# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
## (Established by Govt. of A.P., ACT No.30 of 2008)
## ANANTHAPURAMU – 515 002 (A.P) INDIA

### Food Technology

**Semester-III**

| S.No. | Course Code | Course Name | Category | Hours per week | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | |
| 1. | 20A54402 | Numerical Methods and Probability Theory | BS | 3 | 0 | 0 | 3 |
| 2. | 20A27301 | Food Chemistry | PC | 3 | 0 | 0 | 3 |
| 3. | 20A27302T | Processing of Cereals, Pulses and Oilseeds | PC | 3 | 0 | 0 | 3 |
| 4. | 20A27303T | Fluid Flow in Food Processing | PC | 3 | 0 | 0 | 3 |
| 5. | 20A27304 | Principles of Food Engineering | PC | 3 | 0 | 0 | 3 |
| 6. | 20A27305 | Food Analysis Lab | PC | 0 | 0 | 3 | 1.5 |
| 7. | 20A27302P | Processing of Cereals, Pulses and Oilseeds Lab | PC | 0 | 0 | 3 | 1.5 |
| 8. | 20A27303P | Fluid Flow in Food Processing Lab | PC | 0 | 0 | 3 | 1.5 |
| 9. | 20A27306 | Skill oriented course – I<br>Principles of Food Preservation | SC | 1 | 0 | 2 | 2 |
| 10. | 20A99201 | Mandatory noncredit course – II<br>Environmental Science | MC | 3 | 0 | 0 | 0 |
| | | | **Total** | | | | **21.5** |

**Semester-IV**

| S.No. | Course Code | Course Name | Category | Hours per week | | | Credits |
|---|---|---|---|---|---|---|---|
| | | | | L | T | P | |
| 1. | 20A27401 | Food Biochemistry and Nutrition | BS | 3 | 0 | 0 | 3 |
| 2. | 20A05406T | Introduction to Python Programming | ES | 3 | 0 | 0 | 3 |
| 3. | 20A27402T | Processing of Fruits and Vegetables, Spices and Plantation Crops | PC | 3 | 0 | 0 | 3 |
| 4. | 20A27403T | Heat and Mass Transfer | PC | 3 | 0 | 0 | 3 |
| 5. | 20A52301<br>20A52302<br>20A52303 | Humanities Elective - I<br>Managerial Economics & Financial Analysis<br>Organizational Behavior<br>Business Environment | HS | 3 | 0 | 0 | 3 |
| 6. | 20A05301P | Python Programming Lab | ES | 0 | 0 | 3 | 1.5 |
| 7. | 20A27402P | Processing of Fruits and Vegetables, Spices and Plantation Crops Lab | PC | 0 | 0 | 3 | 1.5 |
| 8. | 20A27403P | Heat and Mass Transfer Lab | PC | 0 | 0 | 3 | 1.5 |
| 9. | 20A27404 | Skill oriented course – I<br>Basic Microbiology | SC | 1 | 0 | 2 | 2 |
| 10. | 20A99401 | Mandatory noncredit course – III<br>Design Thinking for Innovation | MC | 2 | 1 | 0 | 0 |
| 11. | 20A99301 | NSS/NCC/NSO Activities | - | 0 | 0 | 2 | 0 |
| | | | | | | **Total** | **21.5** |

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### Food Technology

| Community Service Internship/Project(Mandatory) for 6 weeks duration during summer vacation |
|---|

**Note:**

1. Eligible and interested students can register either for Honors or for a Minor in IV Semester as per the guidelines issued by the University
2. Students shall register for NCC/NSS/NSO activities and will be required to participate in an activity for two hours in a week during fourth semester.
3. Lateral entry students shall undergo a bridge course in Mathematics during third semester

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**Food Technology**

| **Course Code** | **Numerical Methods & Probability theory** | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|
| **20A54402** | **(Food Technology)** | | **3** | **0** | **0** | **3** |
| | **B.Tech II Year** | | | | | |
| **Pre-requisite** | | **Semester** | **III** | | | |

Course Objectives:

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.

Course Outcomes (CO): Student 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.

| UNIT - I | **Solution of Algebraic & Transcendental Equations:** | 8 Hrs |
|---|---|---|

Introduction-Bisection method-Iterative method-Regula falsi method-Newton Raphson method
System of Algebraic equations: Gauss Jordan method-Gauss Siedal method.

| UNIT - II | **Interpolation** | 8 Hrs |
|---|---|---|

Finite differences-Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

| UNIT - III | **Numerical Integration & Solution of Initial value problems to Ordinary differential equations** | 9 Hrs |
|---|---|---|

Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule
Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Modified Euler's Method-Runge-Kutta Methods.

| UNIT - IV | **Probability theory:** | 9 Hrs |
|---|---|---|

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 - V | **Random variables & Distributions:** | 9 Hrs |
|---|---|---|

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

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| Textbooks: |
|---|
| 1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.<br>2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE.<br>3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India |
| Reference Books: |
| 1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers.<br>2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier. |
| Online Learning Resources: |
| 1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview<br>2. nptel.ac.in/courses/117101056/17<br>3. http://nptel.ac.in/courses/111105090 |

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**Food Technology**

| Course Code | FOOD CHEMISTRY | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27301 | | | 3 | 0 | 0 | 3 |
| Pre-requisite | | Semester | III | | | |

**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.

**Course Outcomes (CO):**

- Understand the concepts of Techniques in food analysis,
- Analyse the proximate analysis of foods
- Summarize the biochemical methods and approaches used in Food analysis.

| UNIT - I | | 8 Hrs |
|---|---|---|

Sampling and sampling techniques. Proximate analysis- Moisture, ash, crude fat, crude fibre, crude protein and carbohydrates by difference. Principles and methods of food analysis.

| UNIT - II | | 12 Hrs |
|---|---|---|

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

| UNIT - III | | 8 Hrs |
|---|---|---|

Determination of starch. Test for unsaturation of fats, rancidity of fats. Quantitative analysis of protein by Biuret method, Ninhydrin method, Lowry's method and Dye-binding method Bioassays for protein quality of grains.

| UNIT - IV | | 10 Hrs |
|---|---|---|

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

| UNIT - V | | 8 Hrs |
|---|---|---|

Principles and methods for estimation of minerals: Atomic absorption spectroscopy, colorimetric, titrimetric and gravimetric methods Methods for determining physical and rheological properties of food.

**Textbooks:**


1. Suzanne **Nielsen**, "Food Analysis", Springer Publishers, 5th Edition, 2017.
2. Y. Pomeranz and C.E. Meloan, "Food Analysis", A.V.I Publishing Company, INC West Port, Connecticut, U.S.A.


**Reference Books:**


1. Plummer, D.T. "An Introduction to Practical Biochemistry", Tata Mc Graw-Hill Publishing Co., New Delhi.2079.
2. Sadasivam, S. and Manickam, A. "Biochemical methods for Agricultural Sciences", New Age International Publisher, New Delhi,2096.
3. ManoRanjanKalia "Food Analysis and Quality Control", 1st Edition, Kalyani Publishers, New Delhi, 2002.
4. Jayaraman, J. "Laboratory Manual in Biochemistry", Wiley Eastern Publishers, New Delhi,2080.

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**Food Technology**

| Course Code | PROCESSING OF CEREALS, PULSES & OILSEEDS | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27302T | | | 3 | 0 | 0 | 3 |
| Pre-requisite | | Semester | III | | | |

**Course Objectives:**

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

**Course Outcomes (CO):**

- 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

**UNIT - I** — **8 Hrs**

Importance of Cereals Pulses and Oilseeds, Composition, Structure and processing characteristics of Cereal grains, Legumes and Oilseeds, Post-harvest technology, Post processing practices for safe storage. Rice: Structure, types, composition, quality characteristics and physicochemical properties of Rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice), By-products.

**UNIT - II** — **12 Hrs**

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 and flour). Assessment of flour quality and characteristics, Macaroni products. Dough rheology- influence of flour constituents in dough rheology.

Baked products-Ingredients Technology and quality parameters: Bread, Biscuits, Cakes and Crackers.

**UNIT - III** — **8 Hrs**

Other Cereals: Corn- Structure, types and composition. Dry and wet milling of Corn. Starch and conversion products. Processed corn products (popped corn, corn flakes etc.) Structure and composition of Barley, Malting of barley, Bajra, Jowar and other cereal grains and millets. Pearling of millets. Parched and snack products. Breakfast cereals – types and manufacturing methods.

**UNIT - IV** — **10 Hrs**

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 - V** — **8 Hrs**

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.

**Textbooks:**


- K. Kulp and J. G. Ponte. Jr., “Hand Book of Cereal Science and Technology”, 2nd Edition, CRC, 2000.

- G. Owens, "Cereals Processing Technology", 2nd Edition, Wood head Publishing, 2001.

**Reference Books:**

1. D.A.V. Dendy and B.J. Dobraszczyk, "Cereals and Cereal products: Chemistry and Technology", Vol. 4, Springer, 1st Edition, 2001.
2. B.O.Juliano, "Rice: Chemistry and Technology", 2nd Edition, AACC,1985.
3. Y.Pomeranz, "Wheat: Chemistry and Technology", 3rd Edition, AACC,1988.
4. A. Karleskind, "Oils and Fats manual", 1st Edition, Lavoisier Publisher, Paris,2096.
5. R.H. Mathews, Marcel Dekker, "Legumes: Chemistry, Technology and Human Nutrition", 1st Edition,2089.
6. D. Swer, "Bailey's Industrial Oil & Fat Products", 5th Edition, John Wiley & Sons, 2005.

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**Food Technology**

| Course Code | FLUID FLOW IN FOOD PROCESSING | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27303T | | | 3 | 0 | 0 | 3 |
| Pre-requisite | | Semester | III | | | |

**Course Objectives:**

- The basic concepts of fluid types and fluid-flow phenomena
- To enable the students to understand the concept and importance of friction factor by using
- To understand the application of friction losses through pipes
- To classify and select the pumps depending on suitability and acquire knowledge on power requirements in pumps

**Course Outcomes (CO):**

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

- Gain knowledge on various types of fluids available and their classification with examples
- Acquires knowledge on different types of flow regimes that fluid can flow
- Know the applications and usage of Bernoulli's theory, Buckingham's Pi theorem, Hagen-Poiseuilli and Rabinowitsch-Mooney equation
- Gain the knowledge on significance of friction factor and their calculations
- Understand frictional losses through pipes and pipe fittings
- Have knowledge on selection of pumps and their performance evaluation

**UNIT - I** **8 Hrs**

**Types of Fluids:** Newtonian & Non-Newtonian Fluids-dilantant, pseudoplastic, bingham plastic, bingham pseudoplastic; classification of fluids based on time dependance: Thixotropic and rheopectic classification of fluids based on density Compressible and In compressible fluids.

**UNIT - II** **12 Hrs**

**Fluid Flow:** Laminar and turbulent flows, Reynolds Number; Equation of Continuity, Bernoulli's equation, applications of Bernoulli's equation, Cavitation, laminar and turbulent flow in pipes (Concept of Boundary Layer & Entrance Length)

**UNIT - III** **8 Hrs**

**Friction Factor**: Definition of Friction Factor; relationship between Friction factor and Reynolds Number by using Dimensionless analysis, Friction Factor: Derivation of friction factor for Laminar Flow by using Hagen-Poiseuille equation; Friction Factor: Turbulent Flow, Moody Chart, Rabinowitsch-Mooney equation: Non- Newtonian Fluids (Power Law Fluids); Generalized Reynolds Number; Friction Chart.

**UNIT - IV** **10 Hrs**

**PressureLosses in Pipes & Flow Measurement:** Energy equation for steady flow of fluids: Pressure, Kinetic & Potential Energy. Major Losses: Frictional Losses; Minor losses: Energy Losses due to sudden expansion, contraction & energy losses due to pipe fittings; Measurement of Flow in Pipes: Venturimeter, Pitot tube, Rotameter and others.

**UNIT - V** **8 Hrs**

**Pumps, Pipes & Fittings:** Classification of Pumps: Centrifugal pumps, Reciprocating pumps, Rotary Pumps; Pressure Head, Suction Head, Discharge Head, Net Positive Suction Head; Power requirement of

| |
|---|
| Pump; Selection of Pumps & Performance Evaluation. Pipe & Pipe Fittings & their selection. |
| **Textbooks:** |
| 1. D. G. Rao, Fundamentals of Food Engineering, Prentice-Hall of India, New Delhi, 2010<br>2. P.G. Smith, Introduction to Food Process Engineering, 2nd Edition, Lincoln, UK, 2010. |
| **Reference Books:** |
| 1. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.<br>2. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009.<br>3. Z. Berk, Food Process Engineering and Technology, Food Science and Technology, 1st Edition, International Series, Elsevier, 2009. |

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**Food Technology**

| Course Code | PRINCIPLES OF FOOD ENGINEERING | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27304 | | | 3 | 0 | 0 | 3 |
| Pre-requisite | | Semester | III | | | |

**Course Objectives:**

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

**Course Outcomes (CO):**

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

| UNIT - I | | 8 Hrs |
|---|---|---|

Introduction to Food Engineering: Definition of terms, System of measurements, The S.I System, Conversion of Units. Steam Generation & Utilization: Concept of normal boiling point, Properties of Steam, Forms of Steam. Pressure-Enthalpy diagram, Problems; Boilers: Classification, Types, Criteria for selection, Maintenance & Applications.

| UNIT - II | | 12 Hrs |
|---|---|---|

Basic principles of Physics & Chemistry: Ideal Gas law, Vander Waal's equation, Amagat's law, Dalton's law, Problems; Kinetic Theory of gases. Thermodynamics: Basic concepts, First law of thermodynamics, Second law of thermodynamics, Zero law of thermodynamics Refrigeration: Basic concepts, Joule-Thomson effect, Refrigerants, Problems, Refrigeration types (VCC, VAC), Applications.

| UNIT - III | | 8 Hrs |
|---|---|---|

Humidity: Humidity & Relative Humidity, Saturation Humidity, Percentage Humidity, Psychometric chart – Utilization, problems; Humidifiers & Dehumidifiers; Applications.

Material balance and Energy balance in various unit operations – Problems, significance in food processing.

| UNIT - IV | | 10 Hrs |
|---|---|---|

Dimensional Analysis, Fundamental -derived units. Conversion of Dimensional equations – Uses, Methods (Rayleigh's & Buckingham's) Examples: Nusselts Number, Reynolds number, Prandtl's number, Froude's number. Engineering properties of Food Materials: Mass- volume- area related properties of foods, rheological properties of solid foods, thermal properties of frozen & unfrozen foods, electrical conductivity of foods, dielectric properties of foods.

| UNIT - V | | 8 Hrs |
|---|---|---|

Measurement & Control of Process Parameters: Various Process Parameters, On-line & Off-line parameters, Critical & non-critical parameters, Measurement of various parameters, controlling methods (Manual, Automatic & Computer control)

**Textbooks:**

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1. R. Paul Singh and Dennis R. Heldman, "Introduction to Food Engineering". Academic Press, 4th Edition, 2009.
2. P.G. Smith, "Introduction to Food Process Engineering". Springer, 2nd Edition, 2011.


**Reference Books:**


1. J.M. Smith, H.C. Van Ness and M.M. Abbott "Introduction to Chemical Engineering Thermodynamics", 7th Edition, McGraw-Hill, Inc., NY, USA. 2005.
2. Z. Berk, "Food Process Engineering and Technology, Food Science and Technology", 1st Edition, International Series, Elsevier, 2009.
3. D. G. Rao, "Fundamentals of food engineering", Prentice-Hall of India, New Delhi, 2010.
4. R.K. Rajput. "Engineering Thermodynamics", 3rd Edition, Laxmi Publications (P) Ltd., Bangalore, 2007.
5. Warren L. McCabe, "Unit Operations of Chemical Engineering", 7th Edition, Julian Smith, Peter Harriott, McGraw-Hill, Inc., NY, USA, 2004.
6. Christie John Geankoplis "Transport Processes and Separation Process Principles" (Includes Unit Operations), 4th Edition, Prentice-Hall, NY, USA. 2003.

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**Food Technology**

| Course Code | FOOD ANALYSIS LAB | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27305 | | | 0 | 0 | 3 | 1.5 |
| Pre-requisite | | Semester | III | | | |

**Course Objectives:**

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

**Course Outcomes (CO):**

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

**List of 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.

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**Food Technology**

| Course Code | PROCESSING OF CEREALS, PULSES AND OIL SEEDS LAB | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27302P | | | 0 | 0 | 3 | 1.5 |
| Pre-requisite | | Semester | III | | | |

**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.

**Course Outcomes (CO):**

- 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.

**List of Experiments:**

1. Determination of physical properties (Bulk Density, Porosity, Sphericity, Angle of repose, Test weight, Particle size, Sieve analysis) of different grains.
2. Estimation of Gluten content, sedimentation value, alcoholic acidity, water absorption capacity and Polenske value of wheat flour.
3. Determination of adulterant ($NaHCO_3$) 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. Pearling of millets.
9. Determination of yeast activity.
10. Estimation 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.
14. Preparation of Cookies.
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.

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**Food Technology**

| Course Code | FLUID FLOW IN FOOD PROCESSING LAB | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27303P | | | 0 | 0 | 3 | 1.5 |
| Pre-requisite | | Semester | III | | | |

**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.

**Course Outcomes (CO):**

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.

**List of 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. Determination of 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.
12. Measurement of viscosity and surface tension of liquids.
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.

**Online Learning Resources/Virtual Labs:**

http://ce-iitb.vlabs.ac.in/exp7/Aim.html?domain=%20Chemical%20Engineering&lab=Chemical%20Engineering

https://eerc03-iiith.vlabs.ac.in/exp/reynolds/

https://eerc03-iiith.vlabs.ac.in/exp/bernoullis/

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**Food Technology**

| Course Code | PRINCIPLES OF FOOD PRESERVATION | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A27306 | | | 1 | 0 | 2 | 2 |
| Pre-requisite | | Semester | III | | | |

**Course Objectives:**

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

**Course Outcomes (CO):**

Upon completion of this course students should be able to understand

- The changes occurring during various food processing techniques
- Technologies involved in storage and preservation
- The effect of enzymes on spoilage reactions of foods.

**UNIT - I** — **8 Hrs**

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 - II** — **12 Hrs**

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 - III** — **8 Hrs**

Preservation of foods by high temperatures: Basic concepts in thermal destruction of microorganisms D, Z and F values. Heat resistance and thermophilic microorganisms. Cooking, blanching, pasteurization and sterilization of foods. Extrusion, baking, roasting, frying, dielectric heating, ohmic, microwave and infrared heating. Assessing efficacy of thermal processing of foods, General process of canning of foods.

**UNIT - IV** — **10 Hrs**

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 - V** — **8 Hrs**

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.

**Textbooks:**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
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**ANANTHAPURAMU – 515 002 (A.P) INDIA**

**Food Technology**


1. Norman N. Potter and J.H. Hotchkiss, Chapman and Hall, "Food Science", 5th Edition,2098.
2. P. J. Fellows, "Food processing technology: Principles and Practice", 3rd Edition, Taylor and Francis, 2009.


**Reference Books:**


1. M. Karel, O.R. Fennema and D.B. Lund, "Principles of Food Science-Part-II: Physical Method of Food Preservation", 2nd Edition, Marcel Dekkar Inc., 2001.
2. V. Kyzlink, "Principles of Food Preservation", 2nd Edition, Elsevier Press, 2003.
3. J. M. Jay, D. Van Nostrand, "Modern Food Microbiology", 7th Edition, 2005.


**EXPERIMENTS:**

1. Demonstration of various perishable food items and degree of spoilage
2. Preservation of food by high concentration of sugar
3. Preservation of food by using salt
4. Blanching of selected food items
5. Preservation of food by heat treatment- pasteurization
6. Demonstration of preserving foods under cold vs. freezing process
7. To study IQF processing of fruits/ vegetable
8. Drying of fruit slices pineapple slices, apple slices in cabinet drier
9. Effect of irradiation on sprouting of potatoes and onions
10. Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid
11. Preservation of food by using chemical preservatives
12. Preservation of bread, cake using mold inhibitors
13. Processing of foods using fermentation technique, i.e. preparation of sauerkraut
14. Study on ohmic heating system
15. Study on effect of high pressure on microbe
16. Visit to food processing industry

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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## ANANTHAPURAMU – 515 002 (A.P) INDIA

**Food Technology**

| Course Code | ENVIRONMENTAL SCIENCE | | L | T | P | C |
|---|---|---|---|---|---|---|
| 20A99201 | (Common to All Branches of Engineering) | | 3 | 0 | 0 | 0 |
| **Pre-requisite** | **NIL** | **Semester** | **III** | | | |

**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.

**Course Outcomes (CO):**

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.

| **UNIT - I** | | **8 Hrs** |
|---|---|---|

**Multidisciplinary Nature Of Environmental Studies: –** Definition, Scope and Importance – Need for Public Awareness.

**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 - II** | | **12 Hrs** |
|---|---|---|

**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

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c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Biodiversity And Its Conservation :** Introduction 0 Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

| **UNIT - III** | | **8 Hrs** |
|---|---|---|

**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.

| **UNIT - IV** | | **10 Hrs** |
|---|---|---|

**Social Issues and the Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

| **UNIT - V** | | **8 Hrs** |
|---|---|---|

**Human Population And The Environment:** Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

**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..

**Textbooks:**

1. Text book of Environmental Studies for Undergraduate Courses ErachBharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S.AzeemUnnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

**Reference Books:**

1. Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
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
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.