• Economic Decision-Making Simplicity: Since the value of money remains constant over the period, comparison between maintenance cost and replacement cost becomes easier and more accurate.

Limitations of Replacing Equipment with Increasing Maintenance Costs (When Money Value Remains Constant):

- **High Initial Capital Requirement**: Replacement requires a large lump-sum investment, which may strain financial resources.
- **Possible Under-utilization of Existing Asset**: The old equipment may still have usable life left, leading to premature disposal and loss of remaining value.
- **Installation and Transition Costs**: Additional costs such as installation, training, and setup may increase total replacement expense.
- **Uncertainty of New Equipment Performance**: The new item may not perform exactly as expected, leading to operational risks.
- **Disruption During Replacement**: Production or operations may be temporarily interrupted during the replacement process.

CLASS 19

Question 5:

A company purchases a machine for 10,000 Rs. The expected maintenance costs and scrap values for each year are given below:

Year	Maintenance Cost (Rs)	Scrap Value (Rs)
1	1000	8000
2	1500	6500
3	2200	4000
4	3200	2000
5	4500	0

Determine the optimal year to replace the machine to minimize the average cost per year, assuming the value of money remains the same.

Solution 5:

Given that a company purchases a machine for 10,000 Rs. Also, the expected maintenance costs and scrap values for each year are given as:

Year	Maintenance Cost (Rs)	

		Scrap Value (Rs)
1	1000	8000
2	1500	6500
3	2200	4000
4	3200	2000
5	4500	0

Step 1: We identify the given data and formula

We are given a machine with purchase cost C = 10,000 Rs. The maintenance costs and scrap values for each year are given in the table. Let n be the number of years the machine is used.

The average cost per year (AC) is calculated by the formula:

$$AC = \frac{TC}{n} = \frac{C + \Sigma M - S}{n}$$

Where, ΣM is the total maintenance cost over n years and S is the scrap value at the end of n years. We have to calculate AC for each year and find the year with minimum average cost.

Step 2: We calculate total maintenance cost

We find the cumulative/total maintenance cost for each year:

Year (n)	Total Maintenance Cost (ΣM)
1	1000
2	1000 + 1500 = 2500
3	2500 + 2200 = 4700
4	4700 + 3200 = 7900
5	7900 + 4500 = 12400

Step 3: We calculate the Total Cost (TC) for each year.

We use the formula:

$TC = C + \Sigma M - S$

Where, C = 10,000, ΣM refers to the total maintenance cost and S refers to the scrap value.

Now we calculate for each year:

Year (n)	Total Maintenance Cost (ΣM)	Scrap Value (S)	C + ΣM	Total Cost (TC = C + ΣM − S)
1	1000	8000	10000 + 1000 = 11000	11000 − 8000 = 3000
2	2500	6500	10000 + 2500 = 12500	12500 − 6500 = 6000
3	4700	4000	10000 + 4700 = 14700	14700 − 4000 = 10700
4	7900	2000	10000 + 7900 = 17900	17900 − 2000 = 15900
5	12400	0	10000 + 12400 = 22400	22400 − 0 = 22400

Step 4: We calculate the Average Cost (AC) for each year.

We use the formula:

$$AC = \frac{TC}{n}$$

Now we calculate for each year:

Year (n)	Total Cost (TC)	Average Cost $\left(AC = \frac{TC}{n}\right)$
1	3000	$\frac{3000}{1} = 3000$
2	6000	$\frac{6000}{2} = 3000$
3	10700	$\frac{10700}{3} = 3566.66 \approx 3567$
4	15900	$\frac{15900}{4} = 3975$
5	22400	$\frac{22400}{5} = 4480$

Step 5: We compare the Average Costs

The minimum average cost is 3000 Rs.

It occurs in Year 1 and Year 2.

Since the average cost increases after Year 2, the machine should not be kept beyond Year 2.

Conclusion: The optimal replacement period is at the end of Year 2 to minimize the average annual cost.