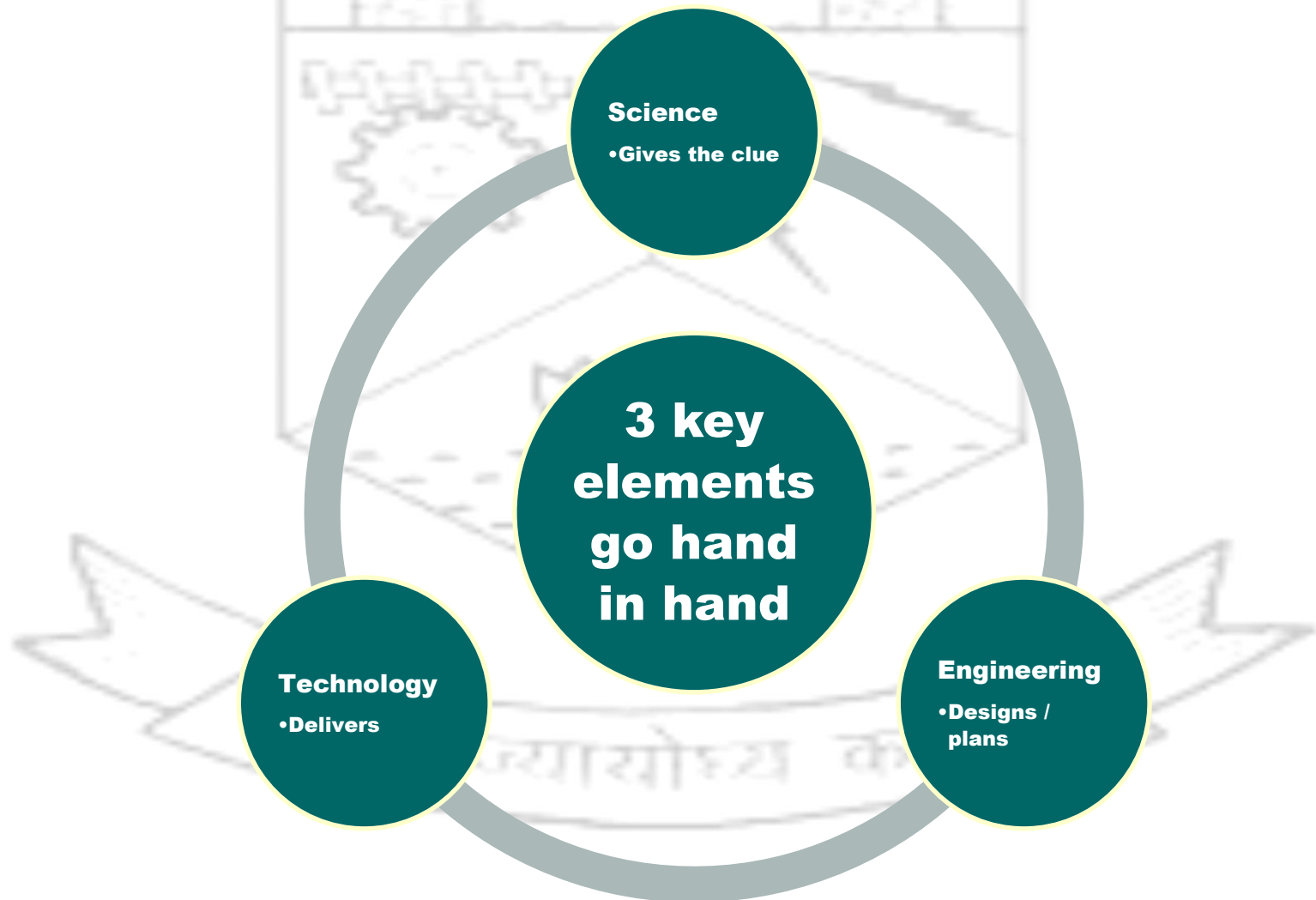# Design Process

Starts with the design form

Later design function creeps in slowly

Together with the design means

PRODUCT

Role of Science, Engineering and Technology in design

Science
•Gives the clue

3 key elements go hand in hand

Technology
•Delivers

Engineering
•Designs / plans

Relation between scientists and engineers

➢ **Scientists employ the technologies that engineers develop to pursue their research**

❖ Computers

❖ Calculators

❖ Meters

❖ Microscopes

❖ Monitors

➢ **When engineers commence to develop a new technology, they resort to the knowledge of the natural world developed by scientists**
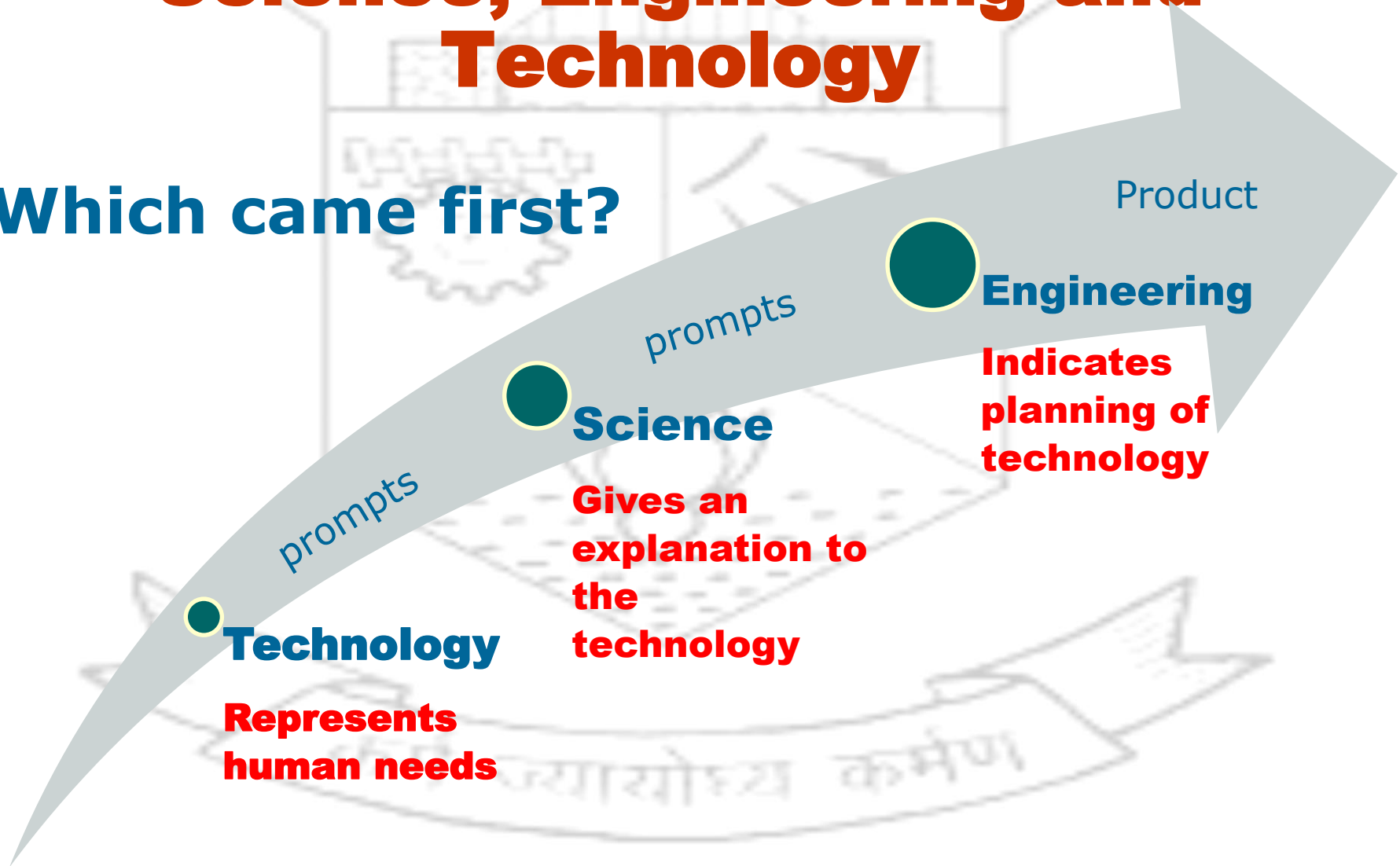
❖ Law of gravity

❖ How fluid flows

❖ How soil performs

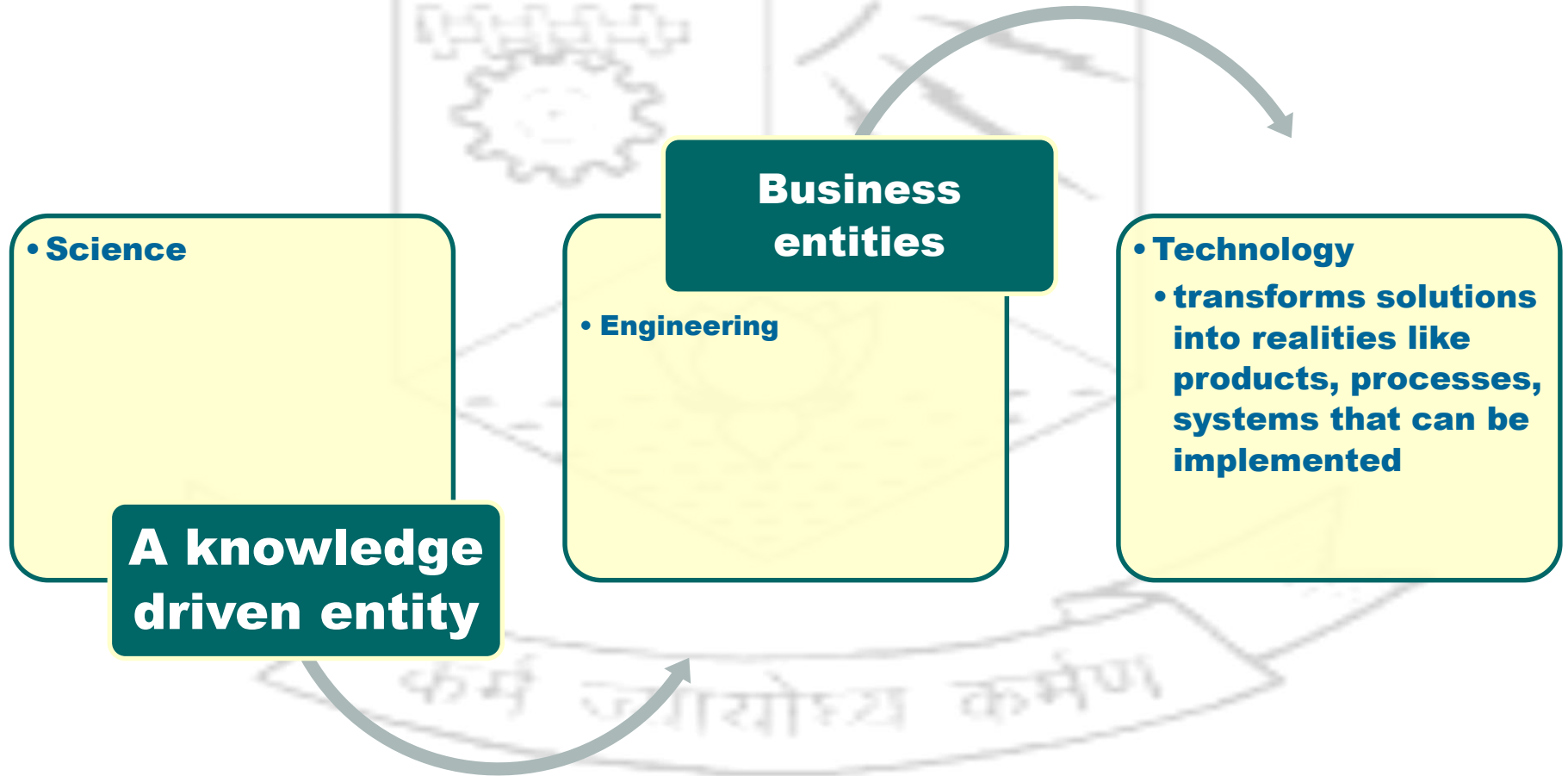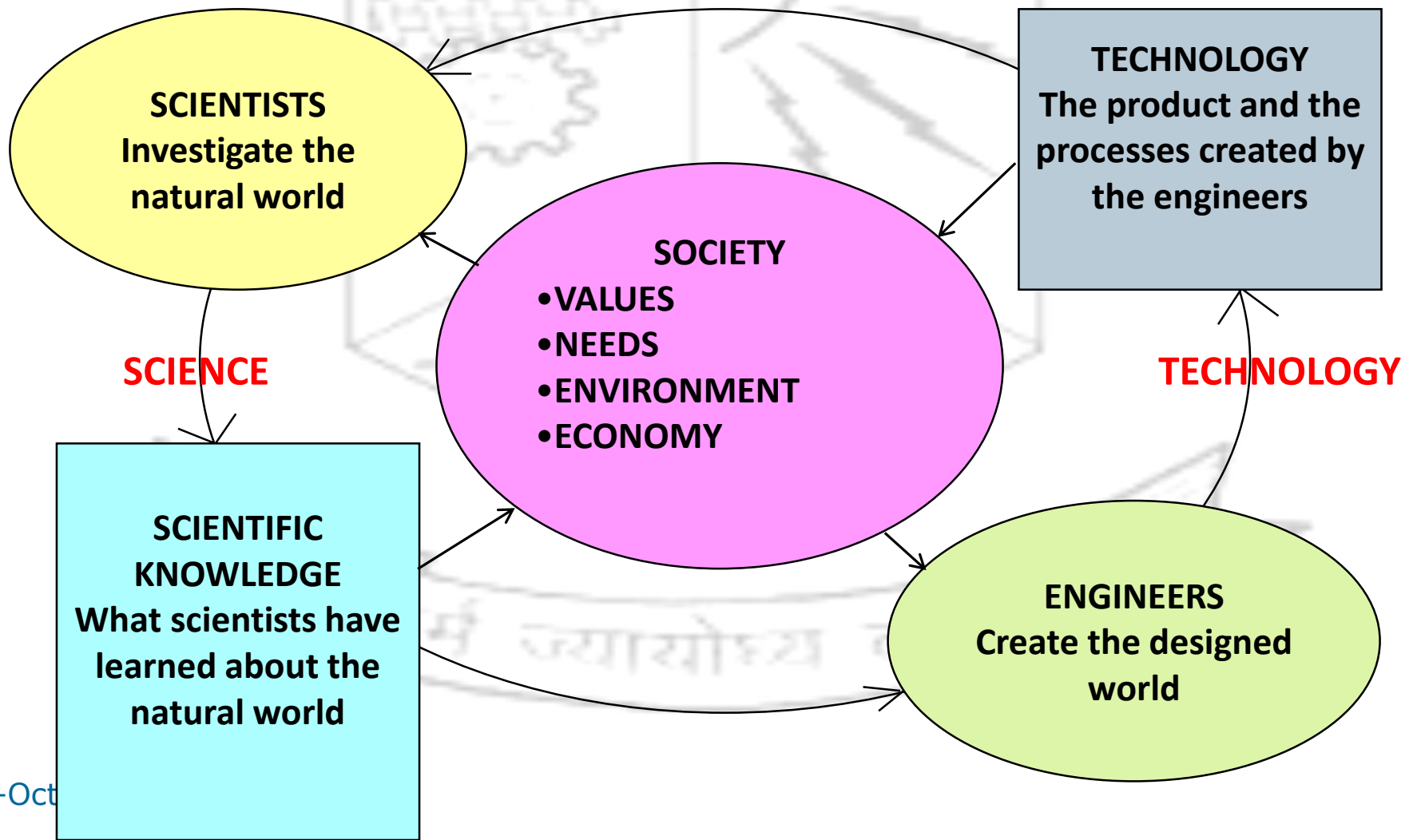❖ How air behaves

Science, Engineering and Technology

Which came first?

Product

Engineering

Indicates planning of technology

prompts

Science

Gives an explanation to the technology

prompts

Technology

Represents human needs

Role of Science, Engineering and Technology in design (Contd.)

Business entities

- Science

A knowledge driven entity

- Engineering

- Technology
- transforms solutions into realities like products, processes, systems that can be implemented

Role of Science, Engineering and Technology in design (Contd.)

SCIENTISTS
Investigate the natural world

TECHNOLOGY
The product and the processes created by the engineers

SOCIETY
•VALUES
•NEEDS
•ENVIRONMENT
•ECONOMY

SCIENCE

TECHNOLOGY

SCIENTIFIC KNOWLEDGE
What scientists have learned about the natural world

ENGINEERS
Create the designed world

Role of Science, Engineering and Technology in design (Contd.)

Example

Technology

Fire can be used to cook food

Science

Burning wood produces heat, water, and carbon dioxide

Heat denatures proteins in food

Engineering

Building a fireplace and chimney makes it easier to cook with fire without filling the room with smoke

Engineering – A Business Proposition

➢ **What Engineering is not**

  ❖ **Not all about designing things**

  ❖ **Not a curiosity shop to try different products, processes, technology, etc.**

➢ **What Engineering is**

  ❖ **Engineering is business**

  ❖ **To succeed it has to pay back or gain profits**

  ❖ **Exceptions**

     o **Strategic products**

Engineering –
A Business Proposition (contd.)

> **Engineering strives on**

Swiftness	Augmentation	Profitability
Making speedy and wise choices	Accepting forward-thinking solutions in engineering perceptions	Getting back the money spent and making profit

Two aspects of design

- **Functional design**

  ➢ **Software designs**

  ➢ **Designs in electronics**

- **Strength design**

  ➢ **Engineers tend to be more oriented towards strength designs**

- **Most designs consider these two aspects often together**

Initiating the thinking process

- ## Creative thinking

  - ### Definition

    - ❖ A recognized method for

      - o Practical resolution of problems and

      - o Creation of solutions

    - ❖ With the intention of an improved future result

Initiating the thinking process

- **Creative thinking (Contd.)**

  ➢ **Types of creative solutions**

  ❖ **When one encounters a totally new problem, the solution should be termed as creative**

    o **Example – invention of telephone**

  ❖ **When one solves the problem differently with an improvement, then also it can be termed as creative.**

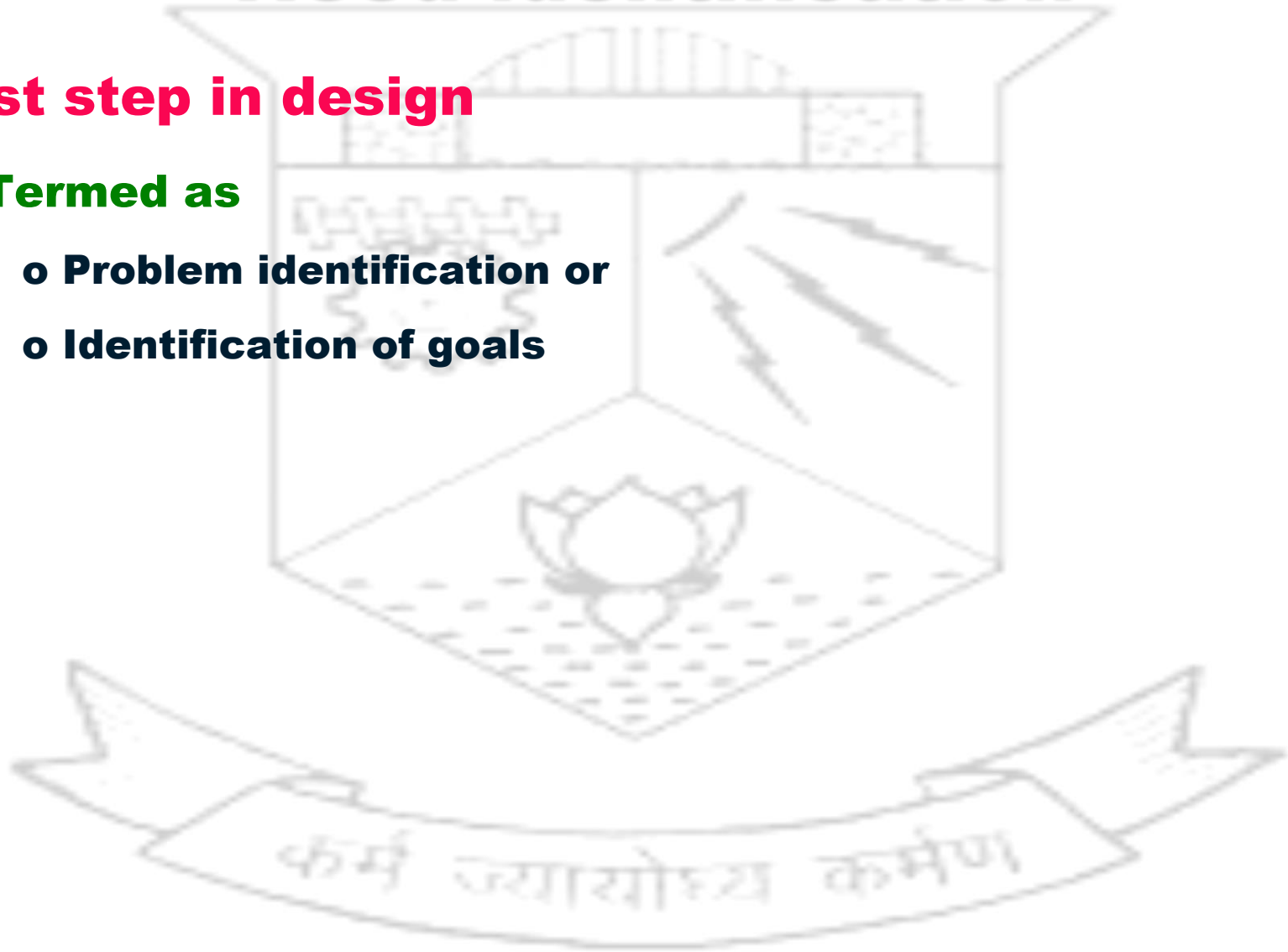   o **Example – Evolution of mobile phones from telephones**

Need identification

> **First step in design**

  ❖ **Termed as**

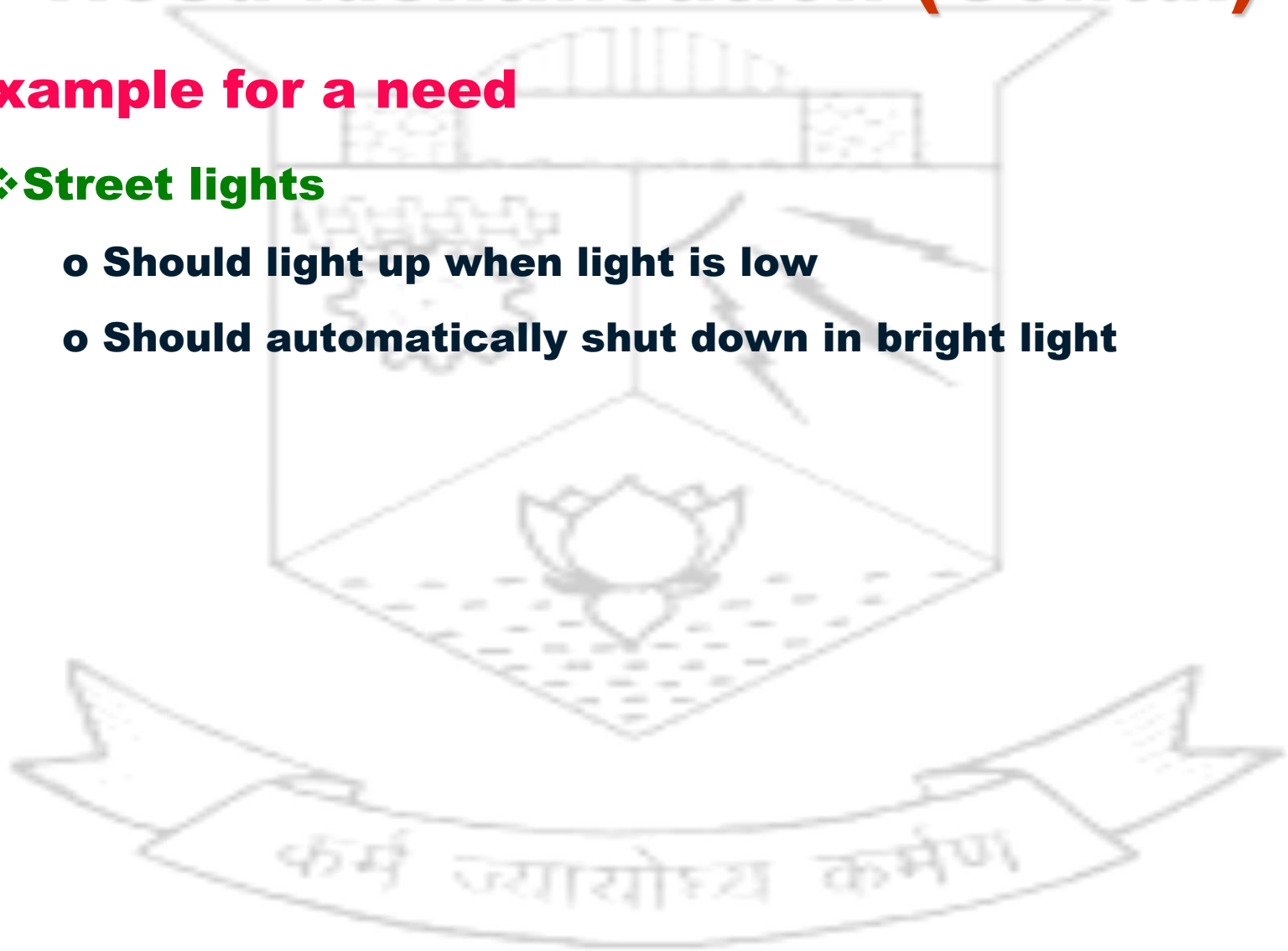   o **Problem identification or**

   o **Identification of goals**

Need identification (Contd.)

➢ **Example for a need**

❖ **Street lights**

o **Should light up when light is low**

o **Should automatically shut down in bright light**

Need identification (Contd.)

➤ **Identify your target population**

❖ A part of need identification

➤ **Target population**

❖ Group of people who will benefit from your project

❖ An identified group of people intended to be served by a particular program or project
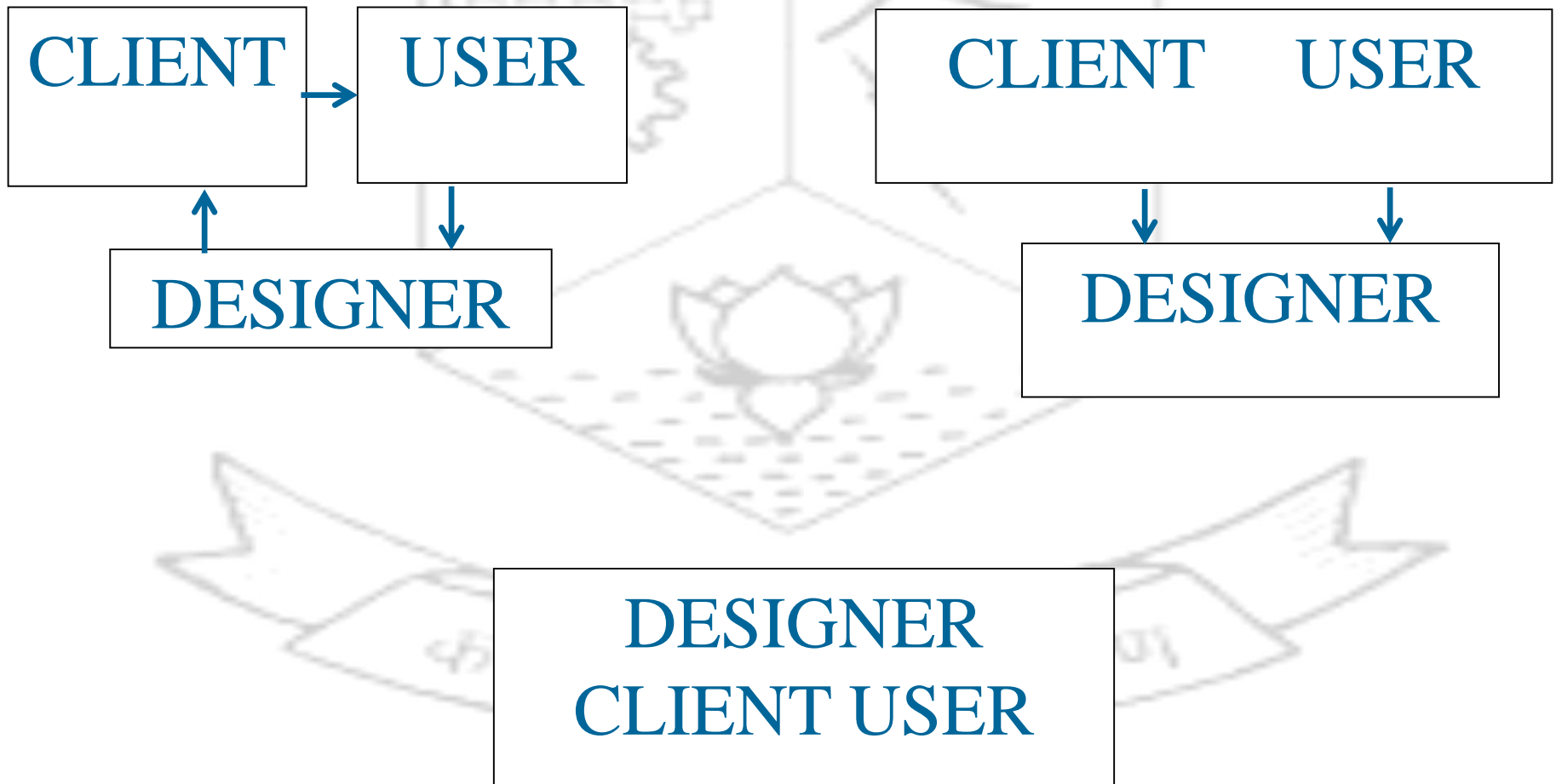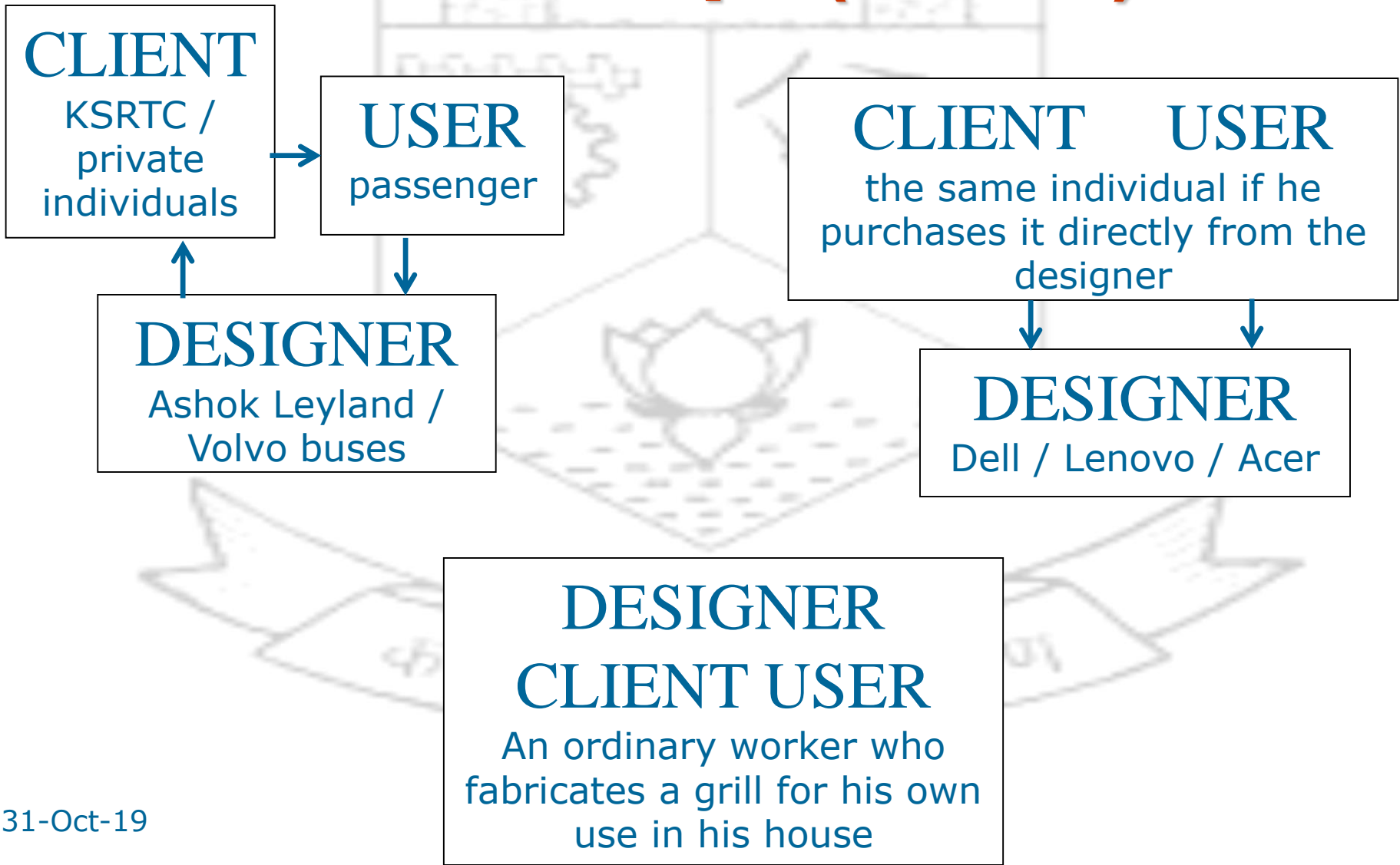
Need identification (Contd.)

➢ **Examples for target population**

❖ Humanity as a whole

❖ Flora

❖ Fauna

❖ Village / city community

❖ Males / females

❖ Students / professionals

❖ Kids / youth / middle age / old age people

❖ Employers / employees

❖ ....

Designer client user relationships

CLIENT → USER

DESIGNER

CLIENT   USER

DESIGNER

DESIGNER
CLIENT USER

Designer client user relationships (Contd.)

CLIENT
KSRTC / private individuals

→

USER
passenger

DESIGNER
Ashok Leyland / Volvo buses

CLIENT   USER
the same individual if he purchases it directly from the designer

DESIGNER
Dell / Lenovo / Acer

DESIGNER

CLIENT USER
An ordinary worker who fabricates a grill for his own use in his house

Market survey and customer requirements

- **Market survey helps**

  ➢ **To identify the customer requirements**

  ➢ **To clarify a design problem in its early stages**

Market survey and customer requirements (Contd.)

- **Three sample questions frequently incorporated in a market survey are:**

  ➢ **What are the characteristics you desire in the product?**

  ➢ **What is the price range at which you are likely to buy the product?**

  ➢ **What were the characteristics of a similar product you used in the past?**

Market survey and customer requirements (Contd.)

- **A sample market survey**

QUESTIONNAIRE

NAME: _____   **AGE:** _____

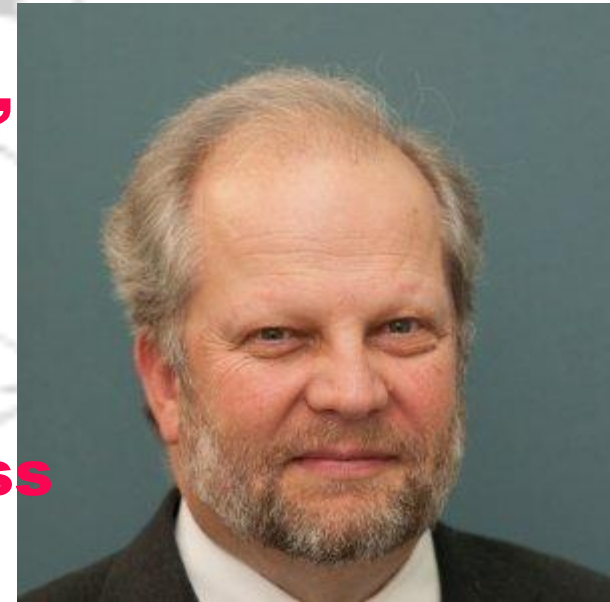**GENDER:** _____   **OCCUPATION:** _____

Please spare a few minutes of your valuable time to answer this simple Questionnaire.

1. Are you a satisfied customer of the Software market?
   Yes ☐   No ☐

2. Are you interested in knowing more about the current trends in Computer Software?
   Yes ☐   No ☐   Haven't Thought About That ☐

3. Are you interested in purchasing the latest versions of Computer Software?
   Yes ☐   No ☐   Some times ☐

4. Which of the following is the Computer Software that you bought recently?
   Anti-virus ☐   Photoshop ☐   Adobe Reader X ☐   Nokia PC Suit ☐

5. Which among the following is your favourite software provider?
   Adobe ☐   Microsoft ☐   Symantec ☐   Infosys ☐

6. What do you think is Infosys' position in the world software export market?
   1ST ☐ 2ND ☐ 3rd ☐ 4TH ☐

7. Are you a frequent buyer of Infosys Software?
   Yes ☐   No ☐

8. When did you last buy brand new Infosys software?
   Less than a week ago ☐   Less than a year ago ☐   1-3 years ago ☐   3-5 years ago ☐

9. Do you think Infosys is successful in exporting its Software to the global market?
   Yes ☐   No ☐   Not Always ☐   Sometimes ☐

10. Do you think Infosys will be triumphant over all its competitors?
    Yes ☐   Maybe ☐   Haven't Thought About That ☐   Never ☐

Customer requirements – The objective tree

- **The objective tree**

  ➢ **Illustrates in diagrammatic form, the ways in which different objectives are related to each other**

  ➢ **Procedure detailed by Nigel Cross**

    ❖ **In his book Engineering Design Methods – Strategies for Product Design**

    ❖ **Published by Wiley and sons in 2008**

Customer requirements – The objective tree (Contd.)

- **The objective tree preparation**

  - ➤ **3 steps**

    - ❖ Prepare a list of design objectives

    - ❖ Order the list into sets of higher-level and lower-level objectives

    - ❖ Draw a diagrammatic tree of objectives, showing hierarchical relationships and interconnections

Customer requirements – The objective tree (Contd.)

➢ **The objective tree preparation**

❖ **Example – To design a water purifier**

o **Step 1. Prepare a list of design objectives**

» Cost effective

» Safe

» Efficient

» Fewer repairs and easy to repair when needed

» Does the job and long lasting

» Low damage and maintenance

» Low or no contamination

» Takes up least possible space

» Safe for humans and environment

» Cleans high volume of water

31-Oct-19

Customer requirements – The objective tree (Contd.)

➢ **The objective tree preparation (Contd.)**

❖ **Example – To design a water purifier (Contd.)**
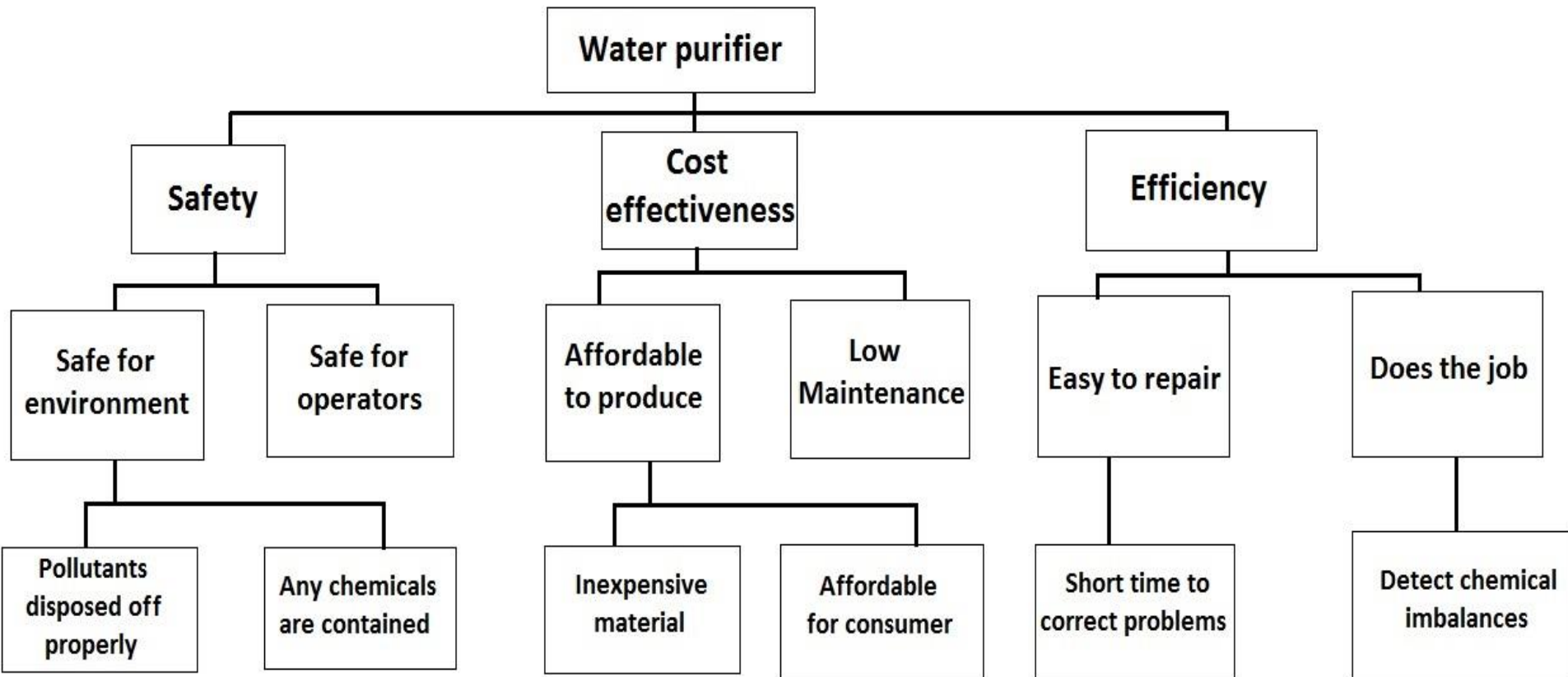
o **Step 2. Order the list into sets as shown in Table**

Safety	Cost Effectiveness	Efficiency
Safe for humans	Cost effective	Does the job
Safe for environment	Few repairs	Long lasting
	Easy to repair	Low damage
	Low maintenance	Low or no contamination
	Affordable	Cleans high volume of water
	Takes least possible space	

Customer requirements – The objective tree (Contd.)

➢ **The objective tree preparation (Contd.)**

❖**Example – To design a water purifier (Contd.)**

o **Step 3. Prepare an objective tree as shown**

Design attributes or objectives

➢ **Characteristics and operations that the user wants in the design**

➢ **2 types**

❖ **Hard attributes**

o **Objective and measurable**

o **Related to the functioning and performance of a product**

o **Examples are strength, speed, weight and price**

o **Purview of engineers**

❖ **Soft attributes**

o **Subjective and emotional**

o **Related to aesthetics**

o **Examples are attractive, young, sporty, pleasant**

o **Purview of industrial designers**

Design attributes or objectives (Contd.)

➢ **Characteristics and operations that the user wants in the design**

➢ **Example**

❖ **Electric kettle for home usage.**

❖ **Hard attributes**

  o **Can be easily defined**

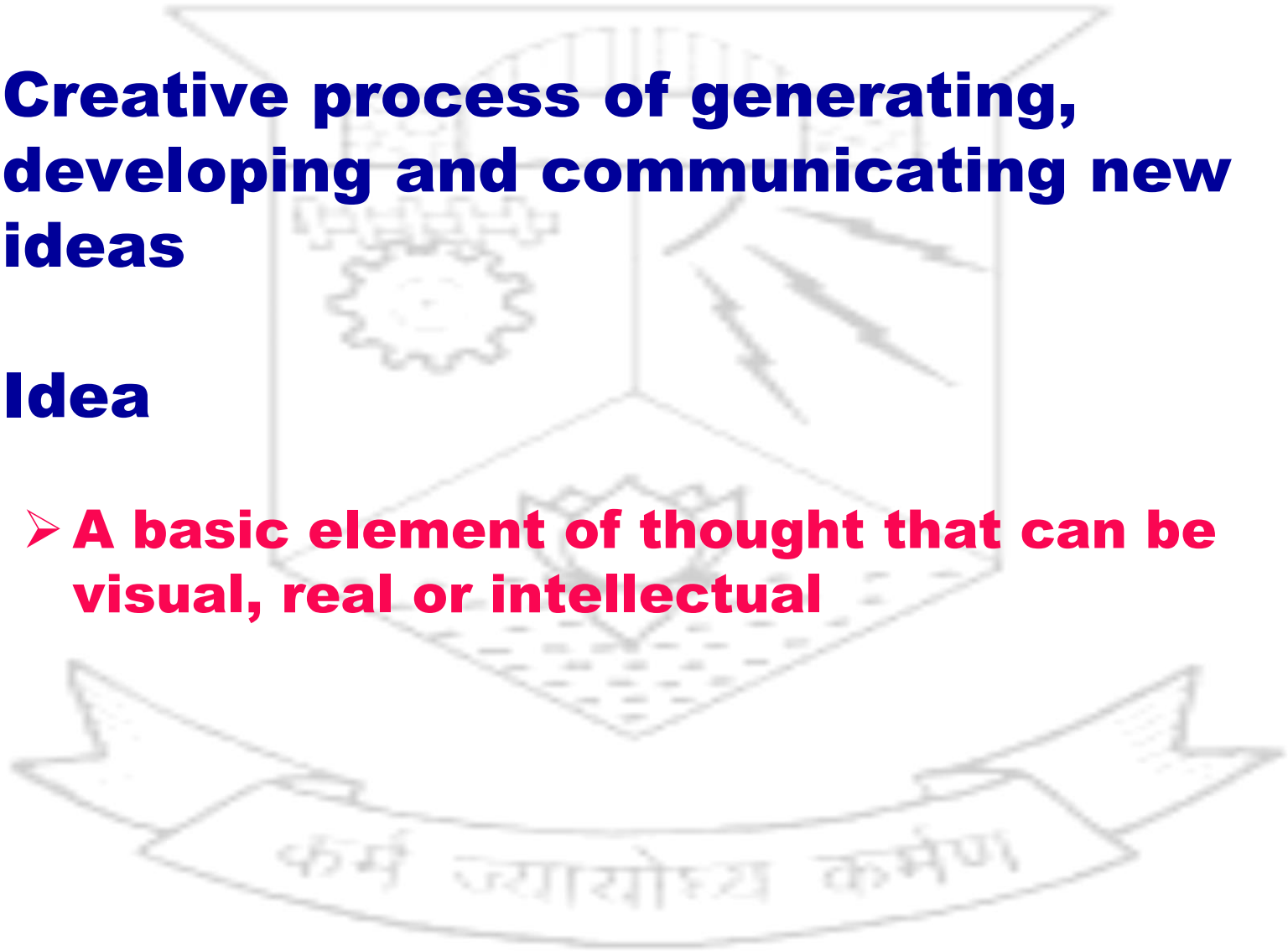 o **Performance, weight and cost**

❖ **Soft attributes**

  o **Cannot be easily defined**

  o **Appearance**

    » **Robust or soft?**

    » **Elegant or rough?**

Ideation

- **Creative process of generating, developing and communicating new ideas**

- **Idea**

  - ➢ **A basic element of thought that can be visual, real or intellectual**

Brain storming

➤ A group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members

➤ The term was popularized by Alex Faickney Osborn in the 1953 book of Applied Imagination

Brain storming (Contd.)

- **General rules of brainstorming are to:**

  ➢ **Reduce social inhibitions among group members**

  ➢ **Stimulate idea generation**

  ➢ **Increase overall creativity of the group**

Brain storming (Contd.)

➢ **Different brain storming approaches**

  ❖ **Nominal group technique**

  ❖ **Group passing technique**

  ❖ **Team idea mapping method**

  ❖ **Directed brainstorming**

  ❖ **Guided brainstorming**

  ❖ **Individual brainstorming**

  ❖ **Question brainstorming**