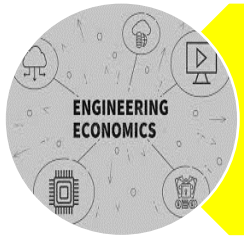

Engineering Economics

INTRODUCTION
(3 hours)



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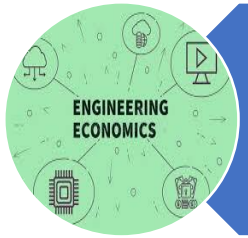
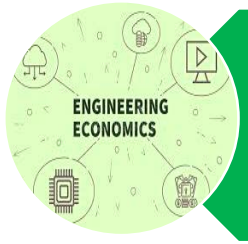
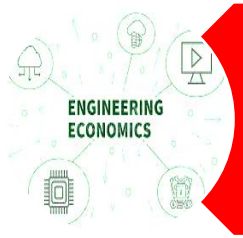


Principles

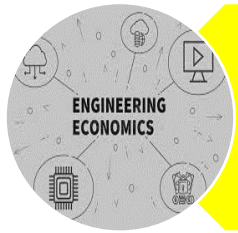


Role of Engineers in Decision Making



Cash Flow Diagram

Day-1



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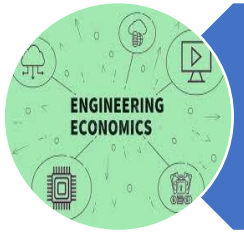


Principles

Origin of Engineering Economics

Economics

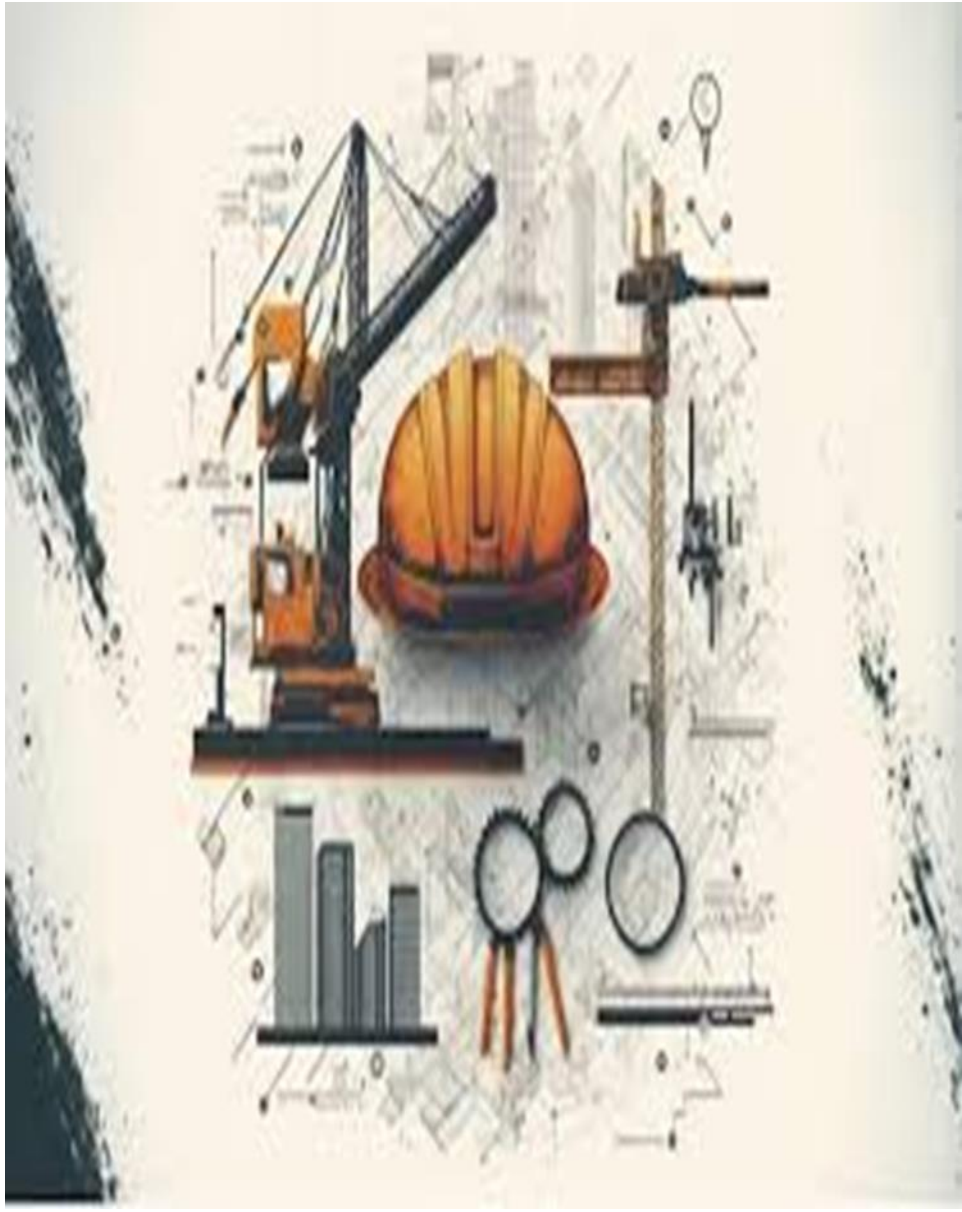
- American Economic Association defines Economics as "the study of scarcity, the study of how people use resources and respond to incentives, or the study of decision-making".
- **The purpose of economics study** is to know how an economic system functions, evaluate its advantages and disadvantages, and provide solutions to economic issues.

Engineering

- Engineering economics is a field that applies economic concepts to engineering problems and decisions.
- Engineering economics involves formulating, estimating and evaluating the economic results when there are multiple ways to achieve a defined goal.
- To be economically acceptable, the selected option should show a positive balance of long-term benefit over long-term cost.

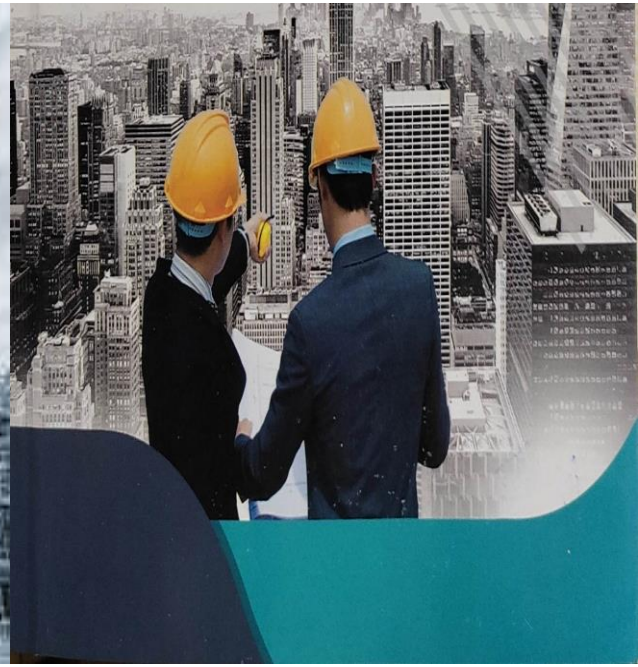
Origin of Engineering Economics…

- Eugen Grant- “father of engineering economics”
- 1930- Published a text book “Principles of Engineering Economy”
- Engineering has continued to ease human life by uplifting from chain and pulley to automated system, stone mortar to mixer and grinders etc.
- Current development are pushing new approaches to risk, sensitivity, resource conservation and efficient use of public money.
- Engineering economics help to the advancement of current development in economical manner.



Principles of Engineering Economics

1. Develop Alternatives
2. Focus on the differences
3. Hold same view point
4. Use of common units of measures
5. Use of all relevant criteria
6. Make uncertainty very explicit
7. Review/ Revisit your decision



Principles of Engineering Economics…

1. Develop Alternatives

- Carefully *define the problem*.
- The *alternative* need to be identified and *defined* for subsequent analysis.
- A decision involves making a choice among *two or more alternatives.*
- Developing and Defining the alternatives for detailed evaluation is important because the resulting impact in the quality of decision.
- Creativity and innovation are essential to the process.

For an instance, if we are buying a mobile phone, our alternatives are either an iPhone or an Android phone.

Principles of Engineering Economics…

2. Focus on the differences

- Only the *differences* in the future outcomes of the alternatives are important.
- Outcomes that are *common* to all alternatives can be *disregarded* in the cor decision.

Principles of Engineering Economics…

3. Hold the same View Point

- The perspective outcomes of the alternatives should be consistently developed from a *defined viewpoint.*
- The perspective of *decision maker* (which is often that of owner) would normally be used.
- The *viewpoint* for the particular decision be first defined and then used consistently in the description, analysis and comparison of alternatives.

Principles of Engineering Economics…

4. Use a Common Unit of Measure

- Using a *common unit of measurement* to analyze as many of the prospective outcomes as possible will make easier the analysis and comparison of alternatives.

For example: Using USD on evaluating the expenses and NPR on income will complicate the analysis.

Principles of Engineering Economics…

5. Use all Relevant Criteria

- Decision maker will **chose the alternative that wil best serve the long-term interest of the owner.**
- **The primary criteria** in engineering economi analysis relates to the long term *financial interes* of the owner.
- Assumptions thus made is the available capital wil be allocated to provide *maximum monetary retur* to the owners.

Principles of Engineering Economics…

6. Make Uncertainty Explicit

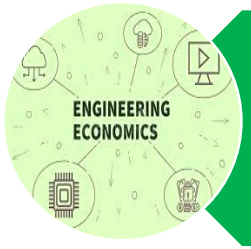
- *Risk and Uncertainty* are inherent in estimating the future outcomes of the alternatives and **should be recognized.**
- The **analysis of the alternatives** involves projecting (estimating) the *future consequences* associated with each of them.
- The **magnitude and the impact** of the future outcomes of any course of action are *uncertain*.
- Dealing with *uncertainty* is an **important aspect of engineering economic analysis.**

Principles of Engineering Economics…

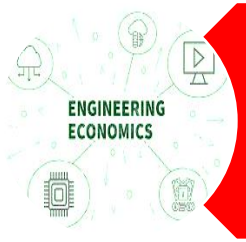
7. Revisit the Decision Making

- A good decision making process can result in a decision that has *undesirable outcome*.
- Other decision, even though relatively successful, will have results significantly *different* from the initial estimates of the consequences.
- Learning from and adapting based on *experience* are essential and are indicators of good organization.

Day-2



Role of Engineers in Decision Making



Cash Flow Diagram

Role of Engineers in Decision Making

Step 1
- Diagnose Problem

Step 2
- Analyze Environment

Step 3
- Develop Viable Alternatives

Step 4
- Evaluate Alternatives

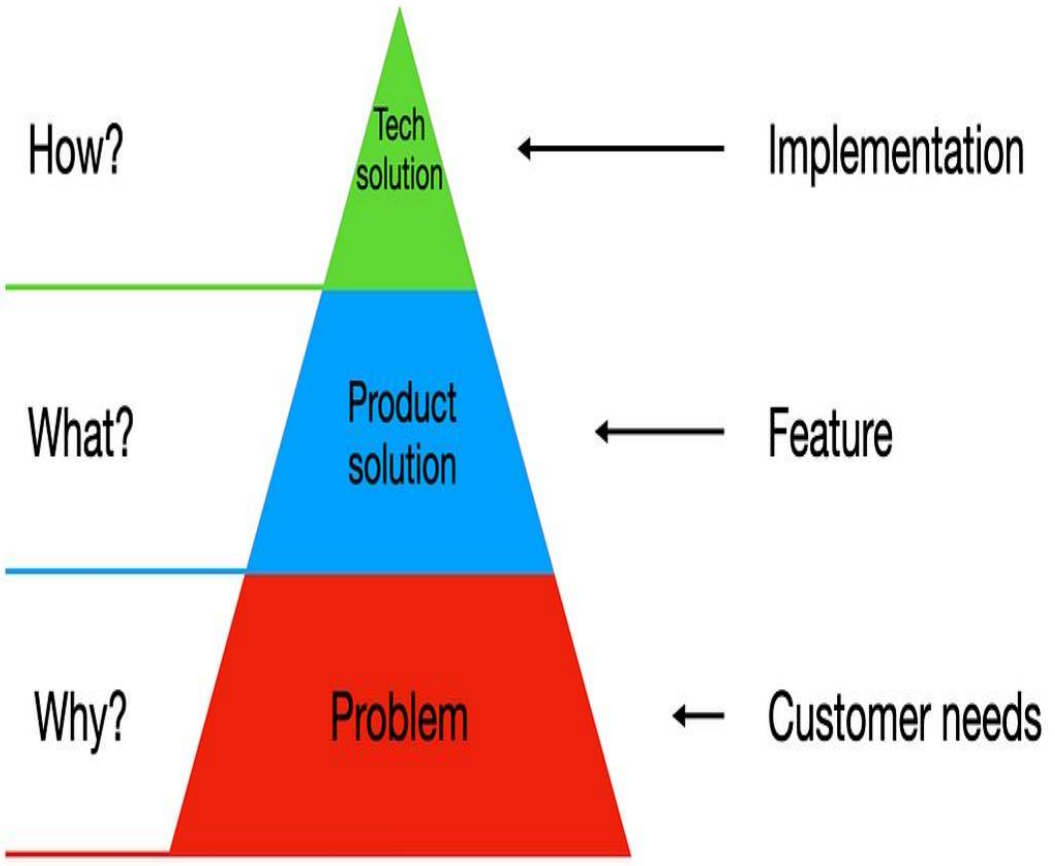
Step 5
- Make a Choice

Step 6
- Implement Decision

Step 7
- Evaluate and Adapt Decision Results

Role of Engineers in Decision Making…

- Engineers play an *essential role* in decision-making, particularly **when complex and technical considerations are involved**.
- The decision making are guided with their *analytical skills* and *techniques to evaluate options, identify potential risks and select the best option.*
- **The techniques and models** of engineering economy *assist* people in making decisions.
- Engineering decision-making are mostly done considering the *future time frame*, primarily.



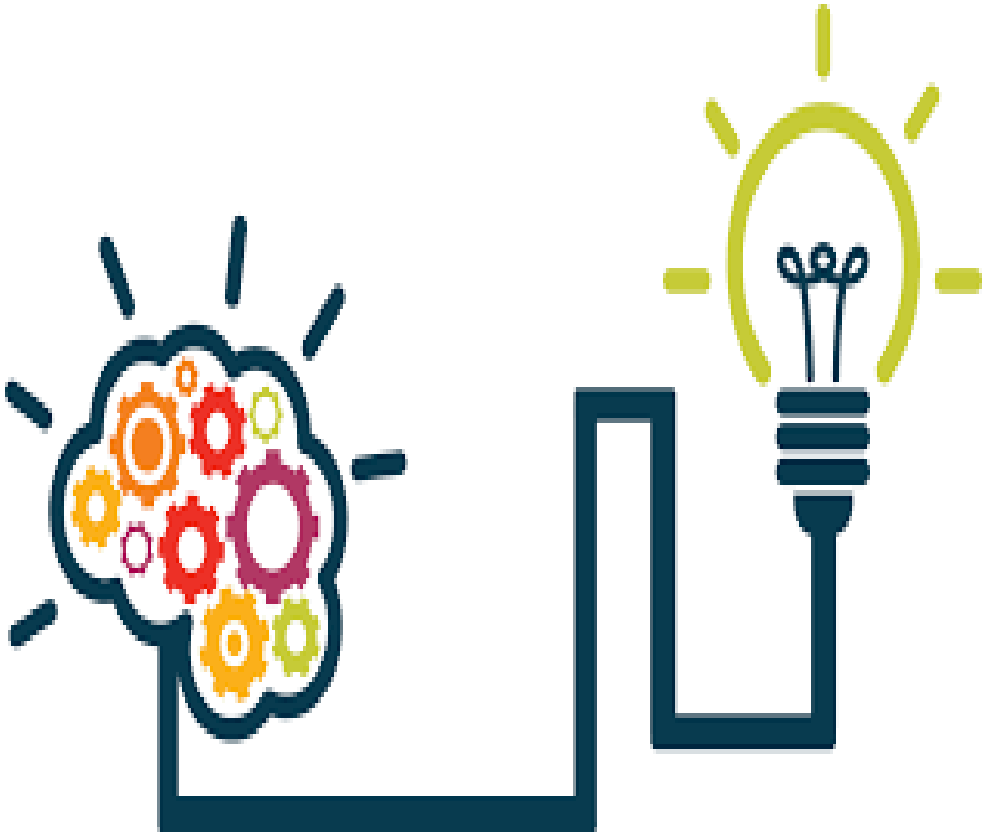
Role of Engineers in Decision Making…

- Estimates often *involve* the three essential elements
  - Cashflow
  - Time of Occurrence
  - Interest Rate
- As the estimates are made for future, the *actual results* may differ from the real.
- The estimated and observed value are different due to the *changing circumstances* and *unplanned events*.
- *Sensitivity analysis* is performed during the engineering economic study to determine how the decision change based on varying estimate.

Role of Engineers in Decision Making…

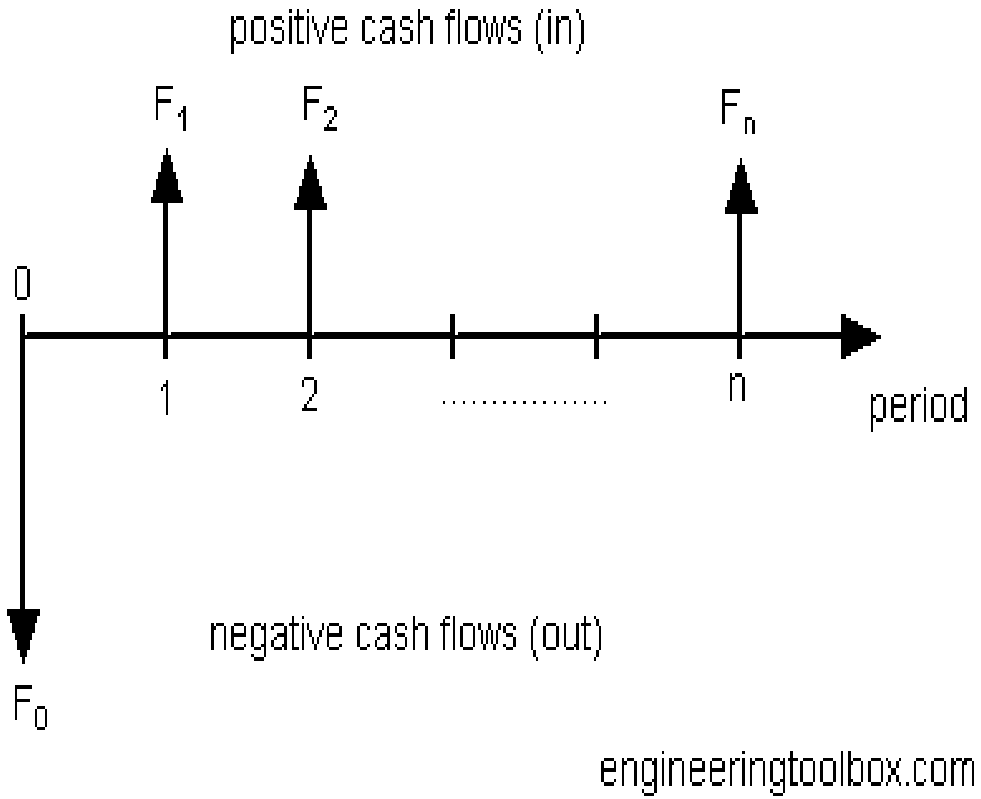
Problem-solving Approach

1. Understand the problem and define the objective.
2. Collect relevant information.
3. Define feasible alternative solutions and make realistic estimates.
4. Identify criteria for decision making using one or more attributes.
5. Evaluate each alternative, using sensitivity analysis to enhance the evaluation.
6. Select the best alternative.
7. Implement the solution and monitor results.



Cash Flow Diagram

- The total sum of cash and cash equivalents being moved in and out of a corporation is referred to as *cash flow*.
- A *cash flow diagram* is a graphical representation of *cash inflows* (receipts) and *outflows* (expenses) over time.
- It is commonly used in engineering economics, finance, and project management to analyze the *timing* and *magnitude of cash transactions*.
- Cash Flow Diagram *illustrates* the size, sign and timing of individual cash flow.
- It forms the *basis* of engineering economic analysis.



Cash Flow Diagram…

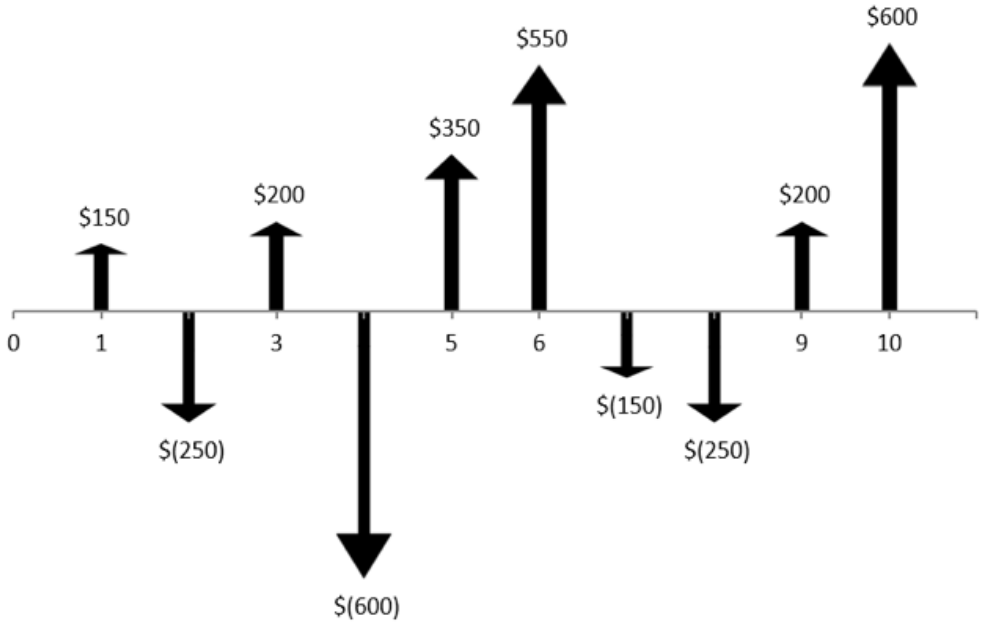
Components of a Cash Flow Diagram

- *Time Axis:*
  - The horizontal axis represents time, typically divided into equal intervals (e.g., months, years).
  - Each time period is marked (e.g., t=0,t=1,t=2,…t = 0, t = 1, t = 2,…..t=0,t=1,t=2,…).
- *Cash Flows:*
  - Cash inflows (positive cash flows) are represented by upward arrows.
  - Cash outflows (negative cash flows) are represented by downward arrows.
  - The length of the arrow indicates the magnitude of the cash flow.
- *Reference Line:*
  - A horizontal line serves as the base or reference line, representing zero cash flow.
- *Annotations:*
  - Each arrow is labeled with the cash amount.
  - Significant points in time (e.g., project start, milestone payments) may be annotated.

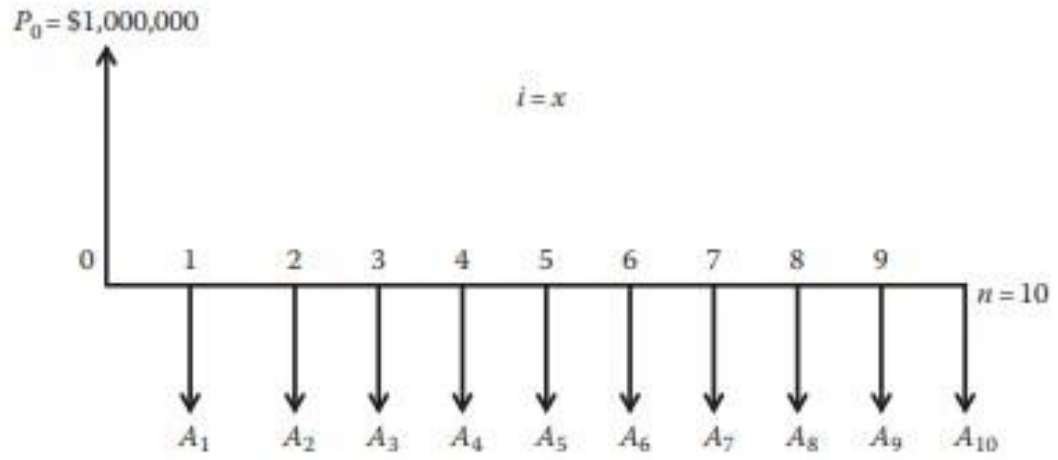
Cash Flow Diagram…

Cash flow diagram shows three things.

1. A time interval divided into an appropriate number of each periods.
2. All cash inflows (withdrawals, income etc) for each period.
3. All cash outflows (deposits, expenditures etc)in each period.



All cash flows are considered to occur at the end of their respective periods, unless otherwise indicated.



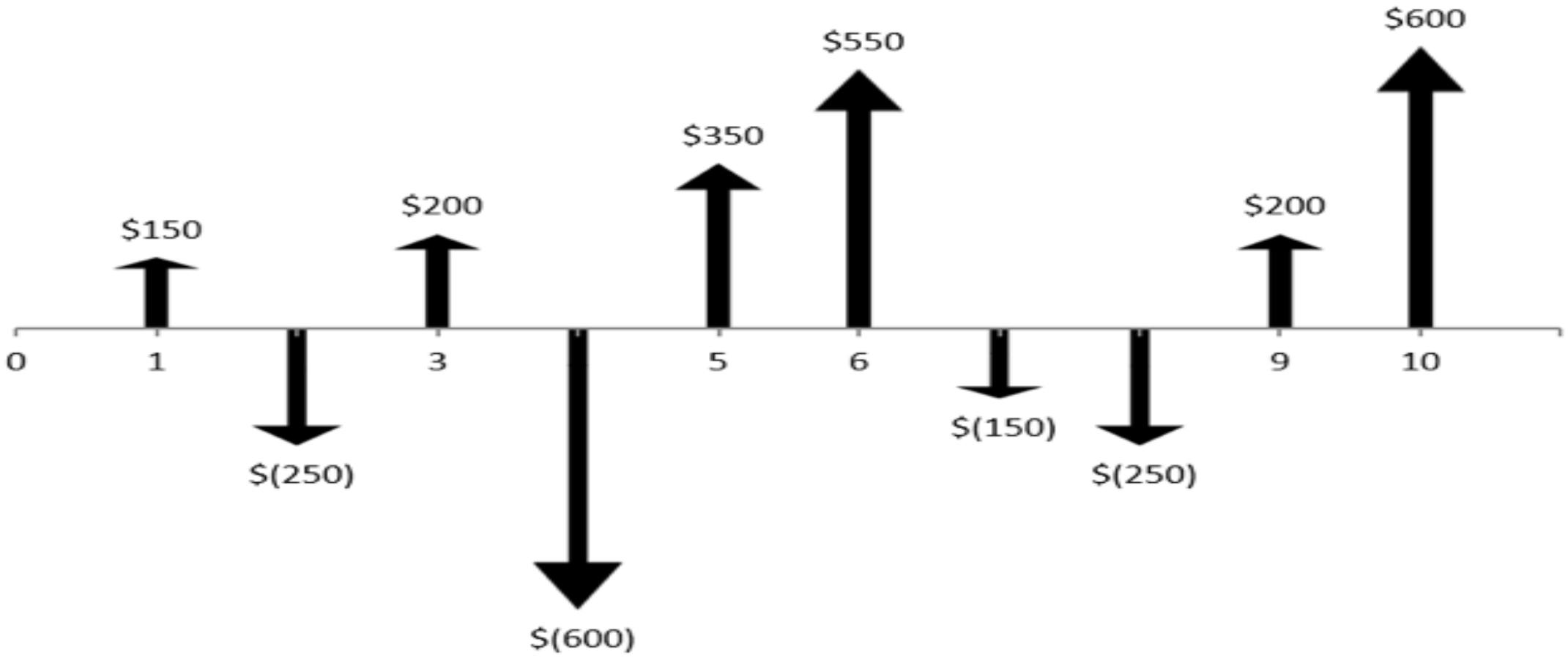
Cash Flow Diagram…

Basic Rules of Creating Cash Flow

- Time is represented by a horizontal line marked with the number of *periods* in the analysis. The choice of time interval will reflect the project or transactions being considered.
- The *horizontal position* of each arrow indicates the *timing* of that cash flow.
- Upward arrows represent *positive* cash flows, also known as inflows, income, or receipts.
- Downward arrows represent *negative* cash flows, also known as outflows, disbursements, or expenses.
- Each arrow represents the *net* cash flow *in that period* (receipts – disbursements). There is only one cash flow arrow for each period representing this net value.

Cash Flow Diagram…

Explain the Cash Flow Diagram



Cash Flow Diagram…

Numerical examples

1. A man borrowed Rs 1000 from a bank at 8% interest. Two end-of-year payments at the end of the first year, he will repay half of the Rs 1000 principal plus the interest that is due. At the end of second year, he will repay the remaining half plus the interest for the second year. Draw the Cash Flow Diagram.

2. Suppose that today you borrowed Rs 10,000 from a friend and you asked the friend to repay the loan within 5 years beginning with Rs 2000 at the end of first year, Rs 1500 at the end of 2^{nd} year, Rs 1000 at the end of 3^{rd} year, Rs 500 at the end of 4^{th} year and 5^{th} year. Draw the cash flow diagram of this transaction.

Cash Flow Diagram…

Numerical examples…

3. A machine will cost $30,000 to purchase. Annual operating and maintenance cost (O&M) will be $2000. The machine will save $10,000 per year in labor cost. The salvage value of the machine after 5 years will be $7000. Draw the cash flow diagram.

4. A mechanical device will cost $20,000 when purchased. Maintenance cost will be $ 1000 per year. The plant earns a revenue of $ 5000 per year for 5 years. The salvage value is $9000. Draw the Cash Flow Diagram.


ANY
QUESTIONS?

“An engineer’s mind is a kaleidoscope of logic, creativity, and curiosity—constantly reshaping the view to see solutions others can’t”


THANK
YOU