II year B.Tech
Course Structures and Syllabi
under R19 Regulations
# JNTUA Curriculum

**FOOD TECHNOLOGY B. Tech Course Structure**

## 2nd Year to 4th Years Course Structure

### Semester – 3 (Theory - 6, Lab - 3)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course No</th>
<th>Course Name</th>
<th>Category</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>19A54304</td>
<td>Numerical Methods &amp; Probability Theory</td>
<td>BS</td>
<td>2-1-0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>19A27301T</td>
<td>Food Chemistry</td>
<td>PC</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>19A27302T</td>
<td>Processing Of Cereals, Pulses &amp; Oilseeds</td>
<td>PC</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>19A27303T</td>
<td>Fluid Mechanics for Food Processing</td>
<td>PC</td>
<td>2-1-0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>19A57301</td>
<td>Basic Microbiology</td>
<td>BS</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>19A27304</td>
<td>Principles Of Food Preservation</td>
<td>PC</td>
<td>2-0-0</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>19A27301P</td>
<td>Food Chemistry Lab</td>
<td>PC</td>
<td>0-0-3</td>
<td>1.5</td>
</tr>
<tr>
<td>8.</td>
<td>19A27302P</td>
<td>Processing Of Cereals, Pulses And Oil Seeds Lab</td>
<td>PC</td>
<td>0-0-3</td>
<td>1.5</td>
</tr>
<tr>
<td>9.</td>
<td>19A27303P</td>
<td>Fluid Mechanics for Food Processing Lab</td>
<td>PC</td>
<td>0-0-3</td>
<td>1.5</td>
</tr>
<tr>
<td>10.</td>
<td>19A99302</td>
<td>Biology For Engineers</td>
<td>MC</td>
<td>3-0-0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total:** 21.5

### Semester - 4 (Theory - 6, Lab - 2)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Course No</th>
<th>Course Name</th>
<th>Category</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>19A27401T</td>
<td>Processing Of Fruit And Vegetables</td>
<td>PC</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>19A27402T</td>
<td>Mechanical Operations And Material Handling</td>
<td>PC</td>
<td>2-1-0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>19A27403</td>
<td>Principles Of Food Engineering</td>
<td>PC</td>
<td>2-1-0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>19A27404</td>
<td>Processing Of Fish And Marine Products</td>
<td>PC</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>19A05304T</td>
<td>Python Programming</td>
<td>ES</td>
<td>2-1-0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>19A27405</td>
<td>Processing Of Spices And Plantation Crops And Medicinal Herbs</td>
<td>PC</td>
<td>3-0-0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>19A27401P</td>
<td>Processing of Fruit and Vegetables Lab</td>
<td>PC</td>
<td>0-0-3</td>
<td>1.5</td>
</tr>
<tr>
<td>8.</td>
<td>19A27402P</td>
<td>Mechanical operations and Material Handling Lab</td>
<td>PC</td>
<td>0-0-3</td>
<td>1.5</td>
</tr>
<tr>
<td>9.</td>
<td>19A99301</td>
<td>Environmental Sciences</td>
<td>MC</td>
<td>3-0-0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total:** 21
19A54304  NUMERICAL METHODS AND PROBABILITY THEORY

Course Objective:
This course aims at providing the student with the knowledge on

- Various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations.
- The theory of Probability and random variables.

Unit-I: Solution of Algebraic & Transcendental Equations:
Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method

Unit Outcomes:
Students will be able to
- Calculate the roots of equation using Bisection method and Iterative method.
- Calculate the roots of equation using Regula falsi method and Newton Raphson method.
- Solve the system of algebraic equations using Gauss Jordan method and Gauss Siedal method.

Unit-II: Interpolation
Finite differences-Newton’s forward and backward interpolation formulae – Lagrange’s formulae. Gauss forward and backward formula, Stirling’s formula, Bessel’s formula.

Unit Outcomes:
Students will be able to
- Understand the concept of interpolation.
- Derive interpolating polynomial using Newton’s forward and backward formulae.
- Derive interpolating polynomial using Lagrange’s formulae.
- Derive interpolating polynomial using Gauss forward and backward formulae.
Unit-III: Numerical Integration & Solution of Initial value problems to Ordinary differential equations

Numerical Integration: Trapezoidal rule – Simpson’s 1/3 Rule – Simpson’s 3/8 Rule

Unit Outcomes:

Students will be able to
- Solve integral equations using Simson’s 1/3 and Simson’s 3/8 rule.
- Solve integral equations using Trapezoidal rule.
- Solve initial value problems to ordinary differential equations using Taylor’s method.
- Solve initial value problems to ordinary differential equations using Euler’s method and Runge Kutta methods.

Unit-IV: Probability theory:

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye’s theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

Unit Outcomes:

Students will be able to
- Understand the concept of Probability.
- Solve problems on probability using addition law and multiplication law.
- Understand Random variables and probability mass and density functions.
- Understand stastical constants of random variables.

Unit-V: Random variables & Distributions:

Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties-Uniform distribution-exponential distribution
Unit Outcomes:

Students will be able to
- Understand Probability distribution function.
- Solve problems on Binomial distribution.
- Solve problems on Poisson distribution.
- Solve problems on Normal distribution.

Course Outcomes:

After the completion of course, students will be able to
- Apply numerical methods to solve algebraic and transcendental equations
- Derive interpolating polynomials using interpolation formulae
- Solve differential and integral equations numerically
- Apply Probability theory to find the chances of happening of events.
- Understand various probability distributions and calculate their statistical constants.

TEXT BOOKS:

2. Ronald E. Walpole, “Probability and Statistics for Engineers and Scientists”, PNIE.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley India

REFERENCE BOOKS:

The subject deals with the basic concepts of food analysis, principles of analytical techniques, separation techniques and rapid result methods.

Course Objectives

- To impart knowledge to the students on the Techniques in food analysis
- To read them with the Analytical techniques in Quality control laboratory.

UNIT – I


Unit Outcomes:

At the end of unit, students will be able to
- Understand the concept of sampling and techniques and its importance
- Know the proximate analysis and its significance

UNIT – II

Basic principles: Refractometry, polarimetry, densitometry, HPLC, GLC, spectrophotometry, electrophoresis, automatic amino acid analyzer.

Unit Outcomes:

At the end of unit, students will be able to
- Illustrate the principles of refractometry, polarimetry and densitometry, automatic amino acid analyzer
- Explain the theory of HPLC, GLC, spectrophotometry, electrophoresis
UNIT – III


Unit Outcomes:

At the end of unit, students will be able to

- Understand the various quality tests like starch determination, test for unsaturation of fats
- Describe the quantitative analysis of protein by biuret and ninhydrin methods

UNIT – IV

Chemical, microbiological, flurometric and colorimetric methods of analysis of fat soluble and water soluble vitamins.

Unit Outcomes:

At the end of unit, students will be able to

- Explain the chemical, microbiological methods of analysis of fat and water soluble vitamins
- Know the flurometric and colorimetric methods of analysis of fat and water soluble vitamins

UNIT – V


Unit Outcomes:

At the end of unit, students will be able to

- Describe the principles and methods for estimation of minerals by atomic absorption spectroscopy, colorimetric, titrimetric and gravimetric methods
- Estimate the methods for physical and rheological properties of food.
Course Outcomes

- Understand the concepts of Techniques in food analysis,
- Understand proximate analysis of foods
- Understand Biochemical methods and approaches used in Food analysis

TEXT BOOKS


REFERENCES

**PREAMBLE**

This course covers fundamentals of cereals and pulses processing, equipments, products and storage requirements.

**Course Objectives**

- To learn about the processing of major cereals and pulses.
- To gain knowledge about grain storage structure and handling devices.

**UNIT – I**


**Unit Outcomes:**

At the end of unit, students will be able to

- Learn composition, structure and processing of cereals, legumes & oilseeds
- Know the post processing operations for storage and further processing
- Knowledge of milling and parboiling of paddy and other processing methods
- Importance of quality assessment related to rice and rice products
- Knowledge on value added products and by products of rice.

**UNIT – II**

Wheat-Structure, Composition, Types, quality characteristics for milling into flour and Semolina. Flour milling, Turbo grinding and air classification, Blending of flours, Flour grades and their suitability for baking purposes, Milling equipment and milled products (Dalia, Atta, Semolina
Baked products-Ingredients Technology and quality parameters: Bread, Biscuits, Cakes and Crackers.

**Unit Outcomes:**

At the end of unit, students will be able to

- Acquired knowledge on fundamentals of wheat and its milling
- Detailed description of quality parameters and value added products from wheat

**UNIT – III**


**Unit Outcomes:**

At the end of unit, students will be able to

- Variations in processes of dry and wet milling of corn
- Advantages of value added products from corn
- Knowledge of millets and malting process

**UNIT – IV**

Pulses: Pulses production, types, chemical composition, anti-nutritional factors, milling of pulses, milling equipment, factors affecting quality, secondary processing of pulses, processed products, fermented products, traditional products, Value addition; effect of processing on nutritive value.

**Unit Outcomes:**

At the end of unit, students will be able to

- Description of pulses and their importance
- Impact of anti-nutritional factors in pulses on processing
- Knowledge on milling of pulses and value added products
UNIT – V

Processing of oil seeds for direct use and consumption. Oil extraction methods- mechanical (Ghani and Expellers) and chemical methods (solvent extraction), Processing of extracted oil: Refining, Hydrogenation, Interesterification. Processing of deoiled cake into protein concentrates and isolates, Texturized vegetable protein, Functional protein preparations. Peanut butter, Margarine and Spread.

Unit Outcomes:

At the end of unit, students will be able to

- Explanation of oil extraction methods
- Need of refining and other processes like hydrogenation etc.
- Importance of protein derivatives from oilseeds

Course Outcomes

- Students will get information about the classification of various grains
- Students also exposed to various processing methods and machinery used
- Students will learn value added products from all grains

TEXT BOOKS


REFERENCES

PREAMBLE

The subject covers properties of fluids and its flow characteristics, flow through pipes. Importance of dimensional analysis and its applicability. Types and Selection of pumps.

Course Objectives

- The basic concepts and fluid-flow phenomena and the kinematics of flow
- To enable the students to design efficient water conveyance systems like canals, channels and pipes from places of origin to delivery points by acquiring knowledge on the principles of mechanics of fluids, water measurement and regulation

UNIT – I

Introduction and Properties of Fluids: Concept of fluid mechanics, definition of fluid, density, specific weight, Viscosity: Newtonian and Non-Newtonian fluids, kinematic viscosity, dynamic viscosity, variation of temperature with viscosity, Surface tension, vapour pressure, incompressible and compressible fluids, ideal and real fluids

Unit Outcomes:

At the end of unit, students will be able to

- Explain the properties of fluids and concept of fluid mechanics
- Differentiate Newtonian and non-Newtonian fluids
- Concept of viscosity and types and their effect on temperature
- Description of basics of classification of fluids

UNIT – II

Fluid Mechanics Pressure Measurement: Static pressure of liquids, absolute and gauge pressures, pressure measurement devices: mechanical instruments, electro-mechanical instruments electronic instruments. Dynamics of Fluid Flow, Euler’s equation of motion, Bemoulli’s equation, applications of Bernoulli’s equation, cavitation.
Unit Outcomes:
At the end of unit, students will be able to
- Measure the fluids by various instruments.
- Explain the different forces acting on fluids.
- Importance of dynamic flow and their applications.

UNIT – III
Kinematics of Fluid Motion and Classification of Flow: Method of describing fluid motion, classification of flow: steady and unsteady; uniform and non-uniform; one, two and three dimensional flow Laminar and turbulent flows, streamline, pathline and streakline Acceleration equations, continuity equations.

Unit Outcomes:
- Description of kinematics of flow.
- Classify the fluid flow.
- Derive the continuity equation and its importance.

UNIT – IV

Unit Outcomes:
At the end of unit, students will be able to
- Calculate the energy losses in pipe & fittings.
- Role of equivalent length in fluid flow.
- Knowledge on various flow measurements.

UNIT – V
Fluid Machines: Pumps – classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump. Centrifugal pumps: Pumps in series and parallel, basic equations applied to centrifugal pump, operating characteristics of centrifugal pumps. Submersible pumps: Reciprocating pumps: working of reciprocating pump, double acting pump, gear pump.
Unit Outcomes:

At the end of unit, students will be able to
- Basis for selection of pumps, types of pumps
- Applications of pumps and efficiency of pumps.

Course Outcomes

By the end of the course the students will be able to
- Gain knowledge on Bernoullies theory, Buckingham’s Pi theorem, Hagen-Poiseuille equation
- Gain the knowledge on mechanical gauges, flow of fluids in the pumps, and Archimedes principles and theory
- Understand flow through mouth pieces, flow through orifices and pumps

TEXT BOOKS


REFERENCES

PREAMBLE
This subject includes the basic concepts of microbiology, classification of micro-organisms, growth factors, types of culture media etc.

Course Objectives

- To learn the basic microbiological classification and microbial techniques.
- To enable students to gain knowledge on various microbial cultures and their growth factors.

UNIT – I

Evolution and scope of microbiology; History of microbiology; Classification of microorganisms, Applied areas of microbiology; Microscopy – Optical & Electron- Optical: Bright field, dark field, ultraviolet, phase contrast, fluorescent; Electron- Scanning electron microscopy, Transmission electron microscopy; Morphology, general characteristics & Reproduction of algae; Morphology general characteristics and reproduction of fungi and molds.

Unit Outcomes:

At the end of unit, students will be able to
- Importance of field of microbiology in different areas
- Awareness on microscopy and its types
- Basic information on Morphology, reproduction of algae, fungi

UNIT – II

Morphology general, characteristics, structure, classification, identification, reproduction, nutrition and growth of bacteria, bacteria genetics; bacteria recombination; Bacterial conjugation, transduction; Bacterial transformation

Unit Outcomes:
At the end of unit, students will be able to
- Explain the morphology, reproduction of bacteria
- Know about cell structure, classification and identification of bacteria
- Acquires knowledge on bacterial recombination and their types
- Basics of bacteria genetics

UNIT – III

Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants.

Unit Outcomes:

At the end of unit, students will be able to
- Know about the importance of mutation and its types
- Occurrence of mutations and adverse effect and repair of mutations
- Explain the phenotypes of bacterial mutants and their designation

UNIT – IV

Viruses – Structure, shape classification based on nucleic acid; replication and multiplication; food borne viruses

Unit Outcomes:

At the end of unit, students will be able to
- Explain the study of virus structure
- Know the classification of nucleic acid
- Basic concepts of replication and multiplication

UNIT – V

Factors affecting growth of microorganism, Intrinsic factors and Extrinsic factors; Identification of bacteria- bacteria straining, estimating members cell counts, viable, plate counts; Pure culture: Definition, methods of isolation, preservation techniques; control of microorganisms by physical, chemical, antibiotic and other chemotherapeutic agents.

Unit Outcomes:
At the end of unit, students will be able to

- Know the factors affecting growth of microorganisms both internal and external
- Identify the bacteria and enumeration
- Acquires knowledge on pure cultures, isolation methods, preservation techniques
- Various methods of controlling microorganisms

**Course Outcomes**

By the end of the course, students will learn

- Significance and importance of microbiology
- Morphology of various microorganisms
- Control of microorganisms and preservation of pure cultures

**TEXT BOOKS**


**REFERENCES**

2. George J Banwart, “Basic Food Microbiology”
3. S S Purohit “Microbiology Fundamentals and Applications”
4. M R Adams & M O Moss “Food Microbiology”
5. James M Jay “Modern Food Microbiology”

17 Page
PREAMBLES

This course helps the students to apply basic food science knowledge and get to know biochemical changes occurring during various processing and preservation techniques.

Course Objectives

- Emphasis on importance of food technology into reduce the spoilage and improve the quality
- To explore the various preservation methods

UNIT – I

Definition and scope of Food Science and Technology, Historical development of food processing and preservation, general principles of food preservation. Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods.

Unit Outcomes:

At the end of unit, students will be able to

- Understand the scope and importance of Food Science and Technology
- Know the developments in food processing
- Have idea on principles of preservation and its methods

UNIT – II

Preservation of foods by low temperatures: (A) Chilling temperatures: Consideration relating to storage of foods at chilling temperatures, Chilling injury, Applications and procedures, Controlled and Modified atmospheric storage of foods, Post storage Handling of foods.

(B) Freezing temperatures: Freezing process, Slow and quick freezing of foods; effect on foods, other occurrences associated with freezing of foods. Technological aspects of pre freezing, Actual freezing, Frozen storage and thawing of foods, Individual Quick Freezing.
Unit Outcomes:

At the end of unit, students will be able to
- Gain knowledge on preservation of foods by chilling and its applications
- Understand the concepts of freezing and its types

UNIT – III


Unit Outcomes:

At the end of unit, students will be able to
- Acquire knowledge on cooking, blanching, pasteurization and sterilization and other high temperature preservation techniques
- Know the concepts on thermal destruction of foods

Unit – IV

Preservation by water removal: (a) Principles, Technological aspects and application of evaporative concentration process; Freeze concentration and membrane process for food concentrations. (b) Principles, Technological aspects and application of drying and dehydration of foods, Cabinet, tunnel, belt, bin, drum, spray, vacuum, foam mat, fluidized-bed and freeze drying of foods.

Unit Outcomes:

At the end of unit, students will be able to
- Understand the importance of concentration and evaporation in food processing
- Know the dehydration and its applications
UNIT – V

Chemical & Natural Preservatives: Classification, Principles, Radiations: Sources of radiations, units and dosages, effect on microorganisms and different nutrients; dose requirements for radiation preservation of foods., safe limits, irradiation mechanism and survival curve, technological aspects; applications of sugar and salt, antimicrobial agents, biological agents, Hurdle technology. Effects of various food processing operations on the nutritive value of foods.

Unit Outcomes:

At the end of unit, students will be able to
- Have knowledge on role of chemical as a preservatives
- Acquires understanding of radiation and its effects on foods
- Know the concept of hurdle technology

Course Outcomes

Upon completion of this course students should be able to understand
- The changes occurring during various food processing techniques
- The changes during storage and preservation
- The effect of enzymes on spoilage reactions of foods

TEXT BOOKS


REFERENCES

Course Objectives

- To expertise the students to analyze the proximate composition and other important constituents present in the food.

EXPERIMENTS

1. Sampling plan; Sampling requirements, Sample collection and preparation for analysis procedures and methods
2. Determination of pH
3. Determination of moisture content of foods by oven drying and distillation methods
4. Determination of Total and Acid insoluble ash content in foods
5. Determination of crude fat content by solvent extraction methods in foods
6. Determination of crude Protein by Kjeldhal Lowry method & other methods
7. Determination of reducing and total sugar content in foods
8. Determination of crude fibre content in foods
9. Determination of specific mineral contents in foods such as Calcium, Iron, Phosphorus, Chloride etc.
10. Determination of specific vitamin content of food such as ascorbic acid, carotenes etc.
11. Determination of specific Natural and/or added Colouring Matters in foods
12. Determination of specific added food Preservatives in foods

Course Outcomes

By the end of the practical exercises, the students will be able to
- Adapt suitable method for food analysis
- Apply the knowledge of Techniques in Food Analysis,
- Differentiate between Qualitative identification and Quantitative estimations
Course Objectives

- Determination of parameters by qualitative and quantitative methods
- Study on some important unit operations used for some grains
- Preparation of standard food products

EXPERIMENTS

1. Determination of physical properties (Bulk Density, Porosity, Sphericity, Angle of repose, Test weight, Particle size, Sieve analysis) of different grains.
2. Determination of Gluten content, sedimentation value, alcoholic acidity, water absorption capacity and Polenske value of wheat flour.
3. Determination of adulterant (NaHCO₃) in wheat flour/Maida.
4. Determination of alkali score and gelatinization temperature of rice.
5. Traditional and improved pre-treatments and their effect on dehusking of some legumes.
6. Removal of anti-nutritional compounds from selected pulses and oilseeds.
7. Study of cooking quality of Dhal.
8. Pearlization of millets.
10. Determination of different quality parameters of oils.
11. Determination of efficiency of oil extraction techniques (mechanical expelling and solvent extraction).
12. Preparation of Bread.
13. Preparation of Biscuits.
15. Preparation of Cake.
16. Preparation of Rusk.
17. Preparation of Crackers.
18. Visit to a Bakery, Confectionery Unit
19. Visit to a working modern roller flour mill and FCI godowns.
20. Visit to working rice mill.
Course Outcomes

- Students are exposed to learn various parameters determination and quantification
- Students will able to prepare and understand the technology involved in foods from grains
- Students will acquire more knowledge by visiting industries
Course Objectives

- To impart knowledge on coefficient of discharge, friction factor, pressure drop on different fluids.
- Importance of pipe fittings and application of various pumps in food industry.

EXPERIMENTS

1. To determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape.
2. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.
3. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
4. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
5. To study the variation of friction factor, ‘f’ for turbulent flow in smooth and rough commercial pipes.
6. To determine the loss coefficients for the pipe fittings.
7. To verify Bernoulli’s equation experimentally.
8. To determine the flow rate and coefficient of discharge using Venturimeter.
9. To measure discharge through Rotameter.
10. To determine the Reynolds number and types of flow (Laminar or Turbulent), the flow rate and coefficient of discharge using Orifice meter.
11. To determine losses due to pipe fitting, sudden enlargement and contraction.
13. To determine the characteristics of centrifugal pump and to find out total head, pump efficiency and overall efficiency of pump.
14. Study of various types of pipes and pipe fittings.
15. Study of different types of valves.
16. Study of reciprocating pump.
17. Determination of frictional coefficient of given pipe.
**Course Outcomes**

By the end of the course the students will be able to

- Know the measurement of fluid pressure, measurement of discharge and measurement of time
- Know how to determine the Coefficient of discharge from the pitot tube experiment
- How to measure the water level from ‘U’ tube manometer.
19A99302 BIOLOGY FOR ENGINEERS

Course Description: To provide basic understanding about life and life Process. Animal an plant systems. To understand what bimolecules, are, their structures are functions. Application of certain bimolecules in Industry.

- Brief introduction about human physiology and bioengineering.
- To understand hereditary units, i.e. DNA (genes) and RNA and their synthesis in living organism.
- How biology Principles can be applied in our daily life using different technologies.
- Brief introduction to the production of transgenic microbes, Plants and animals.

Course Outcomes:

After studying the course, the student will be able to:

- Explain about cells and their structure and function. Different types of cells and basics for classification of living Organisms.
- Explain about biomolecules, their structure and function and their role in the living organisms. How biomolecules are useful in Industry.
- Briefly about human physiology.
- Explain about genetic material, DNA, genes and RNA how they replicate, pass and preserve vital information in living Organisms.
- Know about application of biological Principles in different technologies for the production of medicines and Pharmaceutical molecules through transgenic microbes, plants and animals.

Unit I: Introduction to Basic Biology (8 hours)

Unit Outcomes:
After completing this unit, the student will be able to
- Summarize the basis of life. (L1)
- Understand the difference between lower organisms (prokaryotes) from higher organisms (eukaryotes). (L2)
- Understand how organisms are classified. (L3)

Unit II: Introduction to Biomolecules (8 hours)
Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

Unit Outcomes:
After completing this unit, the student will be able to
- Understand what are biomolecules? their role in living cells, their structure, function and how they are produced. (L1)
- Interpret the relationship between the structure and function of nucleic acids. (L2)
- Summarize the applications of enzymes in industry. (L3)
- Understand what is fermentation and its applications of fermentation in industry. (L4)

Unit III: Human Physiology (8 hours)
Nutrition: Nutrients or food substances. Digestive system, Respiratory system, (aerobic and anaerobic Respiration). Respiratory organs, respiratory cycle. Excretory system.

Unit Outcomes:
After completing this unit, the student will be able to
- Understand what nutrients are (L1)
- Understand the mechanism and process of important human functions (L2 & L3)

Unit IV: Introduction to Molecular Biology and recombinant DNA Technology:
(8 hours)
Prokaryotic gene and Eukaryotic gene structure. DNA replication, Transcription and Translation. rDNA technology. Introduction to gene cloning.
Unit Outcomes:
After completing this unit, the student will be able to

- Understand and explain about gene structure and replication in prokaryotes and Eukaryotes (L1)
- How genetic material is replicated and also understands how RNA and proteins are synthesized. (L2)
- Understand about recombinant DNA technology and its application in different fields. (L3)
- Explain what is cloning. (L4)

Unit V: Application of Biology (10 hours)

Unit Outcomes:
After completing this unit, the student will be able to Understand.

- How biology is applied for production of useful products for mankind. (L1)
- What are biosensors, biochips etc. (L2)
- Understand transgenic plants and animals and their production (L3)

TEXT BOOKS:
1. P.K.Gupta, “Cell and Molecular Biology”

REFERENCE BOOKS:
4. Phil Tunner, A. Metennan, A. Bates & M. white “Instant Notes – Molecular Biology” 2014

28 Page
PREAMBLE

This course enables the students to gain a sound knowledge about the processing and preservation technologies of fruits and vegetables.

Course Objectives

At the end of this course the students get a detailed background about
- Various methods used for preserving fruits and vegetables.
- Different operations involved in processing fruits and vegetables
- Technology behind intermediate moisture and minimally processed fruit and vegetable.

UNIT – I

Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India; Overview of principles and preservation methods of fruits and vegetables; Supply chain of fresh fruits and vegetables;

Unit Outcomes:

At the end of unit, students will be able to
- Acquires the present status and production trends in India and world.
- Have brief idea on overall preservation methods and its principles.
- Know the importance of supply chain in fresh fruits and vegetables.

UNIT – II

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables; Storage of Fresh Fruits and Vegetables: Containers: Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, spoilage organisms, detection and control.
Unit Outcomes:

At the end of unit, students will be able to
- Understand the primary processing methods
- Know the storage of fruits and vegetables
- Assess the spoilage factors in canned foods and responsible microorganisms and their control

UNIT – III

Preparation and preservation of Juice, Squash, Syrup, Sherbet, Nectar, Cordial, Crush etc.; FSSAI specifications, Processing and equipment for above products; Preparation, preservation and equipment for manufacture of crystallized fruits and preserves, Jam, Jelly and Marmalades, defects in making, Candies; FSSAI specifications.

Unit Outcomes:

At the end of unit, students will be able to
- Know the preservation of various fruit products like squash, syrup and cordial etc.
- Understand the process equipment used for crystallized fruits and preserves, jam, jelly etc.
- Explain standards given by FSSAI.

UNIT – IV

Preparation, preservation and equipment for manufacture of Chutney, Pickles, Sauce, Puree, Paste, Ketchup; Toffee, Cheese, Lather. Production of Pectin and Vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products; FSSAI specifications.
Unit Outcomes:

At the end of unit, students will be able to

- Gain knowledge on equipment, process for various fruit and vegetable products
- Know the importance of Specifications given by FSSAI

UNIT – V
Minimally processed Fruits and Vegetables: Factors affecting shelf life and the quality of minimally processed fruits and vegetables, physiology and biochemistry of fresh cut fruits. Dehydration of Fruits and Vegetables: Methods; packaging, storage, quality control. Products: Dehydrated, Wafers and Papads, Soup powders; Food additives: Use in fruit and vegetable preservation; Restructured fruits & Vegetables; FSSAI specifications.

Unit Outcomes:

At the end of unit, students will be able to

- Have broad idea on minimally processed fruits and vegetables
- Understand the factors affecting shelf life and their quality of minimally processed fruits and vegetables
- Know the process technology of different value added products from fruits and vegetables

Course Outcomes

By the end of the course, the students will be able to

- Train the students in the field of Fruit and Vegetable Processing.
- Enable the students learn different preservation techniques to curb post-harvest losses in the field of agriculture.
- Learn processing of fruits & vegetables - different preservation techniques to improve the shelf life of seasonal fruits.
- Understand the importance of FSSAI Specifications

TEXT BOOKS

REFERENCES

PREAMBLE

The broad idea of this subject mentions about each individual operation and its applicability in food processing.

Course Objectives

- To impart knowledge to the students on principles, operation and maintenance of various food processing equipment namely mixing, forming, size reduction, cutting and grinding equipment, centrifugation, filtration material handling equipment like belt, screw and pneumatic conveyors, bucket elevator.

UNIT – I


Unit Outcomes:

At the end of unit, students will be able to
- Know the various properties of foods
- Explain the primary processing operations
- Describe the size reduction and principles, equipment

UNIT – II

Sedimentation: Theory and principles of sedimentation, minimum area for continuous sedimentation, applications in food industry. Filtration: Principle of Constant pressure and constant rate filtration and types of filtration equipment, Settling classifiers and Flotation. Screening, types of screen. Centrifugation: Principle of settling and centrifugation, devices for

**Unit Outcomes:**

At the end of unit, students will be able to

- Acquire basic knowledge on sedimentation, filtration and their equipment
- Explain the principles of centrifugation and membrane separation and its applications

**UNIT – III**

Mixing: Mixing of liquids and solids (powder), mixing equipment, mixing index and mixing time, Agitation and blending, types of agitators, power consumption in mixing. Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; Separation/Grading: Theory and principles: Types of separators – Disk, Indent cylinder, spiral and specific gravity, stone, inclined belt, pneumatic and aspirator separators- separation based on fluidization techniques – magnetic, cyclone and color separator.

**Unit Outcomes:**

At the end of unit, students will be able to

- Know the importance of mixing in solid and liquid foods and their equipment
- Applications of material handling equipment
- Various types of separators and its applications

**UNIT – IV**

Belt conveyor: Principle, characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain; Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors;
Unit Outcomes:

At the end of unit, students will be able to

- Explain the operation of belt conveyor and its practical applications
- Know the principle of screw conveyor and its types

UNIT – V

Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Pneumatic conveying system: Capacity and power requirement, types, air/product separators; Gravity conveyor design considerations, capacity and power requirement. Storage: Methods of storage, silos and bins, hoppers.

Unit Outcomes:

At the end of unit, students will be able to

- Know the detailed working mechanism of bucket elevator and its parts
- Pros and Cons of using bucket elevator
- Acquires knowledge on pneumatic conveyors and its application
- Explain the various methods of storage and their equipment

TEXT BOOKS

1. R.L. Earle. “Unit operations in Food Engineering”.

REFERENCES

2. N. N. Mohesinin “Physical properties of Plant and Animal materials”.
6. P.G Smith “Introduction to Food Process Engineering”.

35 Page
Course Outcomes

By the end of the course, the students will be able to

- Understand different food processing equipment that are being used in food industries
- Study about the principles, operation and maintenance of food processing equipment viz., material handling, cleaning, grading, mixing, forming, size reduction, cutting, grinding, centrifugation, filtration, evaporation and drying
PREAMBLE

The text prescribed for detailed study focuses on basic concepts like units and its conversion, fundamental laws and principles are useful to understand the subject.

Course Objectives

- To familiarize the importance and usage of units.
- To understand the fundamental laws and principles and its application

UNIT – I


Unit Outcomes:

At the end of unit, students will be able to

- Basic terminology related to Food Engineering
- Importance of conversion of units
- Basic knowledge on steam properties
- Classify the boilers and their selection

UNIT – II

Unit Outcomes:

At the end of unit, students will be able to
- Importance and applicability of above laws
- Explain the terminology related to thermodynamics
- Applications of laws of thermodynamics
- Acquires knowledge on Refrigeration and its applications

UNIT – III

Humidity: Humidity & Relative Humidity, Saturation Humidity, Percentage Humidity, Psychrometric chart – Utilization, problems; Humidifiers & Dehumidifiers; Applications. Material balance and Energy balance in various unit operations – Problems, significance in food processing

Unit Outcomes:

At the end of unit, students will be able to
- Know about humidifiers and dehumidifiers and its applications
- Importance of material and energy balances in food processing

UNIT – IV


Unit Outcomes:

At the end of unit, students will be able to
- Have knowledge on dimensional analysis and derivations
- Have idea about engineering properties of foods
UNIT – V


Unit Outcomes:

At the end of unit, students will be able to
- Basic concepts of process parameters
- Knowledge on measurement and control of these parameters
- Various controlling methods.

Course outcomes
- Students will learn the importance of units.
- Students will understand the basic laws and principles and its application in food engineering

TEXT BOOKS


REFERENCES

PREAMBLE

This subject focus on scope and status of marine industry, various processed products with different preservation techniques, novel methods.

Course Objectives

- To impart knowledge on fisheries and other marine foods, their nutritional composition and processing technologies

UNIT – I

Fisheries resources, global and Indian scenario; Types of fish and other marine products; Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish and quality assessment, spoilage of fish- microbiological, physiological, biochemical; Relationship between chilling and storage life.

Unit Outcomes:

At the end of unit, students will be able to

- Gain knowledge on present scenario of fisheries in India
- Know the different types of fish and marine products
- Describe the fish composition and characteristics, quality assessment
- Understand the different spoilage parameters
- Know the importance of relation between chilling and storage life.

UNIT – II

Methods of Preservation of fish: Drying, Salting, Smoking and Curing. General aspects of fish freezing, changes in quality during chilled and frozen storage; Principles of canning, effect of heat processing on fish, storage of canned fish, preprocess operations, post-process operations, cannery operations for specific canned products;
Unit Outcomes:

At the end of unit, students will be able to

- Describe the methods of preservation techniques
- Identify the changes in quality during the storage
- Have detailed idea on canning process and its products

UNIT – III

Fish products: Introduction, fish muscle proteins, surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products; Preparation protocols of indigenous products: Fish sauce and paste.

Unit Outcomes:

At the end of unit, students will be able to

- Explain the various products prepared from fish mainly surmi
- Understand the quality of surmi products and comparison with minced products
- Get to know about fish sauce and paste

UNIT – IV

Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging; Oxygen absorbents and CO₂ generators, ethanol vapour generation, hurdle barrier concept, value added fish products, packaging; Sea food quality assurance, HACCP, EU hygienic regulations and ISO 9000 standards; New kinds of quality and safety problems emerging in sea food processing and preservation.

Unit Outcomes:

At the end of unit, students will be able to

- Know the importance of novel methods like irradiation, high pressure processing, oxygen absorbents and etc.
- Understand the value addition of fish products
- Acquire knowledge on quality assurance and standards for fish processing
UNIT – V

Fish by products - production of fish meal, fish protein extracts, fish protein hydrolysates, fish protein concentrate, fish liver oil and fish sauce and other important byproducts; Quality control of processed fish; Fish processing industries in India.

Unit Outcomes:

At the end of unit, students will be able to
- Understand the byproducts from fish and their processing
- Know the quality control of processed fish
- Get knowledge on fish processing industries in India

Course Outcomes

By the end of the course, the students will be able to
- Gain knowledge in the areas of fish and other marine food preservation and processing technology.

TEXT BOOKS


REFERENCES

19A05304T  PYTHON PROGRAMMING

Course Objectives:

- To learn the fundamentals of Python
- To elucidate problem-solving using a Python programming language
- To introduce a function-oriented programming paradigm through python
- To get training in the development of solutions using modular concepts
- To introduce the programming constructs of python

Unit – I

Introduction: What is a program, Running python, Arithmetic operators, Value and Types.
Variables, Assignments and Statements: Assignment statements, Script mode, Order of operations, string operations, comments.
Functions: Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.

Unit Outcomes:

Student should be able to
- List the basic constructs of Python.
- Solve the problems by applying modularity principle.

Unit – II

Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring.
Conditionals and Recursion: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input.
Fruitful Functions: Return values, Incremental development, Composition, Boolean functions, More recursion, Leap of Faith, Checking types,
Unit Outcomes:

Student should be able to
- Apply the conditional execution of the program.
- Apply the principle of recursion to solve the problems.

Unit - III

Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms.
Strings: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison.
Case Study: Reading word lists, Search, Looping with indices.
Lists: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.

Unit Outcomes:

Student should be able to
- Use the data structure list.
- Design programs for manipulating strings.

Unit – IV

Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables.
Tuples: Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences.
Files: Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules.
Classes and Objects: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.
Classes and Functions:

Unit Outcomes:

Student should be able to
- Apply object orientation concepts.
- Use data structure dictionaries.
- Organize data in the form of files.
Unit – V

**Classes and Functions:** Time, Pure functions, Modifiers, Prototyping versus Planning  
**Classes and Methods:** Object oriented features, Printing objects, The init method, The __str__ method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation  
**Inheritance:** Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Class diagrams, Data encapsulation.  
**The Goodies:** Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, defaultdict, Named tuples, Gathering keyword Args,

**Unit Outcomes:**

Student should be able to  
- Plan programs using object orientation approach.  
- Illustrate the principle of inheritance.

**Text books:**


**Reference Books:**


**Course Outcomes:**

Student should be able to  
- Apply the features of Python language in various real applications.  
- Select appropriate data structure of Python for solving a problem.  
- Design object oriented programs using Python for solving real-world problems.  
- Apply modularity to programs.
PREAMBLE

The subject covers the importance of spices and processing of major and minor spices, plantation crops and medicinal crops and secondary and tertiary processing.

Course Objectives

- To impart knowledge about spice processing and their marketable standards, plantation crops and their importance in Indian economy, post-harvest technology of spices, value added products of spices, packaging of processed spices, food, medicinal and pharmaceutical uses of different spices.

UNIT – I

Importance and Processing of Spices: Classification, chemical composition and principal constituents, History of usage & Spice trade in India and the world.
Spices – production and importance – stage of harvesting and harvesting methods – processing of major spices – Ginger, Chilli, Turmeric and Garlic, Pepper, Cardamom – Unit operations involved – equipment used- value addition of spices.

Unit Outcomes:

At the end of unit, students will be able to
- Get information on history, classification, chemical composition and principal constituents of spices
- Understand the harvesting stages and methods and their processing, utilization of various major spices like ginger, chilli, turmeric etc.
- Know the equipment used and operations involved, valued added products from spices

UNIT – II

Processing of minor Spices: Herbs, leaves and Spartan seasonings and their processing and utilization – All spice, Annie seed, Sweet basil; Caraway seed, Cassia, Cinnamon; Clove, Coriander, Cumin, Dill seed; Fennel seed, Nutmeg, Mace, Mint, Marjoram. Rosemary, saffron,
sage; savory, thyme, ajowan; Asafetida, curry leaves – Unit operations involved – equipment used- value addition of spices.

Unit Outcomes:

At the end of unit, students will be able to

- Understand the harvesting stages and methods and their processing, utilization of various minor spices like herbs, leaves, cinnamon, clove, coriander, nutmeg and etc.
- Know the equipment used and operations involved, valued added products from spices

UNIT – III

Processing of Plantation Crops: Tea Processing Composition and production of tea leaves; processing of tea leaves; CTC tea, black tea, green tea and Oolong tea, grading and packaging; processing of instant tea Coffee Processing Production and processing of coffee cherries by wet and dry method; processing technology for coffee; preparation of brew; processing technology for instant coffee and decaffeinated coffee.

Unit Outcomes:

At the end of unit, students will be able to

- Know about the importance of plantation crops, composition, production and processing of tea leaves, different types of tea, grading and packaging
- Understand the production and processing of coffee by wet and dry method
- Get knowledge on processing technology for instant tea, coffee and decaffeinated coffee, brew.

UNIT – IV

Processing of Plantation Crops: Cocoa processing Cocoa bean- introduction, history and composition; processing of cocoa bean; processed products of cocoa. Coconut, Areca nut, Vanilla and Cashew nut– production and importance – harvesting and stages of harvest – drying, cleaning and grading, processing methods, process and equipment – value added products – grading and types – packaging and storage
Unit Outcomes:

At the end of unit, students will be able to

- Know about the history, importance of cocoa, composition and processing of cocoa beans and processed products
- Understand the harvesting and stages like drying, cleaning and grading and various processing methods for coconut, arecanut, vanilla and cashew nut
- Get knowledge on process and equipment used, value added products from above mentioned plantation crops
- Study of grading, types, packaging and storage for above all plantation crops

UNIT – V

Processing of Medicinal Crops: Importance of medicinal crops – production and export status – processing of medicinal crops – equipment used – principles and operations – active components in various medicinal plants – application and uses – extraction methods

Extraction of Principal Constituents in Spices

Spice Oils & Oleoresins: Flavour extraction from Spices by different methods.

Unit Outcomes:

At the end of unit, students will be able to

- Study about the importance, production and export status of medicinal crops
- Understand the processing and equipment used for medicinal crops
- Know about active components in various medicinal plants and their application, uses
- Get knowledge on extraction methods, Extraction of Principal Constituents in Spices, Oils & Oleoresins: Flavour extraction from Spices by different methods

Course Outcomes

By the end of the course, the students will be able to

- Know history of spices, uses of spices, classification of processed spices according to marketing standards, packaging and different grades
- Learn about flavor development during processing, classification of spices according to economic importance, post-harvest technology and treatments, specifications for marketed products
TEXT BOOKS


REFERENCES


Course Objectives

- Estimation of preservatives like benzoic acid and SO₂, different processed products from fruit and vegetables and each operation importance.

LABORATORY EXPERIMENTS

1. Estimation of benzoic acid & SO₂
2. Pectin determination in fruits and vegetable products.
3. Preparation fruit juices e.g. carambola, orange, pineapple, mango etc.
4. Canning of fruits and vegetables
5. Extraction of Pectin (identification pectin rich foods, chemistry and interaction of pectin with other components)
6. Preparation of jams and jellies, marmalade, crystallized & glazed fruit, preserves and candies (knowledge on selection of fruits)
7. Preparation of Syrup, Squash, Crush
8. Preparation of tutti-frutti
9. Preparation of pickles, chutneys
10. Preparation of tomato products
11. Preparation of Papain
12. Drying of fruit and vegetables (Soup powders, dried products)
13. Visit to a Canning Plant
14. Visit to Fruits and Vegetable processing industries; processing of Mushrooms.

Course Outcomes

- The students will learn the all processing methodology of fruit and vegetable products and significance of each unit operation.
19A27402P  MECHANICAL OPERATIONS & MATERIAL HANDLING LAB

Course Objectives

- To impart practical orientation of usage of different mills, concept of terminal and settling velocity.
- Calculation of filter cake resistances.

LABORATORY EXPERIMENTS

1. Particle size distribution using sieve shaker.
2. To find out the screen effectiveness of a given sample by vibratory screen
3. To find out the grading efficiency of a given sample by destoner
4. To find out the grading efficiency of a given sample in specific gravity separator
5. To find out the grading efficiency of a given sample in spiral separator
6. Estimation of work index of material in grinding
7. Mixing experimentation and determination of mixing index.
8. Determination of power consumption in mixing/agitation.
10. Determine the efficiency of Cyclone separator.
11. Settling velocity of a particle by sedimentation.
12. Determination of separation efficiency of suspension by using tubular bowl/nozzle centrifuge

Course Outcomes

By the end of the course, the students will be able to

- Find out screen efficiency, grading efficiency & separation efficiency
- Find out particle size distribution
- Find out grinding index
- How to find out resistances in filtration
19A99301 ENVIRONMENTAL SCIENCE

Course Objectives:

- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life
- To save earth from the inventions by the engineers.

UNIT – I


Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

Unit Outcomes

- To know the importance of public awareness
- To know about the various resources

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- a. Forest ecosystem.
- b. Grassland ecosystem
- c. Desert ecosystem
- d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Course Outcomes:

- To know about various echo systems and their characteristics
- To know about the biodiversity and its conservation

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Course Outcomes:

- To know about the various sources of pollution.
- To know about the various sources of solid waste and preventive measures.
- To know about the different types of disasters and their managerial measures.

UNIT – IV


Course Outcomes:

- To know about the social issues related to environment and their protection acts.
- To know about the various sources of conservation of natural resources.
- To know about the wild life protection and forest conservation acts.

UNIT – V


Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Unit Outcomes:

- To know about the population explosion and family welfare programmes.
- To identify the natural assets and related case studies.

Course Outcomes:

At the end of the course, the student will be able to

- Grasp multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.
- Understand flow and bio-geo-chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid waste management and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.
- Casus of population explosion, value education and welfare programmes.
TEXT BOOKS:


REFERENCES:

3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House