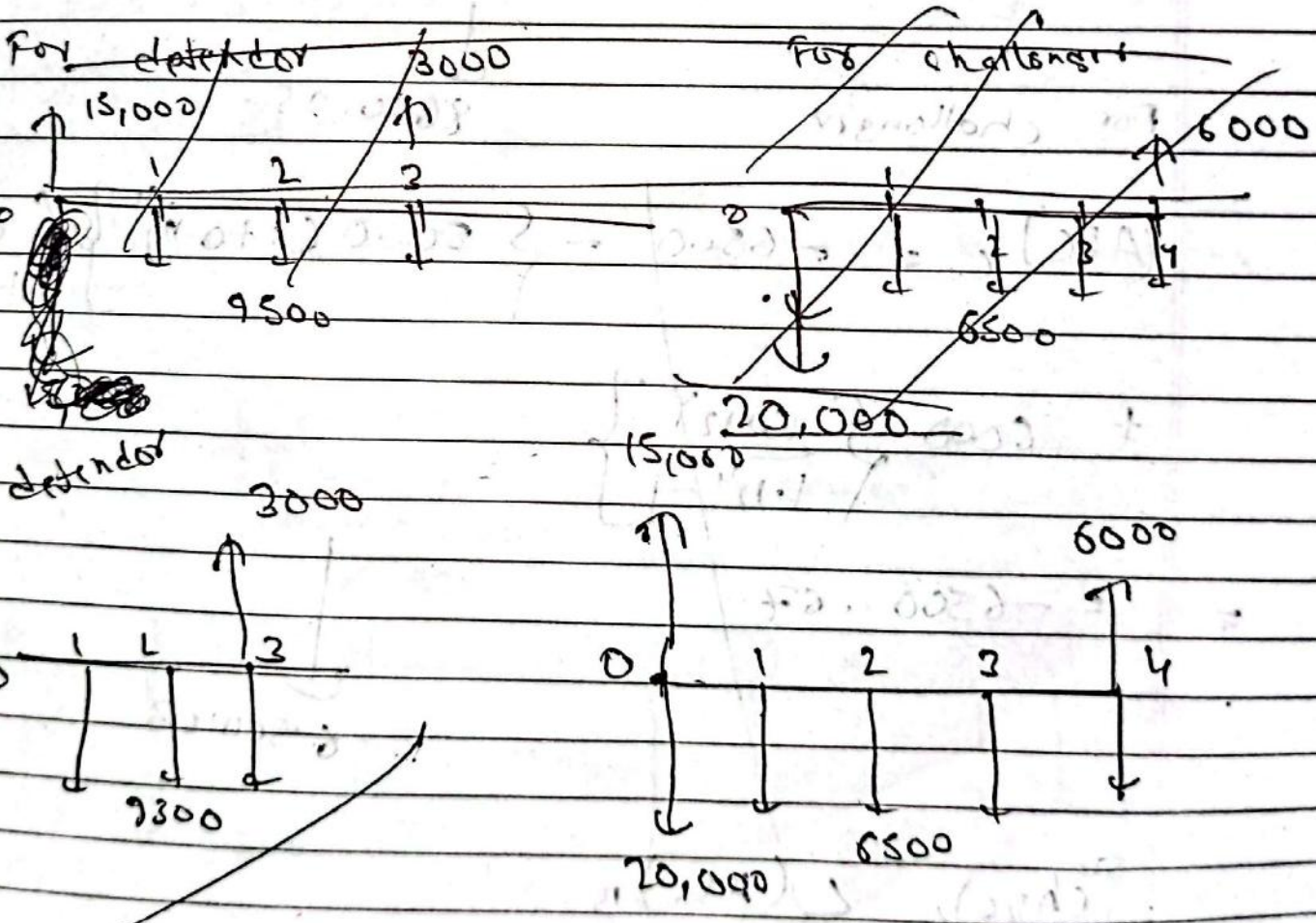
For the replacement analysis of an assest of a company the following information is available. By using cash flow approch decide whether replacement is justified or not take MARR = 12%.

Soln:

(2)

Defender		Challenger	
MP	Rs 15000	IC	Rs 20,000
n	3 yrs	n	= 4 yrs
SV	Rs 3000	SV	= 6000
OM	Rs. 9500	OM	= 6500

Soln:-



Cash flow diagram:-

15,000 use some may ma Invest garna is cash flow approach

(4)

Now find AEC of both:

for defender:

$(AEC)_D = -9500 + 3000\,(A|F, 9\%, n)$

$= -9500 + 3000 \times \left[\dfrac{0.12}{1.12^8 - 1}\right]$

$= -8610.95$

↓ 8610.95

for challenger

$(AEC)_C = -6500 - \{5000(1+0.12)^4\}\left(\dfrac{0.12^4}{1.12^4 - 1}\right)$

$+ 6000\left\{\dfrac{0.12^4}{1.12^4 - 1}\right\}$

$= -6500.67$

↓ 6500.67

So $(AEC)_C < (AEC)_D$

So, we replace defender by challenger.

(5)

for challenger

$(AEC)_C$

$= -6500 + 1867$

$= -6890.76$

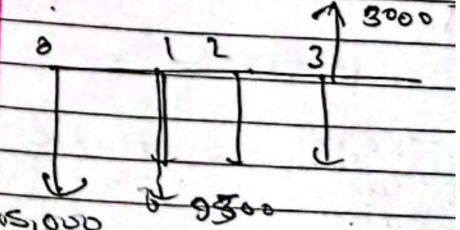
$<$

$(AEC)_C$ $(AEC)_D$

So replace defen

Now by opportunity

(→ market price

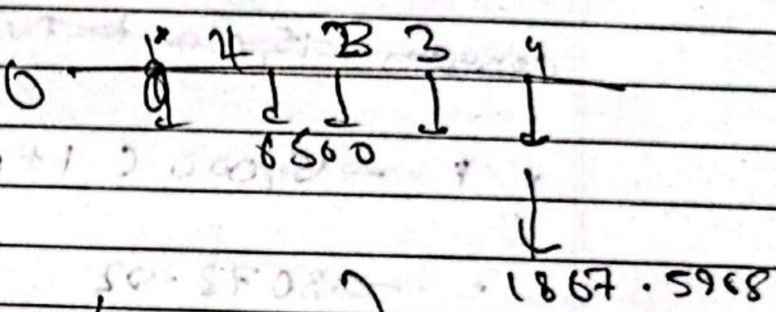


for defender

(3)

for challenger

$(ABC)_C$



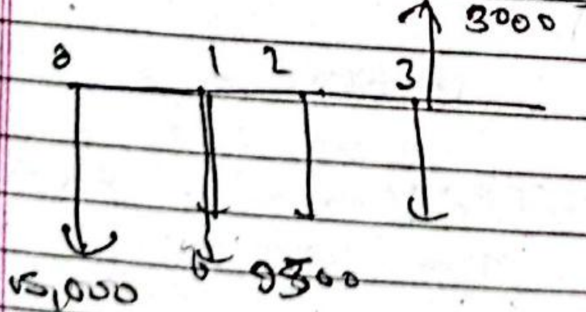
$= -6500 + 1867.5968 \left(\frac{0.12}{1.12^4 - 1} \right)$

$= ₹ -6890.76$

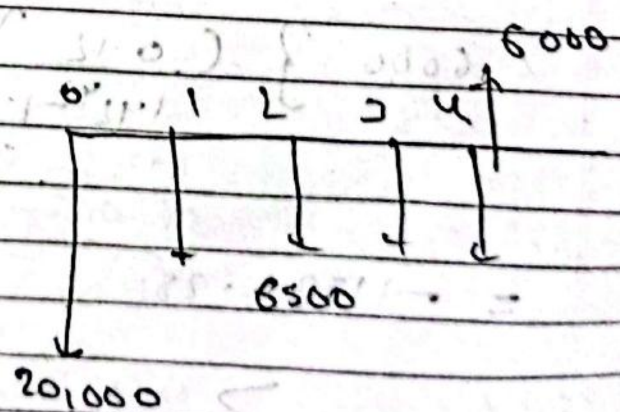
$(ABC)_C < (ABC)_D$

So replace ~~defencer~~ defender by challenger.

Now by opportunity cost approach #
(→ Invest at defender market price)



for defender



For defender

~~Capital 15,000 to PW~~

$= P - 15{,}000(1+0.12)^8 + 3000$

$= -18073.02$

(A|P)

Now

$(AEC)_D = -9500 - 18073.02\left[\frac{0.12}{1.12^3 - 1}\right]$

$= -14856.18$

For challenger

$(AEC)_C = -6500 + \{-20{,}000 \times 1.12^4 + 6000\}\left(\frac{0.12}{1.12^{12}-1}\right)$

$= -11829.28$

$(AEC)_D > (AEC)_C$

~~keep defender~~ replace defender by challenger

A Determine the replac
challenger with the
when MARR is 12

Year	Defender
0	5000
1	1700
2	2000
3	2500

first find $(AEC)_D$

Now, for defender

$FW = -5000(1.12^3) - 2500$

$= -13897.12$

$(AEC)_D = -13897.12$

$(AEC)_C = -13196.16$

$(AEC)_C < (AEC)_D$

so replace D

(7)

Determine the replacement between defender and challenger with the following cost information when MARR is 12%

Year	Defender	Challenger
0	5000	7500
1	1700	500
2	2000	1100
3	2500	1300

cost → 13696.18

just find $(AEC)_D$ and $(AEC)_C$

all cost

Now, for defender

$FW = -5000 - 1700 \times 1.12^{-3} - 2000 \times 1.12^{-2} - 2500 \times 1.12^{-1}$

$= -13897.12$

$(AEC)_D = -13897.12 \times \frac{0.12}{1.12^3 - 1} = -4117.50$

$(AEC)_C = -13696.18 \times \frac{0.12}{1.12^3 - 1} = -4058.84$

$(AEC)_C < (AEC)_D$

so replace D by C

(8)

Replacement Analysis under the finite planning horizon (PW approach)

(1) Calculate AWD and AWC over study period. Slect lowest AW

(2) It is necessary to develop all viable defender challenger combinations and calculate AW or PW for each one over study period.

(3) Select option with lowest ~~cost~~ cost or highest income.

~~[redacted]~~

The annual Equivalent cost of defender and challenger are given in the table below, what is the best replacement strategy? Use MARR = 10%. The planning horizon of the project is 8 years.

EOY (N)	1	2	3	4	5	6
(AEC)D	5400	5200	5500	5700	6200	6600
(AEC)C	7700	6200	5700	5600	5680	5900

Defender least cost 2 ma cha → Economic service life

challenger least cost 4 ma cha

make combination so that (defender lai min 2 yrs chalaune, challenger lai 4 yrs chalaune min)

(make at least 3-4 combinations)

Now,

ESL of Defender = 2

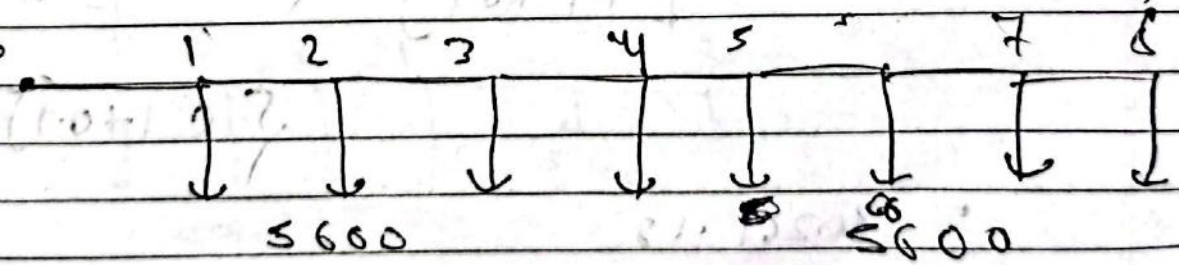
ESL of challenge = 4

Defender 2xD

challenge — 4

challenger — 4

Option 1 (0,0), (C,4), (C,4) (challenger ko year 4 lai some camma 4 rppa at)



PW = -5600 (P/A, 9%, 4)

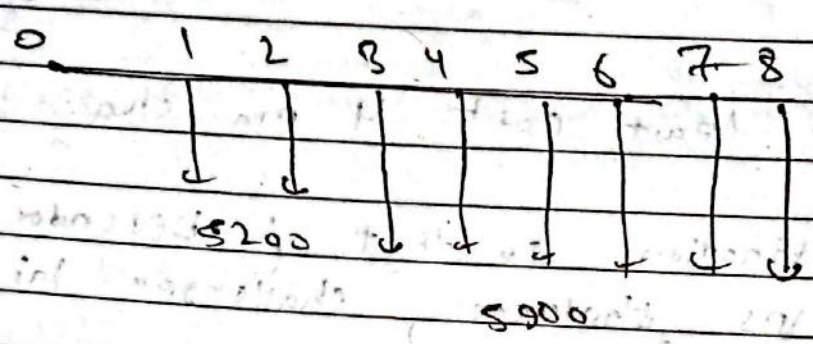
= -29875.58

(All negative so sign not taken here)

(8 years ko lagi same parcha)

(16)

Option 2; (0,2) (6,6)

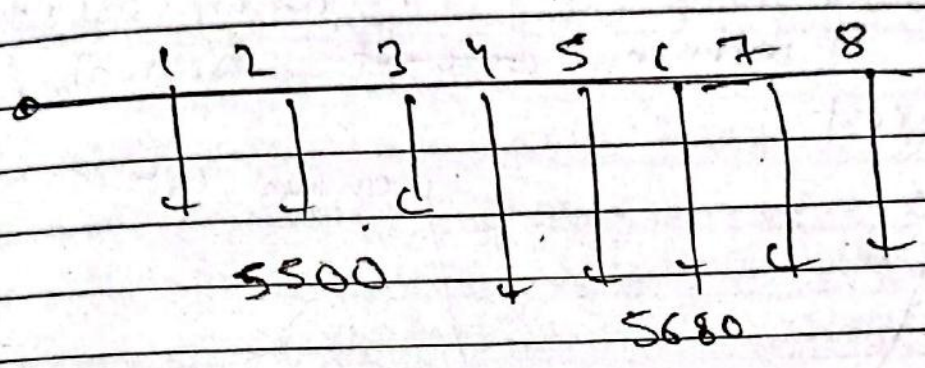


$$PW = 5200\left[\frac{1.1^2-1}{1.1^2\times 0.1}\right]\left[\frac{1.1^2-1}{0.1}\right] + 5900$$

$$PW = 5200\left[\frac{1.1^2-1}{1.1^2\times 0.1}\right] + \left\{5900\left[\frac{1.1^6-1}{0.1}\right]\right\}\left\{(1+0.1)^{-8}\right\}$$

$$= 30261.18$$

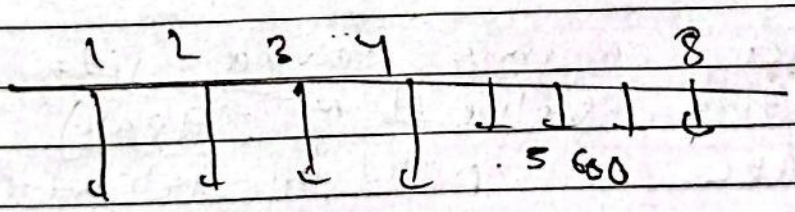
option 3 : (D,3) ((,5)



$$PW = 5500\left(\frac{1.1^3-1}{1.1^3\times 0.1}\right) + \left\{5680\left[\frac{1.1^5-1}{0.1}\right]\right\}\left\{(1+0.1)^{-8}\right\}$$

$$= 29854.74$$

option 4 : (D,4) ((,4)



PW = 30,193

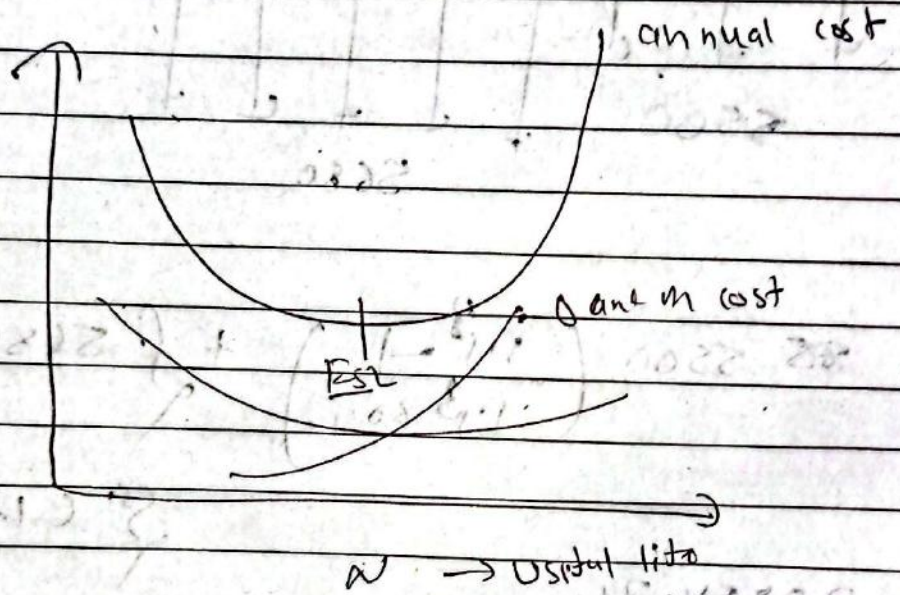
option 3 (D,3) ((,5) is selected

Since this is at cost we select the combination at lowest cost. ~~Investment~~ having highest ~~investment~~ income. income

(12) 4/11/22

Economic service life

→ It is the remaining useful life of an asset that resolves in minimum ~~amount~~ annual equivalent cost.



$$AEC = CR + OC \quad \text{— (i)}$$

CR → capital recovery

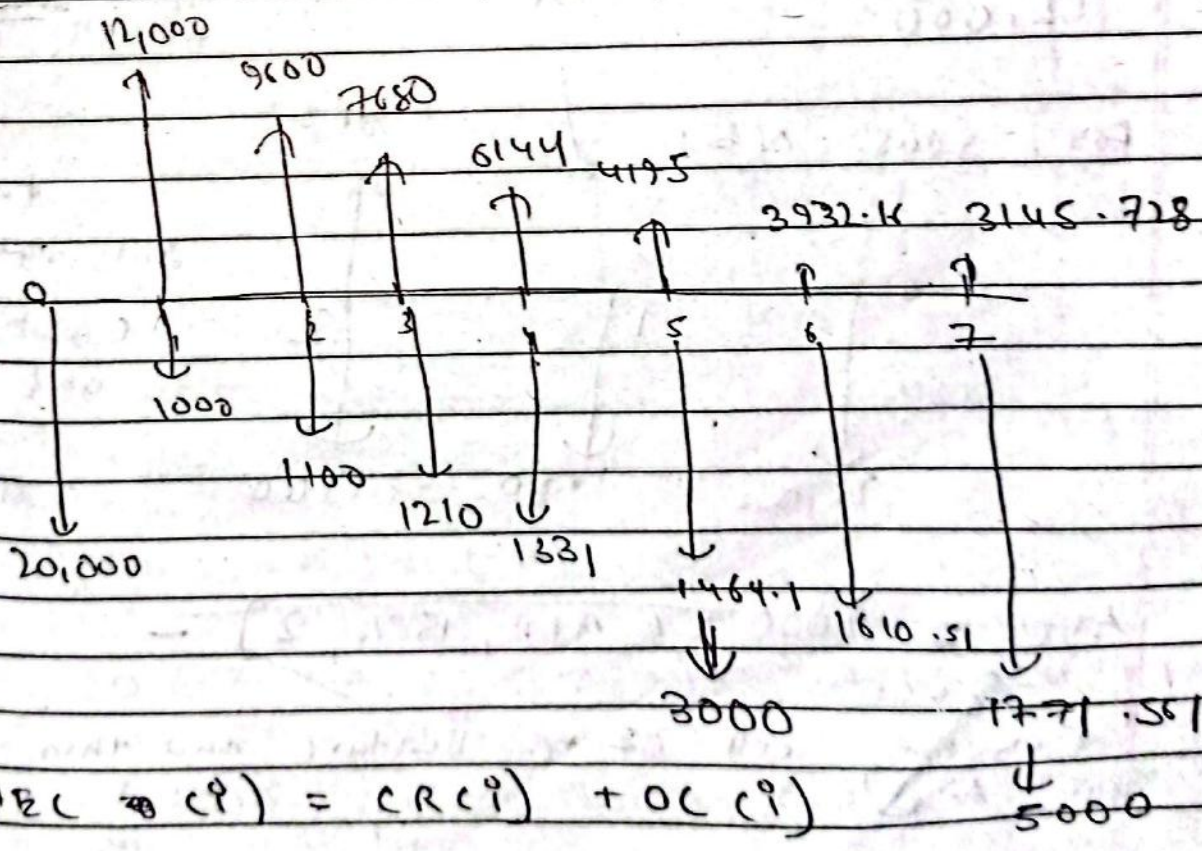
OC → Operating cost

To get exact economic service life we need to find value of N (years) has minimized AEC as expressed in eqn — (i)

(13)

Find the economic service life of a new electric lift truck which costs $ 20,000 has a operation cost $1000 in 1st year and SV of $12000 at the end of 1st year. For the remaining years, O.C increase by 10% each year over previous year O.C similarly S.V declines every year by 20% of previous year S.V. the lift truck has a minimum life of 7 yrs. An overhaul costing $3000 and $5000 will be required during 5th and 7th year of service. The firms require rate of return is 15% per year. (8)

Soln:

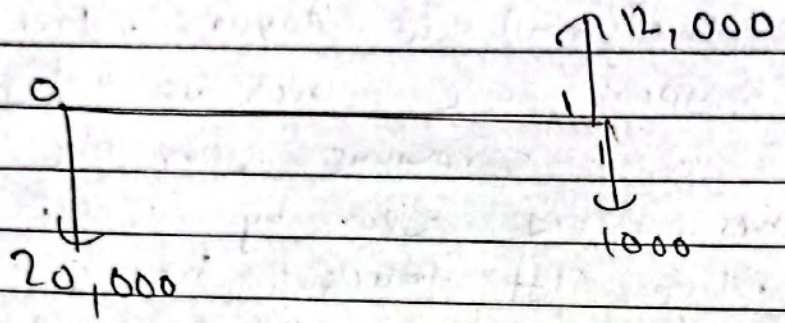


AEC (9) = CR(9) + OC(9)

(14)

For year N = 1

AEC (15%) = CRC (15%) + OC (15%)

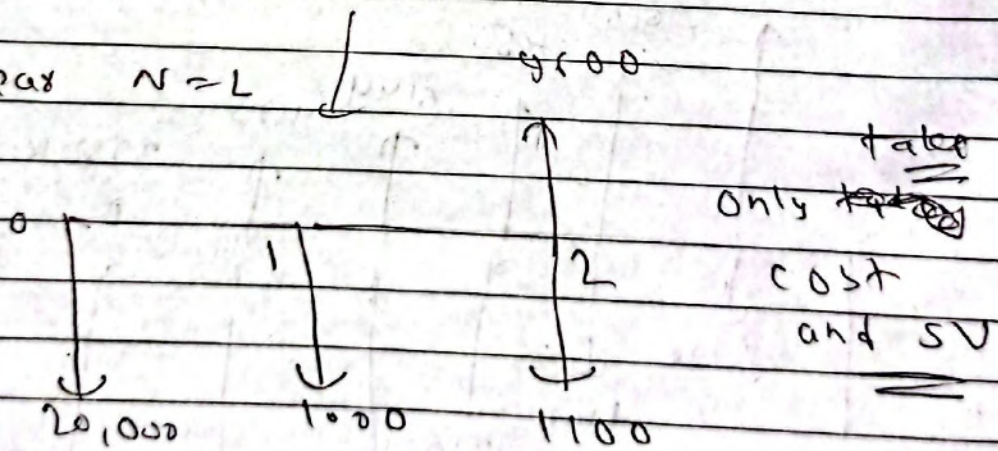


AEC (15%) = 20,000 (A|P, 15%, 1) − 12,000 (A|F, 15%, 1) + 1000 (A|F, 15%, 1)

= 12,000

1st year of SV of machine 2 nd

for year N = 2



take only cost and SV

AEC = 20,000 (A|P, 15%, 2) − 3600

(convert all CF to future and then to A)

(15) ((converting everything to FW and AW ma sarda hunchq)

$= 20,000 \times 1.15^2 + 1000 \times 1.15 + 1100 - 960$

$= 19100$

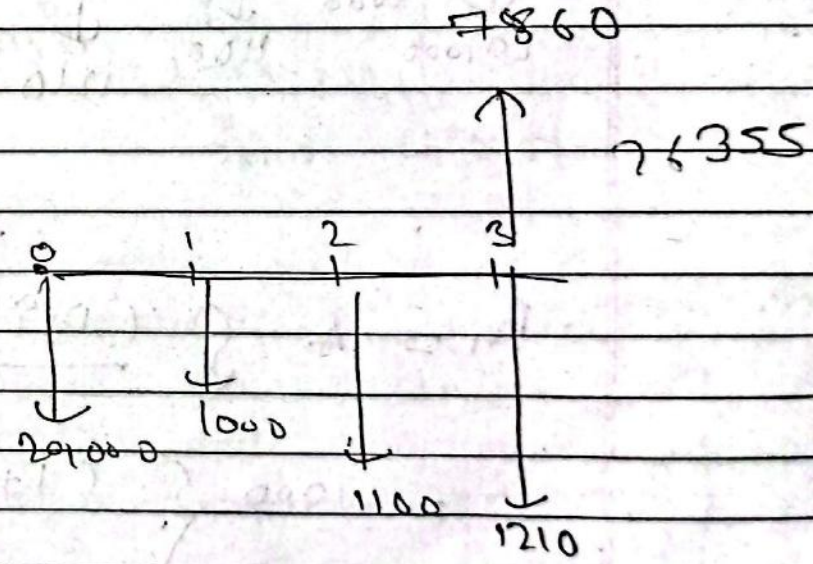
$(AFC)_2 = 19100\ (A/F, 15\%, 2)$

$= 19100 \left[\frac{0.15}{1.15^2 - 1}\right]$ (A/P →

$= 8883.72$

Similarly

Now, $N = 3$



$(AEC)_3 = CR + OM$

$= 20,000\ (A/P, 15\%, 3) - 7860\ (A/F, 15\%, 3)$

$+ (1000 \times 1.15^2 + 1100 \times 1.15 + 1210)(A/F, 15\%, 3)$

$= 7589.63$

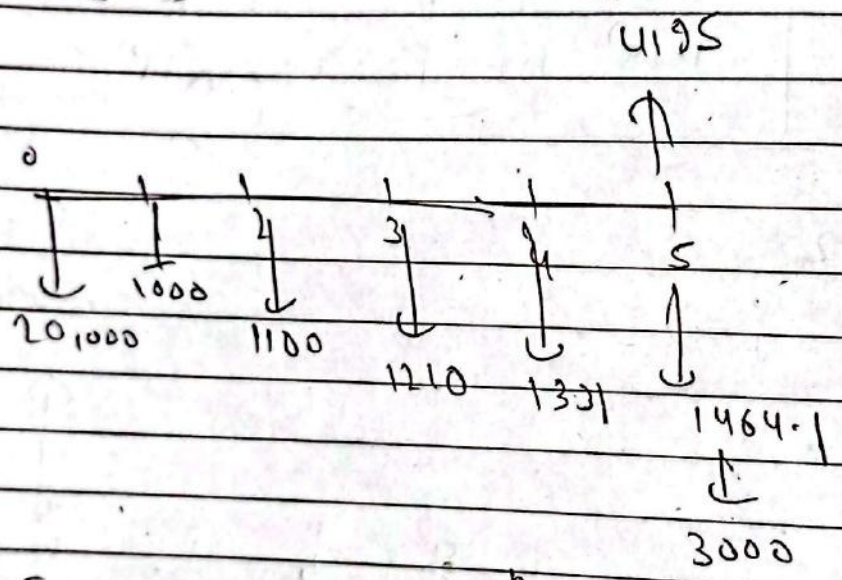
(16)

for year N=4

AEC = $9[1.0]$

For year N=5

AEC =



$$F_n = A\left\{\frac{(1+i)^n - (1+s)^n}{i-s}\right\}$$

$$= 1000\left\{\frac{(1+0.15)^5 - (1+0.1)^5}{0.15-0.1}\right\}$$

$$= 8016.94$$

~~8016.94~~

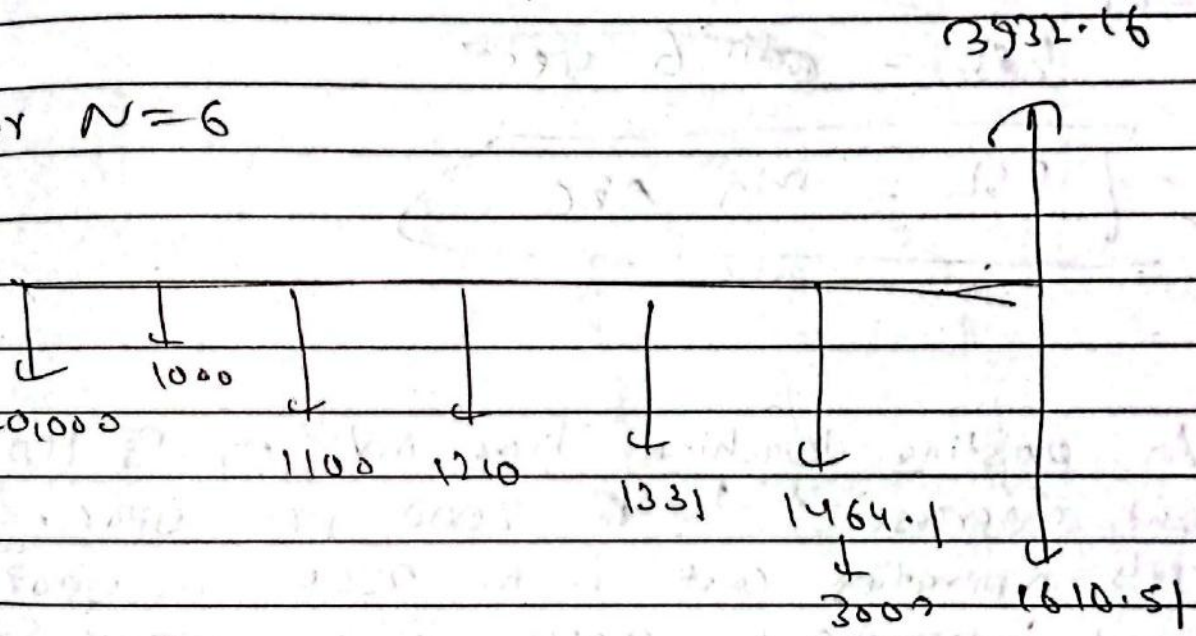
O/M (PW)$_{mc}$ = 8016.94 + 3000

= 11016.94

$(ARC)_5 = 20,000\ (A|P, 15\%, 5) - 4193\ (A|F, 15\%, 5) + 11016.94\ (A|F, 15\%, 5)$

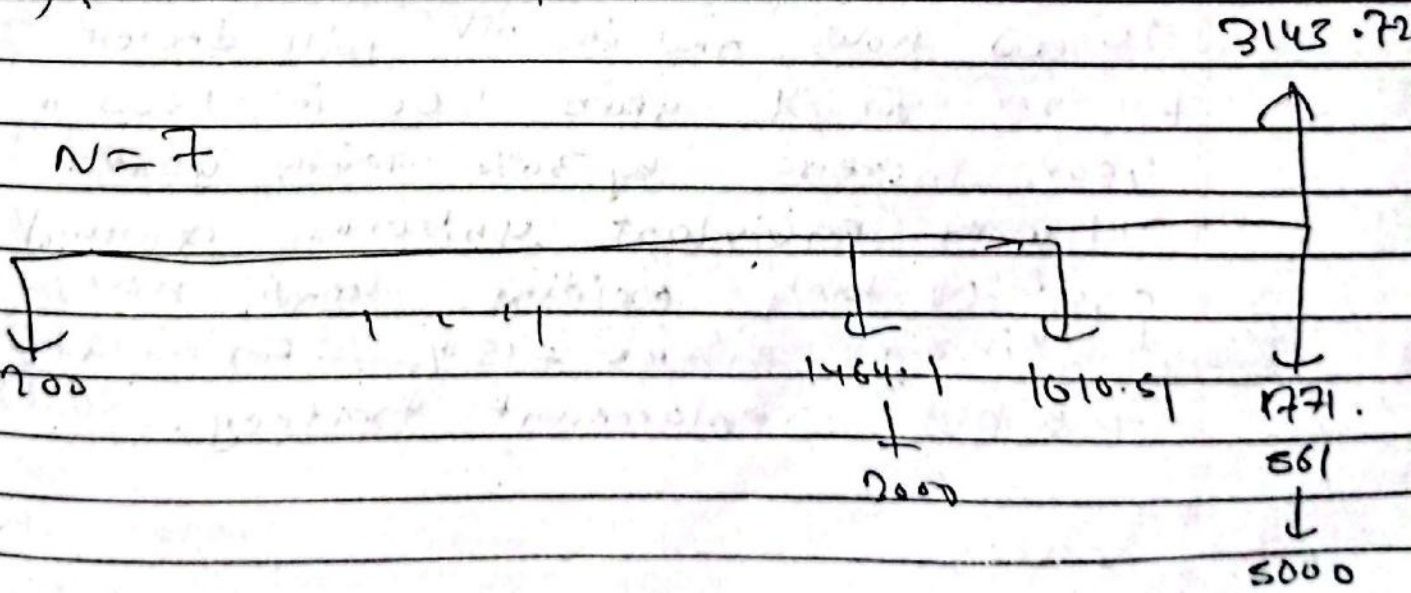
$= 6978.11$

For $N=6$



$(ARC)_6 = 6466.84$

For $N=7$



$(ARC)_7 = 6618.73$

(8)

(AEC) decreases from N=18 to.

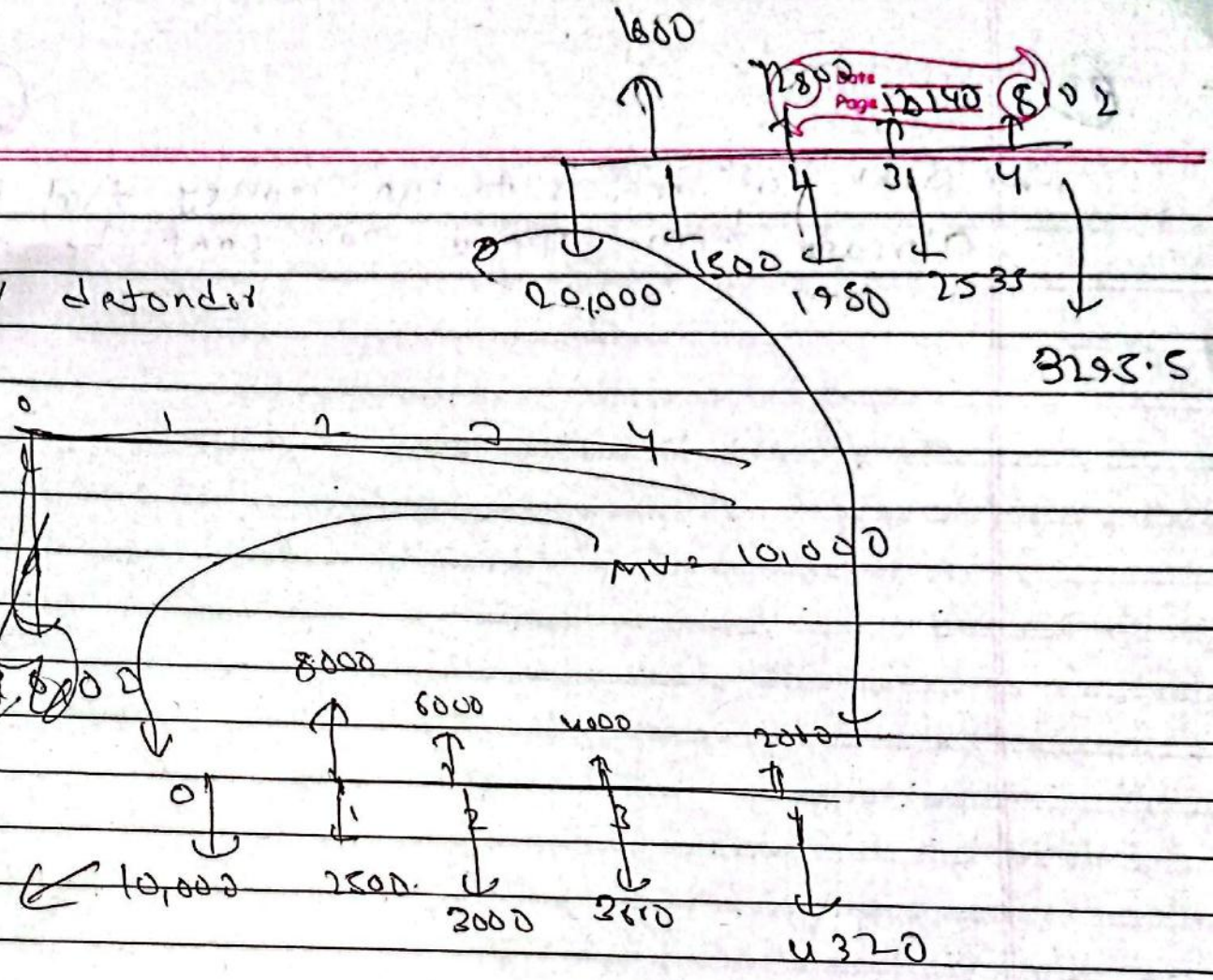
Hence
minimum AEC at 6th year

So,
ESL = 6 year

ESL = min AEC

An existing machine has MV of Rs 10000 and decreases by Rs 2000 per year. Its operating cost is Rs 2500 in year 1 and increased by 20% each year for 4 years. New machine costs Rs 20,000 now and its MV will decrese 20% per yer for 4 years. OC in 1500 in 1st year increase by 30% each year. Calculate equivlant uniform annual cost of both existing and new machine. MARR = 15%. For mulate the best replacement strategy.

(4)



So/n:-

For defender

MV ko sell cost

AEC for	N=1	N=2	N=3	N=4
	= 6000	8093.02	6210.22	6352.36

For new machine

N=1	N=2	N=3	N=4
~~8500~~ 8500	8058.4	7757.74	7581.85

Form bohi

ESL of defender = 1 year

ESL of challenger = 4 year

AEC for challenger > AEC of defender for ESL

Max AEC of defender < AEC of challenger for ESL

(no need to replace defender)

(20)

→ Sunk cost refers to the money that has already been spend and cant be removed #