

ENGINEERING ECONOMICS AND COST ANALYSIS – MG 1452

VIII SEMESTER – MECHANICAL ENGINEERING

FORMULAE :

UNIT – I

$$\text{Profit} = \text{Sales} - (\text{Fixed Cost} + \text{Variable Cost})$$

$$\text{Contribution} = \text{Sales} - \text{Variable Cost}$$

$$\text{Break Even Point in Quantity} = \text{Fixed Cost} / \text{Contribution p.u.}$$

$$\text{Break Even Point in Sales} = \text{Fixed Cost} \times \text{Selling price p.u.} / \text{Contribution p.u.}$$

Or

$$\text{Fixed Cost} / \text{Profit Volume Ratio}$$

$$\text{Profit Volume Ratio (P/V ratio)} = \text{Contribution} \times 100 / \text{Sales}$$

$$\text{Margin of Safety (M.S.)} = \text{Actual Sales} - \text{Break Even Sales}$$

Or

$$\text{Profit} \times \text{Sales} / \text{Contribution}$$

Or

$$\text{Profit} / \text{Profit Volume Ratio}$$

UNIT – II

$$\text{I. Single Payment Compound Amount} - F = P (F/P, i, n) \quad \text{or} \quad F = P (1 + i)^n$$

$$\text{II. Single Payment Present Worth Method} - P = F (P/F, i, n) \quad \text{or} \quad P = F / (1 + i)^n$$

$$\text{III. Equal Payment Series Compound Amount} - F = A (F/A, i, n) \quad \text{or} \quad F = A \times ((1 + i)^n - 1 / i)$$

$$\text{IV. Equal Payment Series Sinking fund Amount} - A = F (A/F, i, n) \quad \text{or} \quad A = F \times (i / ((1 + i)^n - 1))$$

V. Equal Payment Series Present Worth Amount – $P = A (P/A, i, n)$ or $P = A \times ((1+i)^n - 1 / i(1+i)^n)$

VI. Equal Payment Series Capital Recovery Amount – $A = P (A/P, i, n)$ or $A = P \times ((i(1+i)^n / ((1+i)^n - 1))$

VII. Uniform Gradient Series Annual Equivalent Amount :

To find out average amount for the period

if gradual increase – $A = A_1 + G (A/G, i, n)$ or $A_1 + (G \times ((1+i)^n - 1 / i(1+i)^n - i))$

if gradual decrease – $A = A_1 - G (A/G, i, n)$ or $A_1 - (G \times ((1+i)^n - 1 / i(1+i)^n - i))$

then, To find out the future amount using average amount

$F = A ((1+i)^n - 1 / i)$ or $A (F/A, i, n)$

VIII . Effective Interest Rate - $F = P (1 + r)^N$ or $F = P (1 + R)^n$

UNIT III

I. Present Worth Method

Revenue Dominated=> $PW = - \text{Investment} + A(P/A, i, n)$

Cost Dominated => $PW = \text{Investment} + A(P/A, i, n) - F(P/F, i, n)$

$A(P/A, i, n)$ - Annual Income / Annual Expenses

$F(P/F, i, n)$ - Salvage amount – Future Income

II. Future Worth Method

Revenue Dominated=> $FW = - P (F/P, i, n) + A(F/A, i, n)$

Cost Dominated => $FW = P (F/P, i, n) + A(F/A, i, n) - \text{Salvage Amount}$

$P (F/P, i, n)$ - Investment

$A(F/A, i, n)$ - Annual Income

III. Annual Equivalent Method

Revenue Dominated $\Rightarrow AE = -P(A/P, i, n) + \text{Annual Income}$

Cost Dominated $\Rightarrow AE = P(A/P, i, n) + \text{Annual Expenses} - F(A/F, i, n)$

$P(A/P, i, n)$ - Investment

$F(A/F, i, n)$ - Salvage Amount

IV. Rate of Return Method

Only Revenue Dominated $\Rightarrow PW = -\text{Investment} + A(P/A, i, n)$

$A(P/A, i, n)$ - Annual income

To find out the internal rate of return, we need to assume interest rate. Positive amount and the negative amount is required to find out the internal rate.

When, decrease in interest rate will give positive figure and when increase in interest rate will give negative figure.

Then,

$$\text{Rate of return } I = \text{Lowest Assumed interest Rate} + \frac{\text{Value of Lowest assumed Interest}}{\text{Sum of the value of lowest and highest assumed interest}} \times \text{Difference in lowest and highest Interest Rate}$$

Decision : Accept highest rate of interest, which gives more revenue.

UNIT – IV

Replacement Analysis

$$AE = (P - F) \times (A/P, i, n) + F \times i + A$$

P = Present Value, F = Salvage Amount, i = Interest Rate, n = no. of years, A = Annual Expenses

UNIT – V

Depreciation:

I. Straight Line Method

$$\begin{aligned}\text{Depreciation } Dt &= P - F / n \\ \text{Book Value } Bt &= P - (t \times P - F / n)\end{aligned}$$

II. Declining Balance Method / Reducing Balance Method

$$\begin{aligned}\text{Depreciation } Dt &= K (1 - K)^{t-1} \times P \\ \text{Book Value } Bt &= (1 - K)^t \times P\end{aligned}$$

III. Sum of the years digit method

$$\begin{aligned}\text{Depreciation } Dt &= \frac{n-t+1}{n(n+1)/2} \times (P - F) \\ \text{Book Value } Bt &= (P - F) \times \frac{(n-t)(n-t+1)/2}{n(n+1)/2} + F\end{aligned}$$

IV. Sinking Fund Method

$$\begin{aligned}\text{Depreciation } Dt &= (P - F) (A/F, i, n) (F/P, i, n) \\ \text{Book Value } Bt &= P - (P - F) (A/F, i, n) (F/A, i, n)\end{aligned}$$

V. Service Output Method

$$\text{Depreciation} = (P - F) \times \frac{\text{used capacity}}{\text{Total capacity}}$$

Public Alternatives

$$\text{Benefit – Cost Ratio (BC Ratio) } = B_p / P + C_p$$

Or

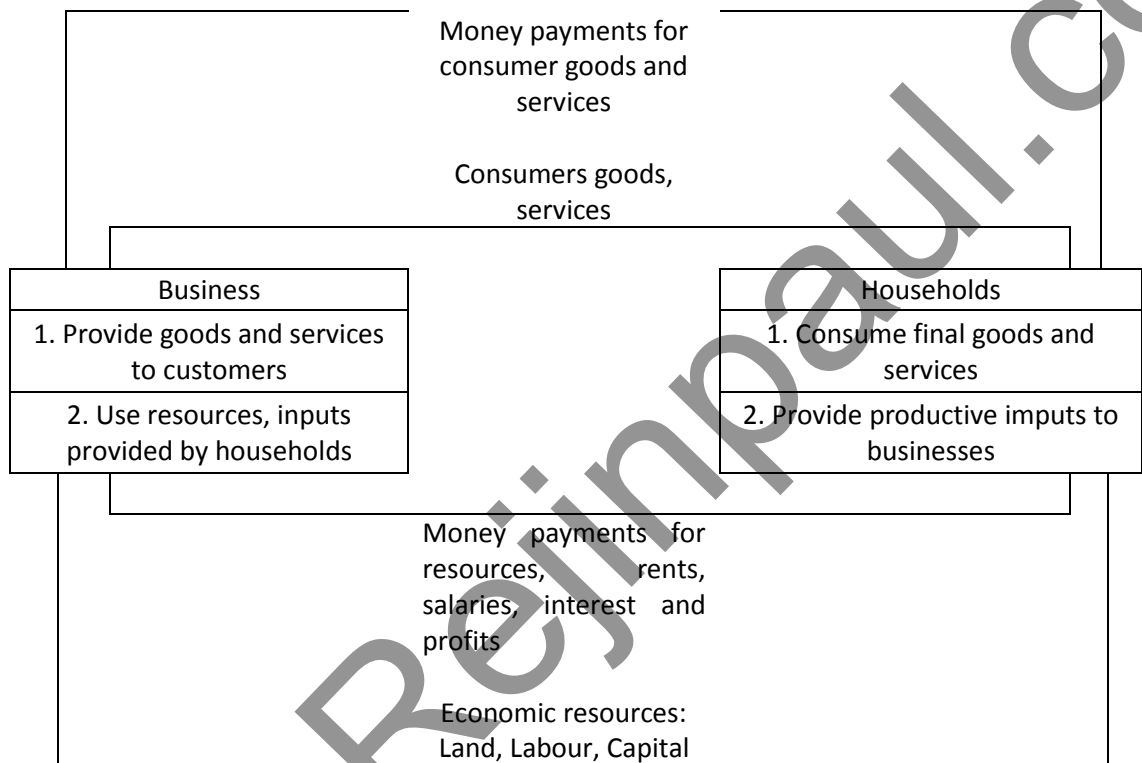
$$\text{Present Worth of benefits} / \text{Present Worth of Cost}$$

THEORY

UNIT – I

Economics : It is the science that deals with the production and consumption of goods and services and the distribution and rendering of these for human welfare.

Flow of economy :



Law of Supply and Demand:

The aspect of the economy is that the demand and supply of a product are independent and they are sensitive with respect to the price of that product.

Factors influencing supply

1. Cost of the inputs
2. Technology
3. Weather
4. Prices of related goods

Concept of Engineering Economics

Engineering is the application of science. It established varied application systems based on different scientific principles. Efficient and effective functioning of the organization would certainly help it to provide goods/services at a lower cost which in turn will enable to fix a lower price for its goods or services.

Definition: Engineering economics deals with the methods that enable on to take economic decisions towards minimizing costs and maximizing benefits to the business organizations.

Types of Efficiency:

Technical efficiency = $\text{Output} \times 100 / \text{Input}$

Economic efficiency = $\text{Worth} \times 100 / \text{Cost}$

Elements of Cost

- | | | |
|-----------------------|---|--|
| 1. Prime Cost | = | Direct Mtls + Direct Labours + Direct expenses |
| 2. Factory Cost | = | Prime cost + Indirect expenses |
| 3. Cost of Production | = | Factory cost + Administrative exps |
| 4. Cost of Sales | = | Cost of production + Selling and Distribution expenses |

Other Cost / Revenues

1. Marginal Cost
2. Marginal Revenue
3. Sunk Cost
4. Opportunity Cost

Break Even Analysis:

The intersection point of the total sales revenue line and total cost line is called the break even point.

UNIT – II

Value Engineering

Value analysis is the systematic application of recognized techniques which identify the function of a product or service, establish a monetary value for the function and provide the necessary function reliably at the lowest overall cost.

Value Analysis vs Value Engineering

Value analysis is the application of a set of techniques to an existing product with a view to improve its value.

Value engineering is the application of exactly the same set of techniques to a new product at the design stage.

Value = Performance / Cost

Functions:

1. Primary function
2. Secondary function
3. Tertiary function

Value Engineering Procedures:

1. Blast: Identify the product, Collect relevant information, Define different function
2. Create: Different alternatives, Critically evaluate the alternatives
3. Refine: Develop the best alternative, Implement the alternative

UNIT –IV

Replacement and Maintenance Analysis

It is an absolute necessity to maintain the equipment in good operating conditions with economical cost. Thus, the organization needs an integrated approach to minimize the cost of maintenance. In certain cases, the equipment will be obsolete over a period of time.

Reasons: a) Physical impairment of the various parts
b) Obsolescence of the equipment

Alternatives: a) Replacement of the existing equipment with a new one
b) Augmenting the existing one with an additional equipment

Types of Maintenance;

- i) Preventive Maintenance
- ii) Breakdown Maintenance

Types of Replacement

- i) Replacement of assets that deteriorate with time
 - a) Determination of economic life of an asset
 - b) Replacement of an existing asset with a new asset
- ii) Simple probabilistic model for assets which fail completely
 - a) Individual replacement policy
 - b) Group replacement policy

Challenger and Defender

If an existing equipment is considered for replacement with a new equipment, then the existing equipment is known as the **defender** and the new equipment is known as **challenger**.

UNIT – V

Evaluation of Public alternatives:

The main objective of the any public alternative is to provide goods/services to the public at the minimum cost. This is nothing but taking decision based on Benefit-Cost ratio (BC).

$$\text{BC ratio} = \text{Equivalent benefits} / \text{Equivalent Costs}$$