I. Introduction to Food Processing and Technology

Food processing is a branch of manufacturing where raw materials are transformed into intermediate foodstuffs or edible products through the application of scientific knowledge and technology.

Since prehistoric times, human beings have processed food items; for instance, grains were dried after harvest to increase their shelf life.

Initially, the primary reasons for processing were to improve **digestibility, palatability**, and to ensure a continuous supply.

In the modern context, food processing converts bulky and perishable materials into more useful, shelf-stable, and concentrated forms, often adding value by increasing portability and convenience.

Due to high foreign direct investment and low production costs, this industry is currently termed the **'sunrise sector'** of the Indian economy.

II. Basic Concepts in the Discipline

To master this subject for the CUET, students must distinguish between several interrelated sciences:

- **Food Science:** This is a distinct field involving the application of basic sciences such as chemistry, physics, microbiology, culinary arts, and agronomics. It is a broad discipline concerned with all technical aspects of food, starting from harvesting or slaughtering and ending with consumption.

- **Food Processing:** This refers specifically to the set of methods and techniques used to transform raw ingredients into finished or semi-finished products. It requires high-quality raw materials from plant or animal sources to create marketable food products with a long shelf life.

- **Food Technology:** This is the science and application of scientific, socio-economic knowledge, and legal rules for production. It utilizes knowledge from food science and food engineering to develop skills for the selection, preservation, processing, packaging, and distribution of safe and nutritious foods.

- **Food Manufacturing:** This is the **mass production** of food products using the principles of food technology to meet the diverse needs of a growing population. It is currently one of the largest manufacturing industries globally.

III. Significance of the Sector in India

India has transitioned from an agro-deficit to an agro-surplus country, which has created a massive need for the storage and processing of agricultural produce.

The Indian food industry is the **fifth largest** in terms of size and contributes nearly **6 per cent of the national GDP**.

Despite this status, it is estimated that **one-fifth to one-third** of agricultural produce is wasted, necessitating concerted action in food preservation.

Furthermore, changes in lifestyle and increasing mobility have led to a higher demand for ready-to-eat and processed foods.

Food Fortification is another significant aspect of this field.

Because simple diets based on staple foods are often deficient in certain nutrients, food technologists add lacking nutrients to staples like salt (iodised salt), milk (Vitamins A and D), and flour (folic acid) to ensure minimum dietary requirements are met.

IV. Historical Development of Food Technology

The scientific foundation of food technology evolved through key research milestones:

- **1810: Nicolas Appert** developed the **canning process**, which had a decisive impact on food preservation.
- **1864: Louis Pasteur** conducted research on wine spoilage, providing an early scientific basis for the field. He developed **pasteurisation**, a process used to destroy disease-producing organisms in milk, which was a major advance in food safety.
- Initially, food technology was primarily used to serve **military needs**.
- In the **20th century**, World Wars and space exploration, along with the rising demand from working women, led to the development of instant soup mixes and ready-to-cook meals.
- In the **21st century**, the focus has shifted toward producing foods that are safe, fresh, and suitable for the changing health needs of consumers.

V. Understanding Food Spoilage

Foods are subject to physical, chemical, and biological deterioration. Spoilage results in off-flavours, texture deterioration, discolouration, and a loss of nutritional value, rendering food unfit for consumption.

Causes of Spoilage:

1. **Biological:** Contamination by microorganisms like **bacteria, fungi, yeasts, and moulds**.
2. **Chemical:** Contamination by pesticides or degradation by naturally present **enzymes** which act as biological catalysts.
3. **Physical:** Factors such as pests, insects, inappropriate temperatures, and excessive exposure to light, oxygen, or moisture.

Microbial Growth Factors: Microorganisms grow rapidly under congenial conditions. Their growth is influenced by the availability of nutrients, moisture, pH levels, oxygen, and the presence or absence of inhibiting substances like antibiotics.

- **High-Risk Foods:** Bacteria prefer protein-rich foods such as meat, fish, poultry, and dairy.
- **The Danger Zone:** Bacteria grow rapidly between **5°C and 60°C**.

VI. Principles and Methods of Food Preservation

The basic concepts in food processing to prevent spoilage involve controlling the environment that allows microbes and enzymes to thrive. These methods include:

1. **Application of heat:** To destroy microbes and denature enzymes.
2. **Removal of water moisture:** To inhibit microbial growth (e.g., drying).
3. **Lowering of temperature:** Storing food in cold environments to slow down reactions.
4. **Reduction of pH:** Increasing acidity to prevent microbial survival.
5. **Controlling oxygen availability:** Using packaging techniques to limit oxidative spoilage.

VII. Classification of Processed Foods

Processed foods can be categorized based on their perishability and the extent of processing they undergo.

Based on Perishability:

- **Perishable foods:** Spoil within 1–2 days (e.g., milk, fish, meat).
- **Semi-perishable foods:** Last for 1–2 weeks (e.g., fruits, vegetables, root crops).
- **Non-perishable foods:** Generally last for up to one year (e.g., grains, pulses, oilseeds).

Based on the Extent of Processing:

1. **Minimally processed foods:** Processed slightly to retain fresh quality, such as cleaning, cutting, or slicing.
2. **Preserved foods:** Methods used do not substantially change the character of the product (e.g., frozen or dehydrated peas).
3. **Manufactured foods:** Original characteristics of raw products are lost; ingredients like salt, sugar, and oil are used (e.g., pickles, jams).
4. **Formulated foods:** Prepared by mixing and processing individual ingredients (e.g., bread, biscuits, ice cream).
5. **Food derivatives:** Components obtained through purification, such as sugar from sugarcane.
6. **Functional foods:** Foods having beneficial effects on human health, like probiotics.
7. **Medical foods:** Used for dietary management of diseases, such as lactose-free milk.

VIII. Knowledge and Skills Required for Professionals

A professional food technologist must possess expertise across three main stages of food production:

1. Food as a Material:

- Understanding seasonal availability and the cost of foodstuffs.
- Knowledge of the **nature, properties, and nutritional content** of food.
- Assessing raw ingredient quality and understanding the influence of pesticides and moisture.

2. Food Product Development:

- Knowledge of food hygiene, safety, and **HACCP (Hazard Analysis and Critical Control Point)**.
- Expertise in large-scale food production and industrial manufacturing systems.
- Ability to conduct **sensory evaluation** (testing and tasting) and manage packaging/labelling.

3. Recipe Development:

- Expertise in cooking and measuring ingredients accurately.
- Designing and adapting basic recipes according to consumer perceptions.
- Using **Information Technology** for contemporary production.

IX. Preparing for a Career

To enter this field, students should follow a structured educational path:

- **10+2 Level:** Successful completion of school education.
- **Undergraduate:** A **B.Sc. degree in Home Science** or a B.Sc. specializing in **Nutrition or Food Technology**.
- **Postgraduate: M.Sc. in Food Science and Nutrition** or Food Technology provides comprehensive grounding for industry jobs and research.
- **Specialized Training:** Short-term certificate and diploma courses are available at institutes like the **Central Food Technological Research Institute (CFTRI)** in Mysore.
- **Management Integration:** Institutes like the **National Institute of Food Technology and Entrepreneurship Management (NIFTEM)** at Sonepat offer specialized postgraduate courses.

X. Scope and Career Avenues

The demand for processed, packed, and convenient food with a prolonged shelf life ensures a rewarding future for food technologists. The industry is estimated to grow at a rate of **20 per cent** annually.

Primary Career Paths:

- **Production:** Production Managers and Project Implementation specialists in food industries.
- **Quality and Safety:** Roles in Quality Assurance, Quality Control Laboratories, and as **Food Safety Officers** or Inspectors.
- **Research:** Research and Development (R&D) to modify existing products or develop new ones.
- **Specialized Sectors:** Careers in dairy, confectionery, beverages, meat processing, and flour mills.

- **Support Roles:** Technical marketing, project financing, consultancy, and scientific writing.

- **Academics:** Teaching and research in universities and colleges.

Self-Employment and Entrepreneurship: Food processing has traditionally been a household activity in India (pickles, papads).

Today, the government provides financial incentives and infrastructure support for entrepreneurs to start ventures ranging from low-investment units (e.g., salted peanuts) to highly technology-oriented enterprises. One can also start analytical food laboratories or food safety consultancies.