B.Tech. – II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS&H	Probability and Statistics	3	0	0	3
2	BS&H	Universal Human Values – Understanding Harmony And Ethical Human Conduct	2	1	0	3
3	Engineering Science	Computer Applications in Food Processing	2	0	0	2
4	Professional Core	Processing of Cereals, Pulses and Oil	3	0	0	3
5	Professional Core	Fluid Flows in Food engineering	3	0	0	3
6	Engineering Science	Food Handling and Storage Equipment	0	0	2	1
7	Professional Core	Processing of Cereals, Pulses and Oil seeds	0	0	3	1.5
8	Professional Core	Fluid flows in Food Engineering Lab	0	0	3	1.5
9	Skill Enhancement course	Food Processing Techniques	0	1	2	2
10	Audit Course	Environmental Science	2	0	0	-
Total			15	2	10	20

B.Tech. – II Year II Semester

S.No	Category	Title	L	T	P	Credits
1	Management Course-I	Food Business Management	2	0	0	2
2	Engineering Science	Principles of Food Engineering	3	0	0	3
3	Professional Core	Food Microbiology	3	0	0	3
4	Professional Core	Processing of fruits, vegetables, spices and plantation crops	3	0	0	3
5	Professional Core	Heat and Mass Transfer	3	0	0	3
6	Professional Core	Food Microbiology Lab	0	0	2	1
7	Professional Core	Processing of fruits, vegetables, spices and plantation crops Lab	0	0	3	1.5
8	Professional Core	Heat and Mass Transfer Lab	0	0	3	1.5
9	Skill Enhancement course	Sensory Evaluation Techniques	0	1	2	2
10	BS&H	Design Thinking & Innovation	1	0	2	2
Total			15	1	12	22
Mandatory Community Service Project Internship of 08weeks duration during summer vacation						

II Year-I Semester

L	T	P	C
3	0	0	3

PROBABILITY AND STATISTICS

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart probability concepts and statistical methods in various applications Engineering

Course Outcomes: Upon successful completion of this course, the student should be able to

1. Classify the concepts of data science and its importance (L2)
2. Interpret the association of characteristics and through correlation and regression tools (L4)
3. Apply discrete and continuous probability distributions (L3)
4. Design the components of a classical hypothesis test (L6)
5. Infer the statistical inferential methods based on small and large sampling tests (L4)

Unit – I: Descriptive statistics and methods for data science:

Data science – Statistics Introduction – Population vs Sample –Collection of data – primary and secondary data – Type of variable: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency – Measures of Variability – Skewness – Kurtosis.

UNIT – II: Correlation and Regression:

Correlation – Correlation coefficient – Rank correlation.
Linear Regression: Straight line – Multiple Linear Regression - Regression coefficients and properties – Curvilinear Regression: Parabola – Exponential – Power curves.

UNIT – III: Probability and Distributions:

Probability– Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT – IV: Sampling Theory:

Introduction – Population and Samples – Sampling distribution of Means and Variance (definition only) – Point and Interval estimations – Maximum error of estimate – Central limit theorem (without proof) – Estimation using t, χ^2 and F-distributions.

UNIT – V: Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Test of significance for large samples and Small Samples: Single and difference means – Single and two proportions – Student's t- test, F-test, χ^2 -test.

Text Books:

- **Miller and Freund's**, Probability and Statistics for Engineers,7/e, Pearson, 2008.
- **S. C. Gupta and V.K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

- **Shron L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists,8th Edition, Pearson 2007.
- **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
- **Sheldon M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011.
- **Johannes Ledolter and Robert V. Hogg**, Applied statistics for Engineers and Physical Scientists, 3rd Edition, Pearson, 2010.

II Year – I Semester

L	T	P	C
2	1	0	3

UNIVERSAL HUMAN VALUES – UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one's self, and one's surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:

Textbook and Teachers Manual

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautiful* - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal
9. *Rediscovering India* - by Dharampal
10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi

11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Mode of Conduct:

Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Tutorial hours are to be used for practice sessions.
While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.
Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf

6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

II Year-I Semester

L	T	P	C
2	0	0	2

COMPUTER APPLICATIONS IN FOOD PROCESSING

Course Objectivess

- Able to know about "The necessity of Software in Food Industries."
- Able to apply software and its applications in Food Industries.

Course Outcomes

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

COs	Statement	Bloom Level
CO1	Proficiency in using software to food industry	L2
CO2	Ability to analyze data in manufacturing of food	L2
CO3	Ability to optimize the process through software	L3
CO4	Ability to integrate the technology within food industry	L2
CO5	Able to create a collaborative document using software	L3

UNIT I

Computerization, Importance of Computerization in food industry and IT applications in food industries. Introduction to Bar charts and Pie charts & the procedure to develop bar charts and pie charts on given Data.

Learning Outcomes:

At the end of unit, students will be able to understand the following.

1. Importance of computerization
2. Construction of bar and Pie charts

UNIT II

Introduction to Software & Programming Languages, Properties, Differences of an Algorithm and Flowcharts, Advantages and disadvantages. Introduction, Fundamentals & advantages of 'C'. Steps in learning 'C' (Character set, Identifiers, Keywords) Steps in learning 'C' (Data types, Constants, Variables, Escape sequences).

Learning Outcomes:

At the end of unit, students will be able to understand the following.

1. Algorithm construction
2. Programming languages in food industry

UNIT III

Concept of Pointers, Structures & Unions. Introduction to Data Structures, Types of Data Structures (Primary & Secondary Data Structures) Concept of Linked Lists, Types of Linked Lists & Basic operations on linked Lists.

Learning Outcomes

At the end of unit, students will be able to understand the following.

1. Data Structure used in Food industry
2. Basic operation of linked list.

UNITIV

Introduction, Introduction to computer and related hardware used in food industry (Touch Screens, Handheld Devices, Palm Tops, Barcode Printers and Scanners, RFID Tags, etc.). Introduction to various software's for their application in food technology

Learning Outcomes:

At the end of unit, students will be able to understand the following.

1. Understanding of barcodes
2. Understanding of RFID tags

UNIT V

Basic Introduction to Application of computers in instrumentation and process control of food industry (PLC, SCADA, etc.), Inventory control and management in food industry using computer.

Learning Outcomes

At the end of unit, students will be able to understand the following.

1. Application of computers in instrumentation and process control
2. SCADA in food industry
3. Application of computers in Inventory control and management

Textbooks

1. Hem Chand Jain, H.N. Tiwar (2022) Basics of Computer Applications in Business
2. Teixeira, A. A., & Shoemaker, C. F. (2012). Computerized food processing operations. Springer Science & Business Media.

References

1. Hubbard, M. R. (2012). Statistical quality control for the food industry. Springer Science & Business Media.
2. https://ebooks.inflibnet.ac.in/hsp05/chapter/computers-in-food-service/#

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India
FOOD ENGINEERING (R23-IInd YEAR COURSE STRUCTURE & SYLLABUS)

II Year -I Semester

L	T	P	C
3	0	0	3

PROCESSING OF CEREALS, PULSES AND OILSEEDS

Course Objectivess

- To learn about the processing of major cereals, pulses & oil seeds.
- To acquaint with production trends, structure, composition, quality evaluation and processing technologies for product development and value addition of various cereals, pulses, and oilseeds.

Course Outcome

COs	Statement	Bloom Level
CO1	Understand the basic composition and structural parts of food grains	L2
CO2	Understand the basics of milling operations for food grains	L2
CO3	Exposed to various processing methods and machinery used	L2
CO4	Identify the problems associated with milling of grains and their solution	L3
CO5	Able to develop value added products from all grains.	L3

UNIT I

Importance of Cereals Pulses and Oilseeds, Composition, Structure and processing characteristics of Cereal grains, Legumes and Oilseeds, Post-harvest technology, Post-harvest 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 of rice milling.

Learning Outcomes

At the end of unit, students will be able to

1. Learn composition, structure and processing of cereals, legumes & oilseeds.
2. Know the post processing operations for storage and further processing.
3. Knowledge of milling and parboiling of paddy and other processing methods.
4. Importance of quality assessment related to rice and rice products.
5. Knowledge on value added products and by products of rice.
6.

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 and flour). 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.)

Learning Outcomes

At the end of unit, students will be able to

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

UNIT III

Importance, morphology, Structure and composition of Millets, major and minor millets, Primary processing of millets Secondary processing of millets, malting, pearling; Millets (Pearl millets, finger millets), milling techniques, significance of composite millet-based flour, value added products.

Learning Outcomes

At the end of unit, students will be able to

1. Knowledge of millets and malting process.
2. Milling techniques

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. Milling of legume-pulses by traditional and improved processes.

Learning Outcomes

At the end of unit, students will be able to

1. Description of pulses and their importance.
2. Impact of anti-nutritional factors in pulses on processing.
3. Knowledge on milling of pulses and value-added products.

UNIT V

Ground nut and Sesame, chemical composition, and 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.

Learning Outcomes

At the end of unit, students will be able to

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

Textbooks

1. A.ChakravarthyPost Harvest Technology of Cereals Pulses and Oil Seeds, 3rd edition,12 February 2021)
2. Owens G, editor. Cereals processing technology. CRC Press; 2001 Apr 12.

References

1. Practical Manual on Post-Harvest Engineering of Cereals Pulses And Oilseeds – Brillion Publishing ,ISBN, 9789392725906, 2022.
2. D.A.V. Dendy and B.J.Dobraszczyk,Cereals and Cereal products: Chemistry and Technology. Springer,3rd edition 2021.

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II Year -I Semester

L	T	P	C
3	0	0	3

FLUID FLOWS IN FOOD ENGINEERING

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.
- To understand the friction losses through pipes.
- To classify and select the pumps depending on suitability and acquire knowledge on power requirements in pumps.

Course Outcomes

COs	Statement	Bloom Level
CO1	Acquires knowledge on different types of flow regimes that fluid can flow in Food industry	L2
CO2	Able handle the fluid flow in food industry	L2
CO3	Understand frictional losses through pipes and pipe fittings without any break down	L2
CO4	Know the applications and usage of Bernoulli's theory, Buckingham's Pi theorem, Hagen-Poiseuilli and Rabinowitsch-Mooney equation	L3
CO5	Have knowledge on selection of pumps and their performance evaluation.	L3

UNIT I

Types of Fluids: Newtonian & Non-Newtonian Fluids-dilatant, pseudoplastic, bingham plastic, Bingham pseudoplastic; classification of fluids based on time dependance: Thixotropic and Rheopectic; classification of fluids based on density Compressible and incompressible fluids.

Learning Outcomes

At the end of unit, students will be able to

1. Differentiate Newtonian and non-Newtonian fluids.
2. Get basics behind classification of fluids.
3. Differentiate fluids with examples.

UNIT II

Fluid Flow; Reynold's experiment, 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)

Learning Outcomes

At the end of unit, students will be able to

1. Know basic types of flows in fluids.
2. Acquire knowledge on Equation of continuity and application of Bernoulli's equation.
3. Get concept of Boundary layer and Entrance length.

UNIT III

Friction Factor: Definition of Friction Factor; relationship between Friction factor and Reynolds Number by using Dimensionless analysis, concept of Friction Factor: Derivation of friction factor for Laminar Flow, Hagen-Poiseuille equation; Friction Factor for Turbulent Flow, Moody Chart.

Learning Outcomes

At the end of unit, students will be able to

1. Know the study of friction factor.
2. Concept of Reynold number and friction factor using Dimensionless analysis.
3. Understand the friction factor by using Hagen-Poiseuille and Rabinowitsch-Mooney equation.
4. Get the knowledge on Generalized Reynold number and Friction charts.

UNIT IV

Pressure Losses 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.

Learning Outcomes

At the end of unit, students will be able to

1. Know the energy equations used for steady flow of fluids.
2. Calculate the frictional losses (major and minor) in pipes & pipe fittings.
3. Knowledge on various flow measurement devices.

UNIT V

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.

Learning Outcomes

At the end of unit, students will be able to

1. Know various types of pumps.
2. Calculate power requirements for pumps.
3. Understand how to select the pumps and their evaluation in terms of performance.
4. Have needed knowledge on selection of pipe and pipe fittings.

Textbooks

1. Rao DG. Fundamentals of food engineering. PHI Learning Pvt. Ltd.; 2009 Nov 30.
2. SMITH PG. Introduction to food process engineering. Chemical engineer. 2003(742):56-.

References

1. Geankoplis CJ. Transport processes and separation process principles:(includes unit operations). Prentice Hall Professional Technical Reference; 2003.
2. Paul Singh R, Heldman DR. Introduction to food engineering.2009
3. Berk Z. Food process engineering and technology. Academic press; 2018 Feb 13.

II Year -I Semester

L	T	P	C
0	0	2	1

FOOD HANDLING & STORAGE EQUIPMENT

Course Objectives

- To study the all the equipment used for handling of foods.
- To develop appropriate storage structures with engineering principles.

Courses Outcomes

COs	Statement	Bloom Level
CO1	Able to understand the conveying systems in food industry	L2
CO2	Able to prevent the cross contamination in food handling	L2
CO3	Able to select the handling equipment's based on food properties	L2
CO4	Able to design storage structure in food industry	L3
CO5	Able to implement FIFO to prevent spoilage	L3

UNIT I

Pneumatic conveying system: air-pressure and vacuum system, lean and dense phases, capacity and power requirement; Gravity conveyor design considerations, capacity and power requirement. Selection, design and applications of pneumatic conveyors. Hydraulic conveyors. Hygienic considerations

Learning Outcomes

At the end of unit, students will be able to

1. Understand the concept of pneumatic conveying systems.
2. Know the importance of lean and dense phases in pneumatic systems.
3. Get knowledge on hydraulic conveyors and hygienic considerations for pneumatic conveying systems and hydraulic conveyors.

UNIT II

Mechanical Conveyors: Belt conveyor - Principle, characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Uniform belt and segmented belt conveyors and their applications. Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors. Hygienic considerations

Learning Outcomes

At the end of unit, students will be able to

1. Acquire knowledge on belt conveyors from principle to design considerations.
2. Understand the concept regarding details of screw conveyors.
3. Know the hygienic considerations for belt and screw conveyors.

UNIT III

Mechanical Conveyors: Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Selection, design and applications of Bucket elevator.

Roller and stake wheel conveyors, chain conveyors, Flexible conveyors, Mobile Transport

Systems, Hoists Cranes, and Elevators. Vibratory conveyors and overhead conveyors. Robots. Hygienic considerations

Learning Outcomes

At the end of unit, students will be able to

1. Learn about bucket elevators from principle to all concepts.
2. Understand the various other mechanical conveyors like Roller and stake wheel conveyors, chain conveyors, Mobile Transport Systems, Hoists Cranes, and Elevators. Vibratory conveyors, overhead conveyors & Robots.
3. Know the hygienic considerations for remaining mechanical conveyors.

UNIT IV

Storage structures Traditional storage structures, improved storage structures, modern storage structures, godown layout, staking pattern and rodent proof godown design; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos. Storage of perishables Cold storage controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage.

Learning Outcomes

At the end of unit, students will be able to

1. Get knowledge on storage structures both traditional and improved methods.
2. Understand the concepts involved while storing perishables and different types of storage methods.

UNIT V

Design of storage structures Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, functional, structural and thermal design of cold stores.

Learning Outcomes

At the end of unit, students will be able to

1. Understand the design criteria for various storage structures.
2. Know the significance of important parameters involved in silo load calculations.

Textbooks

1. Saravacos GD, Kostaropoulos AE. Handbook of food processing equipment. Kluwer Academic/Plenum; 2 nd edition, 2018.
2. Sahay KM, Singh KK. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd.; 4 th edition, 2019

References

1. William Andrew, Inc., Norwich, Handbook of Farm, Dairy, and Food Machinery; 3rd edition,2016.
2. L.W. Newbaver and H.B. Walker, Principal of Agricultural Engineering, 2 nd edition, 2018.

L	T	P	C
0	0	3	1.5

II Year - I Semester

PROCESSING OF CEREALS, PULSES AND OILSEEDS LAB

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

COs	Statement	Bloom Level
CO1	Students are exposed to learn various parameters determination and quantification	L2
CO2	Students will be able to prepare and understand the technology involved in foods from grains	L2
CO3	Students will be able to determine adulteration in flour	L3
CO4	Students will be able to know quality parameters of oil	L3
CO5	Students will acquire practical knowledge by visiting industries	L3

Laboratory 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 ($NaHCO_3$) in wheat flour/ Maida.
4. Determination of alkali score and gelatinization temperature of rice.
5. Effect of Traditional and improved pre-treatment 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 some millets.
9. Determination of yeast activity.
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.
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 modern roller flour mill and FCI godowns.
20. Visit to rice mill.

II Year -I Semester

L	T	P	C
0	0	3	1.5

FLUID FLOWS IN FOOD ENGINEERING LAB

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

COs	Statement	Bloom Level
CO1	Gains hands on experience trough experimentation	L2
CO2	Able to handle the different types of flow measuring device	L2
CO3	Able to find out the losses during fluid flow	L3
CO4	Able to understand the characteristics of pumps and applicability	L3
CO5	Practical application of fluid flows in food industry	L3

List of Experiments

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

L	T	P	C
0	1	2	2

II Year -I Semester

FOOD PROCESSING TECHNIQUES

Course Objectives

- To aware of different processing techniques to develop food products
- To understand the principles of processing techniques for different foods

Course Outcomes

COs	Statement	Bloom Level
CO1	Able to develop products using traditional processing techniques	L2
CO2	Able to use non thermal processing techniques	L2
CO3	Able to develop food products with low cost	L4
CO4	Able to improve shelf life of product	L3
CO5	Able to improve the quality of product	L3

UNIT 1:
Introduction, Significance of food processing, History of food processing techniques, Classes of foods based on perishability, Traditional Processing methods (Salting, pickling, Drying, Smoking, Sugaring).
Learning Outcome:

- Brief understanding of Traditional food processing methods

UNIT 2: Processing Techniques of various food products; Processing methods involved in Meat, fish & Poultry, Fruits & Vegetables, Frozen foods, Milk & milk products, Cereals, Pulses, Legumes and oil seeds.
Learning Outcome:

- Learning about various food processing techniques for different food products.

UNIT 3: Thermal Processing Techniques; Blanching, Pasteurization, Sterilization (Time – temperature combinations and Equipments), Drying and Dehydration (Methods and Equipments).
Learning Outcome:

- To learn how to improve the shelf life of foods by using thermal processing techniques.

UNIT 4: Non-Thermal Processing Techniques; Refrigeration, Chilling, Freezing, Thawing process, Methods of Freezing (Air, Plate, IQF, Cryogenic), Irradiation.
Learning Outcome:

- To learn about learn how to improve the shelf life and preservation of foods by using non thermal processing techniques.

UNIT 5: Novel Technologies in Food Processing; Microwave heating, Ohmic heating, Radio frequency heating, Hydrostatic Pressure Processing, Pulsed electric field, Cold plasma, principles.
Learning Outcomes:

- To learn how to ensure food safety & quality by application of innovation techniques.

Text Books:

1. Vikas Nanda & Savita Sharma, Novel Food Processing Technologies,2017
2. Food processing technology: principles and practice, P. J. Fellows, Taylor and Francis, 5th Edition 2019.

References:

1. JingdunJia, Donghong Liu, Haile Ma Advances in Food PROCESSING Technology, Springer, 2019

II Year I Semester

L	T	P	C
2	0	0	--

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

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

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)

Biodiversity and Its Conservation : Introduction and 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

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

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

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. Erach Bharucha,Text book of Environmental Studies for Undergraduate Courses,Universities Press (India) Private Limited, 2019.
2. Palaniswamy, Environmental Studies, 2/e, Pearson education, 2014.
3. S.Azeem Unnisa, Environmental Studies, Academic Publishing Company, 2021.
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, SciTech Publications (India), Pvt. Ltd, 2010.

Reference Books:

1. Deeksha Dave and E.Sai Baba Reddy, Textbook of Environmental Science, 2/e, Cengage Publications, 2012.
2. M.Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, 2014.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, 2006.

4. J. Glynn Henry and Gary W. Heinke, Environmental Sciences and Engineering, Prentice Hall of India Private limited, 1988.
5. G.R. Chatwal, A Text Book of Environmental Studies, Himalaya Publishing House, 2018.
6. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, 1/e, Prentice Hall of India Private limited, 1991.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- https://www.edx.org/learn/environmental-science/rice-university-ap-r-environmental-science-part-3-pollution-and-resources?index=product&objectID=course-3a6da9f2-d84c-4773-8388-1b2f8f6a75f2&webview=false&campaign=AP%C2%AE+Environmental+Science++Part+3%3A+Pollution+and+Resources&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fenvironmental-science
- http://ecoursesonline.iasri.res.in/Courses/Environmental%20Science-I/Data%20Files/pdf/lec07.pdf
- https://www.youtube.com/watch?v=5QxxaVfgQ3k

Course Outcomes:

COs	Statements	Blooms Level
CO1	Grasp multi disciplinary nature of environmental studies and various renewable and non-renewable resources.	L2
CO2	Understand flow and bio-geo- chemical cycles and ecological pyramids.	L2
CO3	Understand various causes of pollution and solid waste management and related preventive measures.	L2
CO4	Understand the rainwater harvesting, watershed management, ozone layer depletion and waste land reclamation.	L2
CO5	Illustrate the causes of population explosion, value education and welfare programmes.	L3

L	T	P	C
0	1	2	2

II Year -II Semester

FOOD BUSINESS MANAGEMENT

Course Objectivess

- To familiarize students with the principles of management science.
- To impart knowledge on different types of management that are crucial in food businesses operation.
- To make the students understand the economics involved and laws to be followed for running food businesses.

Course Outcomes

COs	Statement	Bloom Level
CO1	Knowledge on marketing strategies to food industry	L2
CO2	Ability to manage budget for food business	L2
CO3	Able to calculate and evaluate economic	L3
CO4	Understand the inventory, procurement in food business supply chain	L2
CO5	Able to prepare draft cost calculation in food industry	L3

UNIT I

Management: Definitions, Scope and importance, Managerial roles and functions, Management - Science or Art? Internal and external environment, Managing for competitive advantage - the challenges of management in cross - cultural environment, Corporate Social Responsibility, Managerial ethics.

Learning Outcomes

By the end of the unit students will

1. Gain knowledge on basics of management and its nature.
2. Understand ethics, environment of managing and corporate social responsibility.

UNIT II

Financial Management: Nature of capital budgeting, decisions-techniques of capital budgeting: pay back method, average rate of return and Time adjusted methods: IRR and NPV, profitability index, and excess present value index. Advanced problems and cases in capital budgeting. Statement of changes in working capital, funds flow and cash flow statement.

Learning Outcomes

By the end of the unit students will

1. Gain knowledge on principles of financial management.
2. Understand the concepts of budgeting, profitability and examples of related case studies.

UNIT III

Human Resource Management: Definition and functions of HRM, Significance of HRM, Evolution of HRM, Role of HRM to increase firm performance, Role and position of HR

department, HRM at global perspective, changing dynamics of HRM in globalized scenario. Importance of recruitment and selection, Nature and significance of human resource development, human resource accounting practices and standards, problems, HR audit-process, HRIS Process and its significance.

Learning Outcomes

By the end of the unit students will

1. Gain knowledge on basics of human resource management and its functions.
2. Understand the significance of human resource development and role of HR.

UNIT IV

Marketing Management: Introduction to marketing: needs, demands, products, exchange, transactions, market, marketing, Evolution of marketing concepts, Indian marketing environment, role and functions of marketing department, Marketing mix and significance of 4Ps, product life cycle stages, Artificial Intelligence in market production.

Learning Outcomes

By the end of the unit students will

1. Understand the concepts and principles of marketing management
2. Gain insights on product life cycle, international trade and payments

UNIT V

Economics and Company Laws: Introduction to economics - Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity. Company Act, 1956 - Nature and Types of companies, formation, memorandum of association, articles of association, kinds of shares, duties of directors, winding up.

Learning Outcomes

By the end of the unit students will

1. Gain knowledge on basics of economics, demand and supply and pricing
2. Understand the company laws act, its features and significance in food business management.

Textbooks

1. Tim Mazzarol , Sophie Reboud. Business Management, 2024.
2. Aswathappa, K. E. M. A. L. (2016). Human resource and personnel management. Tata McGraw-Hill Education..

References

1. Joy-Matthews, J., Megginson, D., & Surtees, M. (2019). Human resource development. Kogan Page Publishers.
2. August, R., Mayer, D., & Bixby, M. B. (2013). International business law: text, cases, and readings. Pearson education.

L	T	P	C
3	0	0	3

II Year -II Semester

PRINCIPLES OF FOOD ENGINEERING

Course Objectives

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

Course Outcomes

COs	Statement	Bloom Level
CO1	Able to know the factors which affect the quality of food	L1
CO2	Knowledge to handle the devices to control the process	L2
CO3	Able to calculate the mass balance in each operation of food processing	L3
CO4	Able to find the energy required for each engineering application	L3
CO5	Able to produce shelf stable products	L3

UNIT I

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: Wet, dry saturated, superheated steam, Pressure-Enthalpy diagram, Problems; Boilers: Classification, Types, Criteria for selection, Maintenance & Applications

Learning Outcomes

At the end of unit, students will be able to

1. Basic terminology related to Food Engineering.
2. Importance and how to use the units.
3. Convert the units.

UNIT II

Humidity & Humidification: Humidity & Relative Humidity, Saturation Humidity, Percentage Humidity, Humid Heat, Humid volume, Dew point, Enthalpy of Humid air, Dry bulb temperature, Wet bulb temperature, Problems, Psychrometric Chart-Utilization, problems; Humidifiers &Dehumidifiers, Applications. Water activity– concepts and importance. sorption isotherms, three stages of water, phase diagram for water, vapor pressure temperature curve for water, heat requirement for vaporization, measurement of humidity.

Learning Outcomes

At the end of unit, students will be able to

1. Know the significance of material balance in food processing.
2. Calculate the material balance for various unit operations in food processing.

UNIT III

Material balance: Law of Conservation of mass- Process flow diagram-system boundaries -overall mass balance– component mass balance –basis and tie material- Continuous vs. Batch-Recycle and bypass-unsteady state mass balance problems on concentration, dehydration, evaporation, crystallization, mixing, solvent extraction –multistage process. Problems

Learning Outcomes

At the end of unit, students will be able to

1. Understand the importance of energy balance in food processing.
2. Calculate the energy balance for various unit operations in food processing.

UNIT IV

Energy balance and evaluation of Heat requirements: Heat capacity – gases – solids – liquids -Latent heat –sensible heat -energy balance for a closed system and open system -total energy balances. Energy balance
problems in heat exchangers- Problems

Learning Outcomes

At the end of unit, students will be able to

1. Understand the importance of energy balance in food processing.
2. Calculate the energy balance for various unit operations in food processing.

UNIT V

Engineering properties of Food Materials: Mass- volume- area related properties of foods, rheological properties of fluid foods & solid foods, thermal properties of frozen & unfrozen foods, electrical conductivity of foods, dielectric properties of foods, colorimetric properties of foods, surface properties, ultrasound properties.

Learning Outcomes

At the end of unit, students will be able to

1. Study the important engineering properties.
2. Know the significance of other properties useful in food processing.

Textbooks

1. Syed S. H. RizviFood Engineering Principles and practices,2024.
2. Berk Z. Food process engineering and technology. Academic press; 2018 Feb 13.

References

1. Smith JM. Introduction to chemical engineering thermodynamics, 2005.
2. Paul Singh R, Heldman DR. Introduction to food engineering, 2009
3. Rao DG. Fundamentals of food engineering. PHI Learning Pvt. Ltd.; 2009 Nov 30.
4. Geankoplis CJ. Transport processes and separation process principles:(includes unit operations). Prentice Hall Professional Technical Reference; 2003.
5. McCabe WL, Smith JC, Harriott P. Unit operations of chemical engineering. New York: McGraw-hill; 1993.

L	T	P	C
3	0	0	3

II Year -II Semester

FOOD MICROBIOLOGY

Course Objectivess

- To impart knowledge on importance of microbes in foods and their classification along with the
- Calculations of shelf life.
- To understand microbial types (and their levels where possible) that can be expected under normal
- Conditions in different food groups.
- To gain proper knowledge on the difference between harmful and beneficial micro-organisms, the
- Factors affecting microbial growth and microbial growth characteristics.

Course Outcomes

COs	Statement	Bloom Level
CO1	Understand the spoilage microorganism	L2
CO2	Able to know the detection techniques	L2
CO3	Able to differentiate food borne and food spoilage microorganism	L3
CO4	Safeguard the food from microorganism	L3
CO5	Able to develop a product using friendly microorganism	L3

UNIT I

The science of microbiology: Its origin and scope. Importance of micro-organisms in foods. Classification of microbes: Bacteria, yeast, molds, viruses. Common bacterial groups in foods. Calculation of shelf life, shelf-life environments, deteriorative reactions, accelerated testing; Simulations of product: Package environment interaction, shelf-life simulation for moisture, oxygen, and light sensitive products.

Learning Outcomes

At the end of the unit students will gain knowledge on:

1. Importance of micro-organisms in foods and their classification.
2. Calculations of shelf life of products in particular environment, their deteriorative reactions and shelf-life simulation of product for different parameters.

UNIT II

Factors influencing microbial growth: Intrinsic factors (food environment): Nutrients in foods, growth factors and inhibitors in foods. Water activity: principle, water activity of foods, water activity and microbial growth. pH: principle, pH in foods, pH and microbial growth. Redox potential and oxygen: principle, redox potential in foods, redox potential, and microbial growth. Extrinsic factors: RH & presence of other gases, temperature principle, food and temperature, microbial growth, and viability. thermal death curve, D, Z and F values and heat resistance of microorganisms.

Learning Outcomes

At the end of the unit students will gain knowledge on:

1. Extrinsic and intrinsic factors influencing microbial growth.
2. Different factors interacting with the foods containing micro-organisms.

UNIT III

Microbial growth characteristics: Microbial growth or reproduction: Binary fission, generation time (or) doubling time, specific growth rate, optimum growth, growth curve. Nature of microbial growth in food: Mixed population, sequence of growth, symbiotic growth, synergistic growth and antagonistic growth.

Learning Outcomes

At the end of the unit students will gain knowledge on:

1. Basic information that is important to understand the mechanisms of food spoilage, food borne diseases, food bioprocessing and strain improvement, and their detection from food.
2. Microorganisms are present in mixed cultures in food and can interact with each other during growth.

UNIT IV

Harmful Micro-organism and Beneficial Micro-organism: Food borne diseases – food infection and food intoxication, Food borne viruses: types of food involved, noro viruses, Rota viruses, prion diseases, toxicity, and symptoms. Microbial toxins: Bacterial toxins, fungal toxins, algal toxins – symptoms, causes and control measures. Micro organisms as food- Single Cell Protein, Fermented food- pickles, sauerkraut- vinegar and lactic acid.

Learning Outcomes

At the end of the unit students will gain knowledge on:

1. Uses of beneficial micro-organisms and effects of harmful micro-organisms on health.
2. Food infections and food intoxications caused by food borne viruses and microbial toxins produced by micro-organisms.

UNITV

Micro biological quality of foods and its significance Fruits and vegetables, nuts, cereals, starches, and gums, TE meat products, Raw and pasteurized milk, fish and shell fish, shell egg and liquid egg, canned foods, soft drinks, fruits and vegetables drinks, bottled water, spices and condiments, sugars and confectionaries, mayon naise, and salad dressing.

Learning Outcomes

At the end of the unit students will gain knowledge on:

1. Microbial population in a food comes from those that enter from different sources as well as from growth of the contaminants before a food is examined.
2. Effect of conditions on microbial load.
3. Information on normal microbial load helps to determine microbiological quality of a food and to set up microbiological standards and specifications.

Textbooks

1. WM Foster, Food Microbiology, 2020.
2. Karl R. Matthews, Food Microbiology : An Introduction, 4th edition (ASM Books) March 2017

References

1. K. S. Bilgrami; Essentials of Microbiology; CBS Publishers, Delhi
2. Pelczar, Chan and Krieg, Microbiology; Tata McGraw Hill, Delhi
3. M. R. Adams, Food Microbiology.
4. Bisen, Handbook of Microbiology

II Year -II Semester

L	T	P	C
3	0	0	3

PROCESSING OF FRUITS, VEGETABLES, SPICES, AND PLANTATION CROPS

Course Objectives

- To enable the students to understand the processing of fruits and vegetables
- To impart technical knowledge of about how to develop products and preservation
- To understand the methods of dehydration

Course Outcomes

COs	Statement	Bloom Level
CO1	Understand the production status and Post harvest handling methods of fruits and vegetables.	L1
CO2	Learn the methods of processing and preservation of freshly harvested and cut fruits and vegetables	L2
CO3	Enumerate the processing and preservation of fruits and vegetables by heat treatment	L3
CO4	Able to extend the shelf life of spices though different techniques	L3
CO5	Able to extract the flavors from spices and plantation crop	L4

UNIT I

Introduction on fruits & vegetables: 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.

Learning Outcomes

At the end of the unit, students will be able to

1. Know the about Production and Processing scenario of fruits & Vegetables in worldwide
2. Understand the Principles and Preservation Methods of Fruits and vegetables
3. Get the knowledge on of Supply chain of Fruits & Vegetables

UNIT II

Post harvesting handling: Physiology and storage conditions, Unit Operations Involved in Fruits & Vegetables Processing; Peeling, slicing, cubing, cutting, and other size reduction operations for fruits and vegetables, blanching of Fruits & Vegetables. FSSAI specifications, preparation, and preservation of juice, squash, syrup, sherbet, nectar, cordial, crush, etc. Processing Flow sheet and equipment Involved for the above products, defects in making.

Learning Outcomes

At the end of the unit, students will be able to

1. Acquire knowledge on Unit Operations Involved in Fruits & Vegetables Processing
2. Description of FSSAI specifications, preparation, and preservation of Different F &V Products.
3. Basic Knowledge on Equipment Involved during F&V processing

UNIT III

Processing of fruits and vegetables: FSSAI specifications, Preparation, preservation, and equipment for the manufacture of Chutney, Pickles, Sauce, Puree, Paste, Ketchup; Toffee, Cheese, Lather. Production of pectin and vinegar. Dehydration of Fruits and Vegetables: Methods, packaging, storage, quality control. Dehydration Products like wafers, papads, soup powders. Minimally processed fruits and vegetables: Minimally processed fruits & vegetable introduction, Factors affecting shelf life and the quality of minimally processed fruits and vegetables.

Learning Outcomes

At the end of the unit, students will be able to

1. Understand the concept of preparation and Preservation of different processed fruits & vegetable products.
2. Acquire knowledge of FSSAI specifications of different processed fruits & vegetable products.
3. Explanation of Minimally processed fruits and vegetables.

UNIT IV

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 and minor spices – Ginger, Chilli, Turmeric, Onion and Garlic, Pepper, Cardamom. Allspice, Aniseed, Sweet basil; Caraway seed, Cassia, Cinnamon; Clove, Coriander, Cumin, Dill seed, Fennel seed, Nutmeg, Mace, Mint, Marjoram. Rosemary, saffron, sage, Savory, thyme, Asafetida, curry leaves. Unit operations involved – equipment used- value addition of spices.

Learning Outcomes

At the end of the unit, students will be able to

1. Basic Knowledge on Classification & Chemical Composition of Spices
2. Acquire the knowledge on Processing of Major & Minor Spices
3. Know the Equipment & Value Addition involved in Processing of Major & Minor Spices.

UNIT V

Processing of Plantation Crops: Processing of Coffee, Tea, Cocoa, Coconut, Arecanut, Vanilla and Cashew nut. Production and importance, harvesting and stages of harvest, drying, cleaning and grading, processing methods, and equipment, value-added products grading, and types packaging and storage.

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

Learning Outcomes

At the end of the unit, students will be able to

1. Understand the Processing of Coffee, Tea and Cocoa, Coconut, Arecanut, Vanilla, and Cashew nut
2. Acquire knowledge about the Pre-Harvesting & Post Harvesting Technologies involved.

3. Get the concept of Oleoresin & Flavor extraction of different Spices by suing different extractive methods.

Text books

1. Fruit And Vegetable Preservation: Principles And Practices Revised And Enlarged 3Ed (Pb 2017)
1. R. P. Srivastava and Kumar, S. (2003) Fruit and Vegetable Preservation: Principles and Practices, 6th edition, International Book Distributors.
2. Pruthi, J. S. (2012). Major spices of India. Crop management and post-harvest technology. Indian Council of Agricultural Research.

L	T	P	C
3	0	0	3

II Year -II Semester

HEAT AND MASS TRANSFER

Course Objectives

- To study about the types of heat transfer and their engineering principles
- To study about the exchange of heat transfer in equipment used in food industries

Course outcomes

COs	Statement	Bloom Level
CO1	Able to understand the principles of heat and mass transfer in food industry	L2
CO2	Able to analyze heat transfer in food applications	L2
CO3	Familiarize the mass transfer phenomena in various unit operations	L2
CO4	Able to calculate thermal conductivity, convective heat transfer coefficient and diffusivity in food processing	L3
CO5	Able to optimize heat and mass transfer equipment's	L4

UNIT I

Introduction to heat transfer and general concepts of heat transfer by conduction, convection and radiation. Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields and one-dimensional conduction without heat generation. Convection: Fundamentals of convection, Basic concepts and definitions, natural and forced convection, hydrodynamic and thermal boundary layers, laminar and turbulent heat transfer inside and outside tubes, Dimensional analysis, and determination of individual and overall heat transfer coefficients.

Learning outcomes

At the end of unit, students will be able to

- Understanding about the types of heat transfer present in the environment
- Details study of conduction takes places in different states of matter and through different objects

UNIT II

Radiation: Basic laws of heat transfer by radiation, black body and gray body concepts, view factors, Kirchoff's law, solar radiations, combined heat transfer coefficients by convection and radiation. Introduction to evaporator, types and operation methods. Overall heat transfer coefficient in evaporator. Calculation methods for evaporators. Condensers used in evaporators and evaporations of biological materials

Learning outcomes

At the end of unit, students will be able to

- Brief knowledge about the convective heat transfer and its thermal behavior on pipes
- Dimensional analysis and calculation of overall heat transfer coefficient

UNIT III

Mass transfer - Modes of mass transfer - Terms and definitions related to mass transfer – Water activity – Prediction of water activity - Methods for determination of water activity – Sorption isotherms – Types – Hysteresis – Equilibrium moisture content– Isotherm models – Basic problems on water activity and isotherm models. Fick's laws for molecular diffusion, Molecular diffusion in solids, liquids, gases and biological solutions.

Learning outcomes

At the end of unit, students will be able to

- Detail study of radiation mode of heat transfer and different laws included
- Study of combined methods of convective and radiation heat transfer

UNIT IV

Mass transfer in Drying – Rate of drying curves - Drying kinetics – Drying equipment's. Extraction – Principles of Extraction – Equipment for extraction. Solid-Liquid extraction – Leaching – Equipment – Applications of leaching in food processing. Super critical fluid extraction – Principles – Extraction systems – Solvents – Applications.

Learning outcomes

At the end of unit, students will be able to

- Understanding about the types and operation methods of evaporator
- Calculations of evaporators and its applications on biologicals products

UNIT V

Drying and Extraction: Mass transfer in Drying, Rate of drying curves - Drying kinetics – Drying equipment. Extraction, Principles of extraction, Equipment for extraction. Solid-Liquid extraction – Leaching, Equipment, Applications of leaching in food processing.

Learning outcomes

At the end of unit, students will be able to

- Brief learning of types of heat exchangers used and design considerations.
- Knowledge on different analysis carried out in heat exchangers.

Text Books:

1. Fundamentals of food engineering, D. G. Rao, PHI Learning Pvt Ltd, 2 nd edition, 2017.
2. Berk Z. Food process engineering and technology. Academic press; 2018 Feb 13.

References:

1. McAdams W.H. "Heat Transmission", 3rd ed., McGraw-Hill.
2. Kern D.Q. "Process Heat Transfer" McGraw Hill Book.
3. Badger W.L. &Bancharo J.T. ,"Introduction to chemical engineering" Tata McGraw Hill Mathematics, Oxford University Press.
4. R. Paul Singh and Dennis R. Heldman, Introduction to Food Engineering, 4th Edition, Academic Press, 2009

II Year -II Semester

L	T	P	C
0	0	2	1

FOOD MICROBIOLOGY LAB

Course Objectives

The major learning objective of this course will be to study:

- Important genera of microorganisms associated with food and their characteristics.
- To learn various techniques for enumeration and control of microorganisms in food.

Course Outcomes

COs	Statement	Bloom Level
CO1	Understand the microbiological techniques	L1
CO2	Able to quantify the microorganism in foods	L2
CO3	Able to do different culturing methods	L1
CO4	Able differentiate different spoilage microorganism in foods	L3
CO5	Able to propose appropriate control measures	L4

List of Experiments

1. Microscope its parts and utility in identification and differentiation of various microorganism as bacteria, yeast, and mould.
2. Familiarization with common techniques for handling pure culture serial dilution, Inoculation, slide preparation incubation, counting etc.
3. Simple and differential staining of microorganisms and their examination.
4. Preparation and sterilization of media and glassware for microbial counts.
5. Determination of Standard Plate Count (SPC) in natural and/or processed foods.
6. Isolation of bacteria and moulds from foods.
7. Microbial examination of cereal and cereal products: Identification, isolation, and confirmation.
8. Microbial examination of vegetable and fruits: Identification, isolation, and confirmation.
9. Microbial examination of vegetable and fruits: Identification, isolation, and confirmation.
10. Microbial examination of fish and other sea foods: Identification, isolation, and confirmation.
11. Microbial examination of fish and other sea foods: Identification, isolation, and confirmation.
12. Microbial examination of milk and milk products: Identification, isolation, and confirmation.
13. Microbial examination of sugar, salts, and spices.
14. Microbial examination of canned products: Identification, isolation, and confirmation.
15. Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus)

16. Thermal death time determination
17. Detection of Salmonella from food sample.
18. Detection of coliforms from water by MPN method.
19. Detection of Staphylococcusaureus from food sample.

II Year -II Semester

L	T	P	C
0	0	3	1.5

PROCESSING OF FRUITS AND VEGETABLES, SPICES AND PLANTATION CROP LAB

Course Objectives

The major learning objective of this course will be to study:

- To enable the students to understand the processing of fruits and vegetables.
- To impart Practical knowledge of about how to develop products and preservation.
- To understand the methods of dehydration.

Course Outcomes

COs	Statement	Bloom Level
CO1	Able to develop different processed products	L2
CO2	Able to know standard formulation to meet the standards	L2
CO3	Able to standardize formulation of products	L2
CO4	Able to extract the bioactive components	L3
CO5	Development of byproduct from waste	L4

List of Experiments

1. Estimation of benzoic acid & SO2
2. Pectin determination in fruits and vegetable products.
3. Preparation of fruit juices e.g., carambola, orange, pineapple, mango, etc.
4. Canning of fruits and vegetables,
5. Preparation of jams and jellies, marmalade, and determination of TSS and Viscosity
6. Preparation of Syrup, Squash, Crush.
7. Preparation of pickles, chutneys
8. Preparation of tomato products like Ketchup, Sauces, and determination of TSS
9. Preparation of Papain
10. Extraction of Pectin (identification pectin rich foods, chemistry and interaction of pectin with other components)
11. Drying of fruit and vegetables (Soup powders, dried products)
12. Preparation of fruit candy
13. Testing the adequacy of blanching
14. Visit a Canning Plant
15. Visit Fruits and Vegetable processing industries; the processing of Mushrooms.
16. Solvent Extraction of oil from Glove & Pepper
17. Preparation of Curry Powder
18. Determination of Curcumin Content from Turmeric
19. Extraction of Oleoresin from Ginger
20. Steam Distillation of Spice

II Year -II Semester

L	T	P	C
0	0	3	1.5

HEAT AND MASS TRANSFER LAB

Course Objectives

- To study about the types of heat transfer and their engineering principles
- To study about the exchange of heat transfer in equipment used in food industries.
- To inculcate basic knowledge about food processing operations involving mass transfer

Course outcomes

COs	Statement	Bloom Level
CO1	Able select the mode of heat transfer for different foods	L2
CO2	Application of heat and mass transfer to various foods	L2
CO3	Able to handle different heat and mass transfer equipment's	L2
CO4	Able to optimize the mode of het and mass transfer to achieve desired product quality	L3
CO5	Able to enhance the process out flow in food industry	L4

To find the thermal conductivity of metallic rod at different temperature and draw the temperature profile for steady and unsteady state conduction.

1. To find out the thermal conductivity of insulating powder.
2. To find the thermal conductivity of liquid / gases.
3. To study the critical heat flux behavior of a liquid
4. To find the heat transfer coefficient for parallel and counter current flow condition for a Double pipe heat exchanger
5. To study the shell & Tube heat exchanger and find the heat duty and over all heat transfer coefficient for parallel flow condition.
6. Compare the heat duty for parallel &Counter flow and find the energy saving.
7. To study the Plate heat exchanger and find the Overall heat transfer coefficient.
8. To study the performance of heat pipe.
9. To find the heat transfer coefficient for open pan evaporator for steady and unsteady state condition.
10. To study Single/Double/Triple effect Evaporator and find its Steam economy.
11. Determination of water activities of foods.
12. Concentration dependency of water activity.
13. Sorption isotherms and storage stability of foods.
14. Studies on Humidification/ Dehumidification columns.
15. Studies on commercial dehumidifiers.
16. Psychrometric chart and psychrometers.
17. Practical examples of Psychrometric processes.
18. Separation factors of the experiments with flash vaporization.
19. Separation factors of the experiments with vapour liquid equilibrium.
20. Separation factors of the experiments with liquid – liquid extraction

L	T	P	C
0	1	2	2

II Year -II Semester

SENSORY EVALUATION TECHNIQUES

Course Objectivess

- To familiarize various sensory evaluation Techniques for different food products
- To know the various analyzing tools for sensory data interpretation for different food.

Course Outcomes

COs	Statement	Bloom Level
CO1	Able to select the sensory test for different foods	L2
CO2	Able design a sensory sheet based on selected test	L2
CO3	Able to determine the shelf life of product	L2
CO4	Able to analyze the data from sensory evaluation	L4
CO5	Able to include software tools for accuracy	L4

Unit – 1 : Introduction- sensory evaluation, importance. History of sensory evaluation techniques, Criteria for selection of method, Sensory properties of foods and its applications in food industry: Odor& texture; appearance & taste. Texture analysis, color measurement, basic flavors. Different types of sensory evaluation techniques. About the differences between odor& smell; Texture& touch and other quality parameters like size, shape, texture, color& gloss.
Learning outcome: Brief explanation about sensory evaluation and its importance.

Unit-2: Panelists: Definition, classification of panelists; Selection & training of panelists (ISO 8568-1) ;Mental fitness and qualities of a qualified panelists. Factors affecting the sensory evaluation. Training of panelists and color detection tests like Ishihara test.
Learning outcome: About different sensory evaluation techniques along with the parameters& their properties.

Unit-3: Different types of sensory tests: discrimination tests, descriptive tests, ranking tests and difference tests like triangle test, application for different foods.
Learning outcome: About the panelists and their role in sensory evaluation

Unit -4 :Duo-trio and paired comparison test. Difference types of scales: Hedonic scale, line scaling and graphic scaling methods and its importance, disadvantages, Application in food industry
Learning outcome: Learn about difference types of tests which were used to measure & analyze the attributes of a food product.

Unit-5: Correlation between instrumental & sensory analysis of food quality attributes. Flavor assessment, modelling of human nose- electronic nose & modelling of human tongue-electronic tongue. Computer aided sensory evaluation of foods and beverages; statistical analysis of sensory data (2 way ANOVA).Consumer Evaluation methods and importance
Learning outcome: About basic features of sensory instruments and their analyzed data

Textbook

1. Sensory Evaluation Techniques" by Morten C. Meilgaard, ISBN 9781420005561,CRC press.
2. Sensory Evaluation of Food: Principles and Practices (Food Science Text Series) 2nd Edition,2010

Reference Books

1. Sensory Evaluation of Food: Principles and Practices By Harry T. Lawless, Hildegarde Heymann ·

II Year II Semester

L	T	P	C
1	0	2	2

DESIGN THINKING & INNOVATION

Course Objectives: The objectives of the course are to

- Bring awareness on innovative design and new product development.
- Explain the basics of design thinking.
- Familiarize the role of reverse engineering in product development.
- Train how to identify the needs of society and convert into demand.
- Introduce product planning and product development process.

UNIT – I Introduction to Design Thinking

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT - II Design Thinking Process

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT - III Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT - IV Product Design

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT – V Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview
- https://onlinecourses.nptel.ac.in/noc22_de16/preview

Course Outcomes:

COs	Statements	Blooms Level
CO1	Define the concepts related to design thinking.	L1
CO2	Explain the fundamentals of Design Thinking and innovation.	L2
CO3	Apply the design thinking techniques for solving problems in various sectors.	L3
CO4	Analyse to work in a multidisciplinary environment.	L4
CO5	Evaluate the value of creativity.	L5