JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Agriculture and Veterinary Science

Department of Food and Biotechnology

SYLLABUS

INTEGRATED BACHELOR OF TECHNOLOGY –

FOOD ND BIOTECHNOLOGY- MASTER OF TECHNOLOGY (FBT)

DURATION –5YEARS/10 SEMESTER

SYLLABUS FOR:
1-5 YEARS

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

PROGRAM DETAIL

Name of Program	-	Integrated Bachelor of Technology (B. Tech.)- Master of Technology (FT)
Program Code	-	B. Tech. FBT- M. Tech. FT
Mode of Program	-	Semester
Duration of Program	-	5yrs/ 10Semester
Total Credits of Program	-	272
Curriculum Type and Medium Choice	-	English

Program Outcomes	Students Acquire in-depth knowledge of Food Biotechnology, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesis existing and new knowledge, and integration of the same for enhancement of knowledge.
Specific Program Outcomes	Students will formulate with detailed research literature, and analyze complex engineering problems for getting better Food & Biotech products using first principles of natural sciences and engineering sciences. Graduates of the course will design solutions with appropriate consideration for public health and Food safety and environmental considerations.

SYLLABUS DETAIL

I Semester

S. No.	Credit	Name of Course
1	6	Elementary Mathematics
2	4.5	Fundamentals of Chemistry
3	1.5	Fundamentals of Chemistry Lab
4	3	Basics of Biosciences
5	1	Basics of Biosciences Lab
6	3	Introduction to food technology
7	4.5	ElementaryPhysics
8	1.5	Elementary physics Lab
9	2	Fundamentals of Biotechnology
10	1	Fundamentals of Biotechnology Lab
11	3	Biomolecules
12	1	Biomolecules Lab
Total	32	

II Semester

S. No.	Credit	Name of Course
1	3	Fundamentals of microbiology
2	1	Fundamentals of microbiology Lab
3	3	Thermodynamics
4	3	Cell biology
5	1	Cell biology Lab
6	2	Unit operations in Food Industry
7	1	Unit operations in Food Industry Lab
8	3	Analytical Chemistry
9	1	Analytical Chemistry Lab
10	3	Fundamentals of Food Science & Technology
11	1	Fundamentals of Food Science & Technology Lab
12	1	Industrial Visit
Total	23	

III Semester

S. No.	Credit	Name of Course
1	3	Metabolism and Bioenergetics
2	1	Metabolism and Bioenergetics Lab
3	3	Basic Enzymology
4	1	Basic Enzymology **Lab**
5	3	Technology of Milk & Milk Products
6	1	Technology of Milk & Milk Products lab
7	3	Principles of Food Preservation
8	1	Principles of Food Preservation **lab**
9	2	Biostatistics
10	1	Biostatistics **lab**
11	3	Food Microbiology & Safety
12	1	Food Microbiology &Safety **lab**
13	2	Molecular Biology
14	1	Molecular Biology **lab**
Total	26	

IV Semester

S. No.	Credit	Name of Course
1	3	Environmental Biotechnology
2	1	Environmental Biotechnology **Lab**
3	3	Recombinant DNA technology
4	1	Recombinant DNA technologylab
5	2	Medical Biotechnology
6	1	Medical Biotechnology**lab**
7	3	Waste management of Food Industries
8	3	Fruits and Vegetable Processing Technology
9	1	Fruits and Vegetable Processing Technology**lab**
10	2	Principles of Immunology
11	1	Principles of Immunology**lab**
12	4	Minor Project
13	1	Industrial Visit
Total	26	

V Semester

S. No.	Credit	Name of Course
1	3	Enzyme technology
2	1	Enzyme technology Lab
3	3	Plant biotechnology
4	1	Plant biotechnology**Lab**
5	3	Cereal, Pulse & oilseed Technology
6	1	Cereal, Pulse & oilseed Technology **lab**
7	2	Basic Food Engineering
8	1	Basic Food Engineering**lab**
9	2	Food Storage and Transport
10	3	Food Laws. Standards & Regulations
11	3	Modern Baking & Confectionary Technology
12	1	Modern Baking & Confectionary Technology **lab**
13	3	Fermentation Technology
14	2	Advances in cereal science and technology
15	1	Advances in cereal science and technology lab
16	2	Food additives and contaminants
17	1	Food additives and contaminants lab
18	10	Industrial Training **(**60 Days, after IV Sem, during Summer vacation**)**
Total	43	

VI Semester

S. No.	Credit	Name of Course
1	3	Molecular Therapeutics
2	1	Molecular Therapeutics Lab
3	3	Sensory Evaluation
4	3	Modeling & simulation of Bioprocess
5	3	Research Methodology
6	3	Food Business Management
7	3	Food Project Planning and Entrepreneurship
8	3	Dairy Engineering
9	1	Dairy Engineering**lab**
10	2	Applied Recombinant DNA technology
11	1	Applied Recombinant DNA technology **Lab**
12	2	Novel Food Packaging
13	1	Novel Food Packaging**Lab**
Total	29	

VII Semester

S. No.	Credit	Name of Course
1	2	Traditional and fermented food
2	1	Traditional and fermented food**Lab**
3	3	Food Plant Design
4	3	Dairy Plant Management
5	3	Immuno Technology
6	1	Immuno Technology**Lab**
7	3	Industrial Biotechnology
8	1	Industrial Biotechnology**lab**
9	3	Pharma Biotechnology & Drug Designing
10	3	Quality Control in Food Processing Industries
Total	23	

VIII Semester

S. No.	Credit	Name of Course
1	4	Protein Engineering
2	4	Advances in Food Engineering
3	4	Agriculture Biotechnology
4	3	Advances in Food Analysis
5	1	Advances in Food Analysis **Lab**
6	6	Minor Project
Total	22	

IX Semester

S. No.	Credit	Name of Course
1	3	Advanced Milk And Milk Products Technology
2	1	Advanced Milk And Milk Products Technology Lab
3	4	Nutraceuticals And Functional Foods
4	3	Food Rheology And Texture
5	1	Food Rheology And TextureLab
6	4	Advanced Meat, Fish, Poultry And Egg Technology
7	4	Research Methodology
8	10	Pre Dissertation Training**(**60 Days**)(**After VIII Sem during summer vacation**)**
Total	30	

X Semester

S. No.	Credit	Name of Course
1	25	Dissertation
Total		

I SEMESTER

Elementary Mathematics **Credits-6**

Objective : To develop the understanding of basic mathematics i.e. algebra, calculus, trigonometry and statistics. Also, to develop the understanding of measurements. Students will able to perform various mathematical operations using methods.

Unit-I Overview of Algebra Classification and types of Finite Set, Venn diagram, Algebra of sets. **Algebra**: Quadratic equation, Nature of roots of quadratic equations, Common Roots. Arithmetic progression, geometric progression and harmonic progression.Determinant of elementary properties of a determinant.Solution of Linear Simultaneous Equations by Cramer's Rule. Adjoin of matrices, Inverse of matrices.

(2 Credit)

Unit-II Overview of calculus and trigonometry Calculus: Differentiation of Implicit and Explicit Functions. Indefinite integrals of standard functions (simple problems), Methods of integration, Trigonometry- Trigonometrically Equations and General Values.

(2 Credit)

Unit-III Overview of statistics Definition and Applications of Statistics in various fields, classification and tabulation of data, graphical representation of data (bar diagram, pie chart, histogram , frequency polygon) Measure of central tendency: Mean, mode, median, variance, standard deviation(definition& simple problems).

(2 Credit)

Recommended text Books:

1. Business maths: D.C.sancheti&V.K.kapoor,S.C.chand publications
2. Algebra,Bhargava, saini , agrawal JPH
3. R.D.sharma,12thDhanpat rai publications

Reference Books:

1. Elements of statistics,S.C.Gupta&V.K.kapoor,sultanchand& son's publishers.

Fundamentals of Chemistry **Credits-6**

Objective : To develop the understanding of basic chemistry and its types. To make students understand about the practical aspects of things. Students will able to identify various matters and equipment used in labs, perform some basic experiments.

UNIT I Overview of Physical Chemistry Solutions: Concept of homogeneous and heterogeneous solution, Introduction of the terms, Ionization, acidity, basicity, equivalent weight and gram equivalent weight with suitable example. Preparation of solution, Normality, Molarity, and Molality as applied in

relation to a solution. Simple numerical problems related to volumetric analysis. Brief concept of gravimetric analysis.

(1.5 Credit)

Practicals (Credit: 0.5)

S.No.	Name of Practical	Nature
1	Preparation of original solution.	Practical
2	Correct group detection	Practical
3	Cu with change in concentration of electrolytes ($CuSO_4$	Practical
4	Zn with $ZnSO_4$	Practical
5	using starch solution as indicator (clock reaction).	Practical

UNIT II- Overview of Inorganic chemistry Occurrence and principles of extraction of aluminium, copper, zinc and Iron. position of hydrogen in periodic table, isotopes, preparation, properties and uses of hydrogen; hydrides-ionic, covalent and interstitial; physical and chemical properties of water, heavy water. Hydrogen peroxide- preparation, properties and structure; hydrogen as a fuel.Uses of hydrogen peroxide.

(1.5 Credit)

Practical (Credit: 0.5)

S.No.	Name of Practical	Nature
1	Systematic detection of ion.	Practical
2	Any two confirmatory tests of cation.	Practical
3	Physical nature.	Practical
4	Flame test.	Practical
5	Charcoal cavity test.	Practical

UNIT III Overview Organic Chemistry Stereochemistry of Organic Compounds: Concept of isomerism. Type of isomerism. Optical Isomerism - Elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers , chiral and acheral molecules and erythrodiastereomers, *, D & L and R & S systems of nomenclature. Geometric Isomerism: Determination of configuration of geometric isomers. E & Z system of nomenclature. Conformational isomerism: Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Application of Stereochemistry in biochemistry.

(1.5 Credit)

Practical (Credit: 0.5)

S.No.	Name of Practical	Nature
1	Recrystallization.	Practical
2	Melting points and Boiling point and the identification of an unknown and known compound nepthlene,Benzene	Practical
3	Molecular modelling.	Practical
4	L.S modelling.	Practical

5	Distillation, steam distillation.	Practical

Recommended text Books:

1. P.W. Atkins, **Physical Chemistry** (7th Edition), Oxford University Press, 2006.
2. R.T. Morrison and R.N. Boyd, **Organic Chemistry**, Prentice Hall of India Pvt. Ltd., 5th Ed, 1990

Reference Books:

1. I. A. Levine, **Physical Chemistry**, McGrawHill, 2009
2. D.A. McQuarrie and J.D. Simon, **Physical Chemistry – a Molecular Approach**, Viva Books Pvt. Ltd., 1998.
3. G. Solomons and C. Fryhle, **Organic Chemistry**, John Wiley & Sons (Asia) Pte Ltd.
4. J.D. Lee, **Concise Inorganic Chemistry**, (5th Edition), ELBS, 1996.
5. D. F. Shriver and P. W. Atkins, **Inorganic Chemistry,** Oxford University Press, 2006.

Basics of Biosciences **Credits-4**

Objecive : Student will learn concept wise knowledge about diversity in biological systems. This course will describe student about classification, morphology and physiology of Plant and Animal Kingdom. This course helps to buildup concept wise knowledge to understand advanced courses of Food and Biotechnology.

UNIT-I Introduction to biology Diversity in biological systems, Cell biology and cell structure, difference between Prokaryotes & Eukaryotes systems, Five-kingdom classification and General characters, Brief account on Ecology, Morphology, Nutrition, osmosis, Locomotion and Reproduction, useful and harmful effects of Bacteria, Viruses, Algae, Fungi and Protozoans.

(1 Credit)

Practical **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	To perform gram staining.	Practical
2	To study different types of Algae by making their slides.	Practical
3	To study different types of Fungi by making their slides.	Practical
4	To study slides of Protozoans.	Practical
5	Study of osmosis by potato osmoscope.	Practical

UNIT-II Classification and physiology of plants Classification of Plant Kingdom. Concepts of Growth, Meristems, Plant growth regulators, Bacterial & Plant photosynthesis; oxygenic and anoxygenic photosynthesis; chlorophyll as trapper of solar energy, photosynthetic reaction centres, Hill reaction, PS I & PS II, Photophosphorylation - cyclic & non-cyclic; Dark reaction & CO2 fixation.

(1 Credit)

Practical **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	To isolate chloroplast from plants.	Practical
2	Separation of plant pigments through paper chromatography.	Practical
3	Demonstration of O_2 evolution during photosynthesis.	Practical
4	Study of distribution of stomata in the upper and lower surface of leaves.	Practical

UNIT-III Classification and physiology of animals Classification of Animal Kingdom, Functions, morphology, growth and Reproduction, economic importance. Phylogeny of Invertebrate & Vertebrate Phyla, Concepts of Species & Ecosystem. Introduction of cell cycle, cell division, Electrolytes, Body fluids.

(1 Credit)

Practical **(0.2 credit)**

Sr. no.	Name of practical	Nature
1	To study mitosis in onion root tip.	Practical
2	To study meiosis in grasshopper testis	Practical
3	To test the presence of urea in urine.	Practical
4	To detect the presence of sugar in urine/blood sample	Practical
5	To detect the presence of albumin in urine.	Practical

Recommended Text Books:

1. NCERT Textbook for Class 11 Biology
2. NCERT Textbook for Class 12 Biology

Reference Books:

1. Cell and Molecular biology – P.K. Gupta
2. Plant Physiology- H.S. Srivastav
3. Animal Physiology- A.K. Berry

Introduction to Food Technology **Credits-3**

Objective : Students would be able to understand the principles of food science, different areas of food science and the historical evolution of food processing. They would be able to understand the basics of plant and animal foods, their types, structure and composition, nutritional value, changes taking place during storage and different processing methods used.

Unit- I Introduction to food composition Introduction , Food composition & Food group, Introduction Introduction to food science and technology, Food composition Food composition – Carbohydrates, protein, fat, vitamins and minerals water, Food groups Composition and nutritive value of Cereals, Pulses, Legumes, Oil seeds, Fruits, Vegetables, Meat, Fish, Poultry and Milk.

(1 Credit)

Unit – II Introduction to food preservation Food preservation -High temperature, low temperature and chemical preservations. Concept of nutrition, Digestion and absorption of nutrients, balanced diet, malnutrition, Packaging-Functions of packaging, types of food packaging materials.

(1 Credit)

Unit III Introduction to role of microbes in food technology Microbiology- Microorganisms important in foods, food contamination, food spoilage, food born diseases, Engineering -Unit operation, principles of heat exchangers, Pasteurizer, refrigerator, freezer and drier.

(1 Credit)

References:

1. Food Science N N. Potter & J Hotchkiss
2. Food Processing and Preservation G Subbalakshmi
3. Food Packaging Technology Handbook NIIR
4. A practical Guide for Implementation of ISO HACCP Sohrab

Elementary Physics

Objective : To impart knowledge of basic concepts in appliedphysics andmake the students familiar with topicslikeinterference,diffraction,polarization,fiberoptics, lasers, wave mechanics, etc. This course isalso aimed at enhancing the analytical capability oftheengineeringstudents.

UNIT I RELATIVITY: Review of concepts of frames of reference and Galileantransformationequation,MichelsonMorleyexperimentanditsimplications,Einstein'sspecialtheoryofrelativity,Lorentztransformationequations, Law of addition of velocities, Mass variation with velocity,Conceptofenergyandmomentum,Mass energyrelation.
OSCILLATIONS&WAVES:Dampedandforcedoscillations,Resonance(amplitude and power), Q – factor, Sharpness of resonance. Equationsof longitudinal and transverse waves and their solutions, Impedance,Reflectionandtransmissionofwavesataboundary,Impedancematchingbetweentwo medium.

(1.5 Credit)

Practical **(Credit: 0.5)**

S.No.	Name of Practical	Nature
1	To determine young's modulus of elasticity of the material of a given wire.	Practical
2	Using a simple pendulum plot L-T graph and hence find the effective length.	Practical

UNITII PHYSICAL OPTICS: Interferencebydivisionofwavefrontandamplitude, Multiple beam interference and Fabry-Perot interferometer,Fresnel diffraction through a straight edge, Zone plate, Fraunhofferdiffraction, single slit and N-slit / grating, Resolving power of telescope,prismandgrating.Polarizationbyreflectionandbytransmission,Brewster's law, Double refraction, elliptically and circularly polarizedlight,Nicolprism,Quarterandhalfwaveplates.
OPTICAL INSTRUMENTS: Cardinal points of co-axial lens systems,spherical and chromatic aberrations and their removal, Huygens and Ramsden'seyepiece.

(1.5 Credit)

Practical **(Credit: 0.5)**

S.No.	Name of Practical	Nature
1	To find the force constant of a helical spring by plotting graph between load and extension.	Practical
2	To find the speed of sound in air at room temperature using a resonance tube by two resonance positions	Practical
3	To study the relation between frequency and length of a given wire under constant tension using Sonometer.	Practical
4	To study the relation between the length of a given wire and tension for constant frequency using Sonometer.	Practical

UNIT-III Lasers : Coherenceandcoherentpropertiesoflaserbeams,Briefworkingprinciple of lasers, Spontaneous and stimulated Emission, Einstein'sco-efficient,Rubylaser,He-Nelaser.

Optical Fiber : Classification of optical fibers, Refractive index profile, Core-claddingrefractive index difference, Numerical aperture of optical fiber, Pulsedispersioninopticalfiber(ray theory).

(1.5 Credit)

Practical **(Credit: 0.5)**

S.No.	Name of Practical	Nature
1	To determine the wave length of sodium light by Newton's ring method.	Practical
2	To determine the height of an object with the help of sextant.	Practical

Recommended text Books:

1. Physics text book for class XI, published by NCERT.
2. physics text book for class XII, published by NCERT.

Reference Books:

S.No.	NameofBooks/Authors	YearofPublication/Reprint
1.	PhysicsofVibrationsandWaves,byH.J.Pain.	2005/JohnWiley&SonsLtd
2.	Vibrations andWaves, byA.P.French.	1971/CRCPress
3.	PerspectiveofModern Physics,byArthurBeiser	1981/McGraw-Hill
4.	Optics,byA. Ghatak.	2006/TataMcGraw-Hill
5.	BerkleyPhysicsCourseVol–1.	2009/TataMcGraw-Hill

Fundamentals of Biotechnology **Credits-3**

Objective : After completion of this course, student will learn about basics and historical perspective of Biotechnology; introductory knowledge of advance technologies of biotechnology along with patenting and ethical issues. so that, students can apply knowledge to solve biological problems.

UNIT I Fundamentals of RDT Definitions and Historical perspective of Biotechnology, Commercial Potential of biotechnology, Scope and Importance of Biotechnology. Introduction to Recombinant DNA technology. Tools of Recombinant DNA technology. Introduction of Recombinant DNA into host cell, Making of Recombinant DNA. Introduction and screening techniques for Identification of Recombinants. Polymerase chain reaction.

(0.5 Credit)

Practicals **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	To isolate genomic DNA from E.coli. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate DNA from E.coli.	practical
2	To prepare Agarose gel for gel electrophoresis (i) Preparation of agarose solution (ii) Gel casting	Practical
3	Introduction of new DNA into E.coli. by the technique of transformation. (i) Make suspension of E.coli. (ii) Making competent cells	Practical
4	To demonstrate PCR.	Practice

UNIT-II Basics of Animal and Plant cell culture Introduction to Microbial Culture Techniques. Different Microbial Culture Techniques. Measurement and Kinetics of Microbial Growth. Scale up of Microbial Process. Isolation of Microbial Products. Strain Isolation and Improvement. Applications of Microbial Culture Technology. Bioethics in Microbial Technology. Introduction to Plant tissue culture. Cell and Tissue CultureTechniques. Applications of Cell and Tissue Culture. Introduction to animal cell culture. Animal Cell Culture Techniques. Scale-up of Animal Culture Process. Applications of Animal Cell Culture.

(1 Credit)

Practicals **(0.6 credit)**

Sr. no.	Name of practical	Nature
1	To isolate pure strain of E.coli. by the technique of streaking plate method. (i) Serial dilution of soil sample (ii) Media preparation (iii) Streaking plate	Practical
2	To clean glassware and accessories used in plant tissue culture.	Practical
3	To prepare MS media. (i) Preparation of stock solutions	Practical

	(ii) Media preparation and autoclaving	
4	To initiate callus culture from explants. (i) Collection and cleaning of explants (ii) Inoculation of explants into media.	Practical
5	To learn aseptic techniques of animal tissue culture.	Practical
6	To prepare BSS solutions. (i) Weighing of reagents (ii) Mixing and autoclaving	Practical

UNIT-III Introduction to patenting Introduction to Patenting. Criterion for patents. Reading a patent. National and International Patent Laws. Ethical issues in agriculture and health care. Biotechnology in India and global trends. Product safety and Marketing.

(0.5 Credit)

Recommended text book:

- Biotechnology- U. Satyanarayan

Reference Books :

1. Gene cloning and DNA analysis- T.A. Brown
2. Culture of animal cells- R. Ian Freshney
3. Introduction to plant biotechnology- H.S. Chawla
4. Microbiology- Pelczar
5. Biochemistry- J.L. Jain

Bio-molecules **Credits-4**

Objective : Student will learn general account of the chemical nature of living cells including Carbohydrates, Lipids, Protein and Vitamins. These are basic concept wise knowledge from this course will make student able to learn advance knowledge related to Food and Biotechnology.

Unit-I Carbohydrates General account of the chemical nature of living cells. Carbohydrates: Classification (Monosachharides, Di- sachharides and Polysachharides), configurations and conformations, sugar derivatives, structural and storage polysaccharides.

(1 Credit)

Practical **(0.3credit)**

Sr. no.	Name of practical	Nature
1	To perform Molish test for the qualitative estimation of carbohydrate. (i) Preparation of Molish reagent (ii) Estimation and observation of carbohydrate	Practical
2	To perform Benedict test for the qualitative estimation of carbohydrate. (i) Preparation of Benedict's reagent (ii) Estimation and observation of carbohydrate	Practical
3	To perform Fehling's test for the qualitative estimation of reducing sugar's	Practical

	(i) Preparation of Fehling's reagent (ii) Estimation and observation of carbohydrate	
4	To perform Barfoed's test for the qualitative estimation of reducing sugar's (i) Preparation of Barfoed's reagent (ii) Estimation and observation of carbohydrate	Practical
5	To perform Inversion of Sucrose: (i) Preparation of reagents for inversion (ii) Estimation of converted sugar by Fehling's reagent.	Practical

Unit-II Proteins Amino acids: General properties, peptide bond, essential and non-essential amino acids. Classification, different levels of protein structure, forces stabilizing protein structure, protein folding, protein modification.

(1 Credit)

Practical **(0.3 Credit)**

Sr. no.	Name of practical	Nature
1	To perform Ninhydrin test for the qualitative estimation of amino acids. (iii) Preparation of Ninhydrin reagent (iv) Estimation and observation of amino acids.	Practical
2	To perform Xanthoproteic testfor the qualitative estimation of amino acids. (iii) Preparation of Xanthoproteic reagent (iv) Estimation and observation of amino acids.	Practical
3	To perform Millon's testfor the qualitative estimation of amino acids (Tyrosine, Phenylalanine & Glycine). (iii) Preparation of Millon's reagent (iv) Estimation and observation of amino acids.	Practical
4	To perform Lead-Sulfide test for the qualitative estimation of Cysteine and Cystine. (iii) Preparation of Lead sulfite reagent (iv) Estimation and observation of amino acids.	Practical
5	To perform Sakaguchi testfor the qualitative estimation of Arginine. (i) Preparation of Sakaguchi reagent (ii) Estimation and observation of amino acids	Practical

Unit- III Lipids and Vitamins Lipids: Classification, properties of lipid aggregates and biological significance.Vitamins: Water and fat soluble vitamins and their deficiency diseases .

(1 Credit)

Practicals **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	To Estimate the Saponification value of oils. (i) Preparation of reagents. (i) Determination of Saponification number.	Practical
2	To Estimate the acid value of oils. (i) Preparation of reagents. (ii) Determination of acid value by titration	Practical

3	Determination of Total Lipid Concentration (i) The preparation of a sample for solvent extraction (ii) Extraction of lipids and its determination.	Practical

Recommended Text Books:

1. Fundamentals of Biochemistry - J.L.Jain , S. Chand publication
2. Fundamentals of Biochemistry - Dr A C Deb

Reference Books:

- Biochemistry- U. Satyanarayana, U. Chakrapani , BOOKS AND ALLIED (P) LTD. (2008)

II Semester

Fundamentals of Microbiology **Credits-4**

Objective : Student will learn about the basics of microbes; physiology of microbes and their role in agriculture, public health, medicine and industry. With the help of this course, student will able to think and apply microbes with new innovative ideas for betterment in Food and Biotechnology.

Unit- I Introduction-aims and scope Introduction-aims and scope, Role of microbes in agriculture, public health, medicine and industry, Organization of prokaryotic and eukaryotic cells: Structure and function of cell organelles and surface structure and cellular reserve materials; Distinguishing features of various groups of microorganisms: actinomycetes, bacteria, molds, yeasts and algae and their broad classification.

(1 Credit).

Practicals **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	Purify the given bacterial sample by serial dilution method (i) To prepare culture media for microorganisms (ii) Growth study of Microorganisms	practical
2	Perform Gram's staining in given bacterial sample (i) Preparation of staining solutions (ii) Microscopic observation and identification	Practical
3	Identify the fungal flora of soil and their microscopic view (i) To prepare culture media for microorganisms (ii) Microscopic examination and identification	Practical
4	Preparation of culture media for algae (i) Media preparation and standard stock preparation (ii) Autoclaving and finalization of media for inoculation	Practical
5	Perform antagonistic activity of micro organisms n (i) Culture media preparation, inoculation of 2 different organisms (ii) Observation of result	Practical

Unit-II Characteristics of micro-organisms Characteristics of selected groups of microorganisms including microorganisms of extreme environment, Microbial nutrition and growth-principles of nutrition, growth measurement techniques, effect of environmental and culture parameters on growth, assimilation of nitrogen and sulphur, Isolation and preservation of cultures.

(1 Credit)

Practicals **(0.4 credit)**

Sr. no.	Name of practical	Nature
1	Isolate the microorganism of extreme environmental condition (i) To prepare culture media for microorganisms (ii) Streaking	practical
2	Study the bacterial growth curve with complete phases (i) Preparation of culture media for microorganisms (ii) Microscopic observation and identification of density of MO	Practical
3	Isolate nitrogen fixating bacteria and their identification (i) To prepare culture media for microorganisms (ii) Staining, Microscopic examination and identification	Practical
4	Effect of environmental conditions on bacterial growth (i) Media preparation and standard stock preparation (ii) Effect of unusual condition on MO	Practical
5	Perform the preservation process for bacterial culture (i) Culture media preparation, inoculation (ii) Observation of result after complete duration	Practical

Unit-III Energy transduction in microbial systems Energy transduction in microbial systems: fermentation, aerobic and anaerobic respiration. Phototrophic microorganisms, Phosphoketolase, Entner-Doudoroff and glyoxalate pathways, Control of microbial growth effect of heat, disinfectants and therapeutic agents, Microbial pathogenicity, Bioassays.

(1 Credit)

Practicals **(0.2 credit)**

Sr. no.	Name of practical	Nature
1	Study the batch and fed batch culture condition on bacterial growth (i) To prepare culture media for microorganisms (ii) Observation of different density and growth of MO	practical
2	Isolate the bacterial pigments form cyanobacteria (i) Preparation of culture media for microorganisms (ii) Microscopic observation and identification and isolation of Chl pigment	Practical
3	Chromatographic evaluation of bacterial pigments (i) To prepare culture media for microorganisms (ii) Chromatographic identification of pigment	Practical
4	To determine the ability of Microorganisms to degrade and ferment carbohydrates with the production of acid or acid and gas (i) Media preparation and standard stock preparation (ii) Microbial production	Practical

5	To detect the antibiotic sensitivity on the given culture sample (Antibiotic Sensitivity Test) (i) Culture media preparation, inoculation (ii) Observation of result after complete antimicrobial activity	Practical

Recommended Text Books:

- Microbiology – L. M. Prescott
- A Textbook Of Basic And Applied Microbiology - Aneja K.R.

Recommended Reference Books:

1. Pelczar Microbiology
2. Practical microbiology by Satish Gupte
3. Basic practical microbiology a manual – Cuteri

Thermodynamics **Credits-3**

Objective : Student will learn about the basic concepts of thermodynamics, stored and transit forms of energy, thermodynamic system, thermodynamic processes. Students will also be able to understand about laws of thermodynamics, Rankine, air standard cycles and heat transfer mechanisms.

UNIT – I Basic concept of Thermodynamics Basic Concepts: Introduction and scope of Thermodynamics, Thermostatics, Thermodynamic properties, Cycle integral for property and non-property variable, Stored and transit forms of energy, Thermodynamic systems and control volume, Isolated system, Universe, Steady flow system, their characteristics and examples, Types of work, Thermodynamic Processes.

(1 Credit)

UNIT – II Laws of Thermodynamics Laws of Thermodynamics: Zeroth Law, First Law of Thermodynamics, Second Law of Thermodynamics, Carnot Theorem, Steam Engine,Concept of entropy,T-S Diagram ,availability and irreversibilities. Pure Substances: Behaviour of pure substances.

(1 Credit)

UNIT – III Heat transfer Rankine vs. Carnot, modified Rankine cycle. Air Standard Cycles: Assumptions, Analysis of Otto, Diesel, Dual and Joule cycles, Calculation of cycle work and state values. Introduction to Heat Transfer, Refrigeration and Air-Conditioning.

(1 Credit)

Recommended text Books:

1. Heat thermodynamics and statistical physics by Brij lal, N.Subrahmanyam, S.Chand publication New Delhi.

Reference Books:

1. Timoshenko S P and Young D H, "Engineering Mechanics", McGraw Hill (International) 4/e, New Delhi (1984).

2. Beer, Ferdinand: Johnston, Jr., E. Russell, "Vector Mechanics for Engineers: Statics (in SI Units)", 3rd Edition Tata McGraw Hill, 2000.
3. R C Hibbeler, "Engineering Mechanics: Statics (in SI Units)", Pearson Education, India, 2000.

Cell Biology **Credits-4**

Objective : Students will understand the structures and basic components of prokaryotic and eukaryotic cells, including membranes, and organelles. This course give knowledge to understand cell division process, significance of mitosis and meiosis process. Students will apply their knowledge of cell biology to in cell function, cell singnaling pathways, cell differentiation and cell biology techniques.

Unit-I Ultra-structure of Plant and animal cell Cell – Shapes, morphology, Cell theory, Cells , Structure-function relationship including organelles and their Biogenesis (e.g., Endoplasmic reticulum, Mitochondria, Chloroplast, Golgi body, nucleus, lysosomes, vacuoles), Membrane structure , Membrane transport, Cytoskeleton, Extracellular matrix , Cell junctions.

(1 Credit)

Practicals **(0.5 credit)**

Sr. no.	Name of practical	Nature
1	Study of Microscopy**: -** Simple, Compound, & Phase Contrast Microscope (i) Learn about simple microscope (ii) Learn about compound microscope (iii) Learn about phase contrast microscope	Practical
2	Study of cell organelles by using Models, Charts and Slides**.** (i) Study of models (ii) Study of charts**(**iii**)**Study of slides	Practical
3	To demonstrate osmosis by using potato osmoscope**.** (i) Setting up of potato osmoscope (ii) Demonstration of osmosis	Practical

Unit-II Brief Idea about cell cycle Cell cycle: different phases of cell cycle (G_1, S- phase, G_2 and M-phase). Regulation of cell cycle: role of cyclins and CDKs, Check points. Mitosis: phases of mitosis (prophase, metaphase, anaphase, telophase and cytokinesis). Significance of mitosis. Meiosis: phases of meiosis and gametogenesis.

(1 Credit)

Practicals **(0.5 credit)**

Sr. no.	Name of practical	Nature
1	Squash preparation of Onion root tip to study Mitosis**.** (i) Squash preparation (ii) Making slide (iii) Observation of mitosis	Practical
2	Preparation of polytene chromosome in chironomous larva/fruit fly**.** (i) Separation of chromosome (ii) Making slide**(**iii**)**Observation of chromosomes	Practical
3	Study of meiosis in Grasshopper testis**.**	Practical

	(i) Separation of testis (ii) Making slide (iii) Observation of meiosis	
4	Learn about cell cycle and Gametogenesis through charts and models	Practice

Unit- III Cell signaling Cell Signaling: different pathways (G-protein mediated, cAMP mediated and tyrosine kinase mediated), secondary messengers. Cell differentiation, program cell death, techniques in Cell biology (microscopy, chromatography, centrifugation and spectroscopy).

(1 Credit)

Recommended Books:

1. Cell and molecular biology by P.K. Gupta
2. Cell biology by C. B. Panwar, Rastogi publication.

Reference books:

1. Molecular Biology of the Cell- Bruce Alberts, Alexander Johnson, Julian Lewis and Martin Raff.
2. The Cell: A Molecular Approach, Sixth Edition by Geoffrey M. Cooper and Robert E. Hausman

Unit Operations in food Industry **Credits-3**

Objective : Upon successful completion of this course, students should be able to:
1. Explain basic principles of unit operations and also waste treatment in food industry.
2. Explain the methods and effects of preservation and processing on food product quality.
3. Apply numerical solution to solve problems involved in unit operations of food processing.

UNIT I Flow, Heat Transfer Principles of fluid flow, heat transfer, heat exchanger, EMC & Water activity, Evaporation, Distillation, Drying, Dehydration; Types of dryers, Material handling equipment; Size reduction, Energy requirement in Size Reduction.

Practical **(1 Credit)**

S. No.	Name of practical	Nature
1	Solvent Extraction (Extraction)	Practice
2	Distilled Water Preparation (Distillation)	Practice
3	Study & Demonstration of Spiral & Planetary Mixers (Mixing)	Practice
4	Sieve Analysis (Sieving)	Practice
5	Study & Demonstration of Ball Mill (Size Reduction)	Practice
6.	Study & Demonstration of Refrigeration System (Refrigeration)	Practice

UNIT – II Separation, Mixing etc. Sieve analysis, Mixing, Kneading, Blending, Homogenization, Size Separation, Sedimentation, Extraction, Leaching, Crystallization, Thermal Processing, Refrigeration principles, Cooling, freezing, thawing of food materials.

(0.5 Credit)

UNIT – III Mechanical Separation, Grading & Emulsification Absorption and adsorption, Mechanical Cleaning, Grading, Sorting, Filtration, Membranic Separation, Emulsification.

(0.5 Credit)

Recommended Books:

1. Albert Ibarz, Gustavo V. Barbosa-Canovas, Unit Operations in Food Engineering, CRC Press 2010
2. Norman N. Potter, Joseph H. Hotchkiss. Food Science, Springer, 1998
3. R.L. Earle and M.D. Earle, Food Engineering, 1978

Analytical Chemistry

Credits-4

Objective : Students will understand the basic techniques used in analytical chemistry. This course will give student a brief knowledge about separation methods, solvent extraction methods, chromatographic techniques, separation techniques for inorganic and organic compounds. Students will apply their knowledge in spectroscopic techniques, laws of spectroscopic techniques, basic instrumentation of spectroscopic analysis, thermal diagnosis and differential scanning colorimetry.

Unit- I Separation methods Solvent extraction (liquid-liquid extraction): General principles, relationship between percentage of extraction and distribution coefficient and distribution ratio, multiple extraction, extraction of metal organic complexes and ion association complexes. Chromatographic techniques: Classification, basic principles, theory of chromatography- Ion exchange chromatography - ion exchange process, synthesis and structure of ion-exchange resin and separation of lanthanides. Paper and thin-layer chromatography- stationary and mobile phases, various techniques of development – visualization and evaluation of chromatograms, separation of inorganic and organic compounds.

(1 Credit)

Practicals **(0.5 credit)**

Sr. no.	Name of practical	Nature
1	To perform Ion exchange methods- (i) To the preparation of solution. (ii) To separation and estimation of mg (II) and Zn (II).	Practical
2	To perform of Solvent extraction- (i) To prepare solution. (ii) To separation and estimation of Mg (II) and Fe.	Practical
3	To the study Green leaves with the help of Thin layer chromatography-. (i) To preparation and Identification of organic compound.(Benzene) (ii) Determination of R_f value.	Practical
4	To the study of Organic compound with the help of Column chromatography. (i) Separation of fluoresin and methylene blue.	Practical

	(ii) Separation of a mixture of dying using cyclo hexane and ethyl acetate(8.5:1.5).	
5	To the study of Paper chromatography-Ascending and circular. (i) Separation of a mixture of Phenylalanine and glycine. (ii) Observation of result.	Practical

Unit- II Spectral methods UV absorption spectroscopy: Beer-Lambert law, molar extinction coefficient, analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophores and oxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones.

(1 Credit)

Practicals **(0.5 credit)**

Sr. no.	Name of practical	Nature
1	Spectral methods – (i) To Determine of Beer -Lambert law. (ii) Calculation of law by U.V	Practical
2	Spectroscopy methods- (i)To prepare the solution. (ii) Simultaneous determination of Co (II) and Cr (III) in a mixture of both by spectro- photometric method.	Practical
3	Thermal Methods- (i) To the study of Determine the content of iron in vitamin tablets by colorimetric method. (ii) Calculation by colorimetric methods.	Practical
4	To the study of fluoresin and methylene blue with the help of Column chromatography- (i) Identification of organic compound. (ii) Separation of a mixture of dying using cyclo hexane and ethyl acetate(8.5:1.5).	Practical
5.	To Analysis Solvent extraction methods- (i)To the Preparation of solution. (ii) Separation and estimation of Mg (II) and Fe metal.	Practical

Unit-III Thermal methods Theory, instrumentation and applications of Thermogravimetric method of analysis (TGA), (b) Differential thermal methods of analysis (DTA), (c) Differential scanning colorimetry (DSA).

(1 Credit)

Recommended text book:

- Qualitative analysis ,G.R.Chatwal,

Reference books:

1. Vogel's Qualitative analysis ,Svehla,Orient Longman.
2. Inorganic synthesis Mc GrawHell

Fundamentals of Food Science & Technology **Credits-4**

Objective : Students would be able to understand Scope of food processing in India and different areas of food processing. They would be able to understand the processing of different food products like meat and meat products, Fruit and vegetable, milk and milk products and marine products.

UNIT I Food Processing & Packaging and Food Industries Scope of food processing in India; Introduction to food processing, food preservation, food packaging, food drying and dehydration. Important food industries in India; role of Food Science & Technology in national economy.

(1 Credit)

Practical **(0.4Credit)**

S. No.	Name of practical	Nature
1	Study of Various Processed foods available in the market	Practical
2	Study of Different Methods of Food Preservation	Practical
3	Study of Different types of Drying Techniques	Practical
4	Study of Different types of Packaging Materials	Practical
5	Study of Different Food Industries in India	Practical

UNIT – II Processing of food products Fruit and vegetable processing, processing of meat and meat products, processing of milk and milk products, processing of marine products.

(1 Credit)

Practical **(0.4 Credit)**

S. No.	Name of practical	Nature
1	Processing of Fruits	Practical
2	Processing of Vegetables	Practical
3	Processing of Milk & Milk Products	Practical
4	Processing of Meat Products	Practical
5	Processing of Marine Products	Practical

UNIT III Unit operations and Food Engineering Unit operations in food industry**.** Rheology of food**.** Basic principles of food engineering**.** Introduction to various food processing equipments**.**

(1 Credit)

Practical **(0.2 Credits)**

S. No.	Name of practical	Nature
1	Study of Various Food Processing Equipments	Practical
2	Study of Unit operations in Food Industry	Practical
3	Study of Food Rheology	Practical

Recommended Books:

1. Norman N. Potter, Joseph H. Hotchkiss. Food Science, Springer, 1998
2. Vickie A. Vaclavik, Elizabeth W. Christian, Essentials of Food Science, Springer, 2008
3. B. Srilakshmi, Food Science, New Age International, 2007

III SEMESTER

Metabolism and Bioenergetics **Credits-4**

Objective : This course will give student a brief knowledge about molecular basis of life, structure and classification of proteins, classification of lipids, classification of carbohydrates. Students will learn about nucleic acid structure, enzyme classification, kinetics of enzymes, metabolism of carbohydrate, lipid and amino acid metabolisms and photosynthesis reaction.

UNIT I Bioenergetics and Carbohydrate metabolism Molecular basis of life, proteins, classification, structure, function, dynamics, specificity and techniques; Protein configuration, conformation, conformational analysis, Ramachandran's map and energy calculations; Helix to coil transition of proteins. Carbohydrates and lipids,classification, structure and function, membrane fluidity. Structural proteins, actin, myosin and muscle contraction .

(1 Credit)

Practicals (0.4 credits)

Sr. no.	Name of practical	Nature
1.	To understand the principle and operation of Spectrophotometer	Practical
2.	Determination of reducing sugars by Nelson- Somogyi's method 1. Preparation of reagents 2. To perform the assay 3. Observation and Calculations	practical
3.	Determination of starch in plant Tissue 1. Preparation of reagents 2. To perform the assay 3. Observation and Calculations	Practical
4.	Determination of Glycogen in Liver 1. Preparation of reagents 2. To perform the assay 3. Observation and calculations	Practical

UNIT II Lipid Metabolism Nucleic acids, nomenclature, properties and techniques, backbone torsional angle and sugar conformation. Enzymes, introduction, classification, kinetics and Catalysis. Metabolism, basic concepts and design.

(1 Credit)

Practical (0.4 credit)

Sr. no.	Name of practical	Nature
1	Extraction and estimation of total lipid content in the given sample of oilseed 1. Preparation of reagents and extraction of total lipids 2. Estimation of total lipids	Practical
2	Separation and identification of various lipids by Column Chromatography 1. Preparation of reagents 2. Separation of Lipids	Practical

	3. Identification of lipids	
3	Separation of various Components in different lipid fractions by thin layer chromatography 1. Preparation of reagents 2. Separation of various components	Practical
4	Estimation of Cholesterol content by Liebermann- Burchard method 1. Preparation of reagents 2. To perform the assay 3. Observation and Calculations	Practical

UNIT III Protein and Nucleic acid metabolism Carbohydrates and lipids,classification, structure and function. Metabolism of carbohydrates, glycolysis, citric acid cycle and oxidative phosphorylation, lipid, amino acid and nucleotide metabolism..Integration of metabolism, coordinated control and regulation. Photosynthesis, chloroplast, dark and light reactions.

(1 Credit)

Practical (0.2 credit)

Sr. no.	Name of practical	Nature
1.	Estimation of protein by Lowry's method 1. Preparation of reagents 2. To Perform the assay 3. Observation and Calculations	Practical
2.	Determination of Protein by Bradford method 1. Preparation of reagents 2. To perform the assay and calculation for the concentration of protein	Practical

Recommended text Books:

1. A.L. Lehninger, D.L. Nelson, M.M. Cox, " Principles of Boichemistry", 3rd Edn., Worth Publishers.

Reference Books:

1. Biochemistry by Voet and Voet
2. Biochemistry by U. Staynarayan
3. Biochemistry by Lubert Stryer. W. H. Freeman & Company, NY.
4. G. Zubay, "Biochemistry", 4th Edn., McGrawhill Publishers.

References/Correlation with Ancient Indian Literature:

- AsvalayanaGrhya Sutra II 7https://www.australiancouncilofhinduclergy.com/uploads/5/5/4/9/5549439/asvalayana-eng.pdf
- Atharvedahttp://www.sacred-texts.com/hin/av.htm
- Yajurvedahttp://vedicheritage.gov.in/science/

Basic Enzymology **Credits-8**

Objective : This course will give student a brief knowledge about basic characters of enzymes, activation energy, enzyme classification and purification of enzyme. Students will learn about kinetics of enzyme, enzyme substrate complex, enzyme inhibition, reversible inhibition, non reversible mechanism of enzyme action and modification of enzymes.

UNIT I Introduction & Classification of enzymes Introduction– Characterstics of Enzymes, Concept of Activation energy, free energy, Difference between enzyme and biocatalyst, IUB enzyme classification (specific examples), enzyme specificity, methods for isolation, purification and characterization of enzymes.

(1 Credit)

Practicals (0.5credit)

Sr. no.	Name of practical	Nature
1	To examine the effect of pH on activity of alkaline phosphatase 1. Preparation of Reagents 2. To perform the assay 3. Observation and calculations	Practical
2	To determine the temperature optima for alkaline phosphatase 1. Preparation of Reagents 2. To perform the assay 3. Observation and calculations	Practical
3	Time course of enzymatic reaction 1. Reagent preparation 2. To perform the assay and observe for the results	Practical
4	Specificity of enzyme action**.** 1. Preparation of Reagents 2. To perform the assay and observation	Practical

UNIT II Enzyme kinetics Kinetics of enzyme action –Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of Km & Vmax and their physiological significances. Importance of Kcat/Km. Kinetics of zero & first order reactions. Classification of multi-substrate reactions with examples of each class. Derivation of the rate of expression for Ping Pong, random & ordered Bi-Bi mechanisms. Use of initial velocity, inhibition and exchange studies to differentiate between multi-substrate reaction mechanisms.

(1 Credit)

Practicals (0.5 credit)

Sr. no.	Name of practical	Nature
1.	To understand the principle and operation of Spectrophotometer	Practical
2.	Influence of substrate concentration on the rate of enzymatic reaction. 1. Preparation of Reagents 2. To perform the assay 3. Observation and calculations	Practical
3.	Inhibition of enzyme activity Determination of K_i values 1. Preparation of Reagents 2. To perform the assay 3. Observation and calculations	Practical
4.	Determination of β-amylase activity in germinating barley seeds 1. Preparation of Reagents 2. To perform the assay 3. Observations and calculations	Practical

UNIT III Enzyme Inhibition and Mechanism of Enzyme action Reversible and irreversible inhibition. Competitive, non-competitive, uncompetitive, mixed type inhibitiors and their kinetics, determination of Ki and numerical based on these. Suicide inhibitor. Mechanism of Enzyme Action – Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain and distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of

chymotrypsin, lysozyme, glyceraldehyde 3-phosphate dehydrogenase, aldolase, carboxypeptidase, triose phosphate isomerase and alcohol dehydrogenase.

(1 Credit)

Recommended Text Books :

1. N.S. Kulkarni -General Enzymology

Reference Books

1. Travor and Palmer - Enzymology
2. A.L. Lehninger, D.L. Nelson, M.M. Cox, " Principles of Boichemistry", 3rd Edn., Worth Publishers.

References/Correlation with Ancient Indian Literature:

- Ras Ratna Samuchchayhttps://www.exoticindiaart.com/book/details/rasa-ratna-samucchaya-NZI038/
- Rasayan Shastra https://www.pgurus.com/chemistry-ancient-india/

Technology of Milk & Milk Products **Credits-4**

Objective : Students would be able to understand the basics of milk and milk processing. Understand the importance of dairy, the techniques that can be used for preservation and manufacturing of various value added milk products. Understand the processing of various milk products like butter, ghee, flavored milk, yoghurt and shrikhand, ice cream, cheese, channa, paneer, condensed milk and milk powder.

UNIT I Composition of Milk Milk: Definition, composition, and Present milk industry scenario and its future, Physical and chemical properties, Nutritive value of milk and milk products and its national and international standards. Practices related to procurement and transportation of milk, soy milk manufacturing and processing, Types of Milk- standardized milk, recombined milk, toned milk and double toned milk.

(1 Credit)

Practical **(0.4 Credit)**

S. No.	Name of practical	Nature
1	To determine the titratable acidity of milk	Practical
2	Determination of Physico- chemical properties of Milk	Practical
3	To test the quality of milk using COB test	Practical

UNIT – II Testing &Microbiology of Milk Testing the authenticity of Milk & Milk Products: Detection of foreign fats, milk of other species, microbiology of milk, Spoilage of Milk, Good Hygeine Practices in Milk Processing: Principal Hazards, cleaning and disinfection agents and processes. Reception, cream separation.

(1 Credit)

Practical **(0.4Credit)**

S. No.	Name of practical	Nature
1	To conduct the platform test of milk sampling of dairy products	Practical
2	Detection of common adulterants in Milk	Practical

3	Separation and standardization of Milk	Practical

UNIT III Processing of Milk & Milk Products Milk Processing: Clarification,Homogenization, Pasteurization, Sterilization of Milk, UHT Milk, Aseptic Packaging and Storage. Technology of Traditional Indian Dairy products, Technology of fat rich dairy products like Cream, Butter, ghee and margarine, Technology of fermented milk and probiotic milk based products, flavored milk.

(1 Credit)

Practical **(0.2 Credits)**

S. No.	Name of practical	Nature
1	Preparation of Flavored Milk	Practical
2	Preparation of traditional Indian dairy products	Practical
3	Preparation of white and salted butter and ghee	Practical

Recommended Text Books:

1. Many N.S. Shadakshasawamy M, Food Facts and Principles, New Age International, 2004.

Reference Books

1. Norman N. Potter, Joseph H. Hotchkiss. Food Science, Springer, 1998
2. Vickie A. Vaclavik, Elizabeth W. Christian, Essentials of Food Science, Springer, 2008

References/Correlation with Ancient Indian Literature:

- Prasna Upanishad 1-5https://esamskriti.com/Prasnopanishad-TNS-Complete.pdf
- Brihadaranyaka Upanishad (V.12)https://www.swami-krishnananda.org/brdup-audio.html
- ChhandogyaUpanishad (VII. 26)https://www.chinfo.org/images/userupload/Reflections/16_Bhumaiva_Sukham_Chand_7.pdf
- Chhandogya Upanishad (VII. 9)https://www.chinfo.org/images/userupload/Reflections/16_Bhumaiva_Sukham_Chand_7.pdf

Principles of Food Preservation **Credits-4**

Objective : This course deals with the techniques and principles involved in processing and preserving the various food products. The student will be able to apply the principles and methods involved in the processing of different foods and discuss their processing. They would understand important application of various preservation methods in food industries.

UNIT I Water Activity & Moisture Removal Principles of food preservation, Asepsis, removal of microorganisms, Maintenance of anaerobic conditions, Methods of food preservation. Water Activity and Food Preservation, Free and Bound water, Effect of water activity on quality of food constituents during storage (proteins, lipids and carbohydrates) Effect on physical and nutritional quality, Water activity and food stability, Effect of packaging material on water activity.

(1 Credit)

Practical **(0.4Credit)**

S. No.	Name of practical	Nature
1	Measurement of water activity in Fresh fruits	Practical
2	Measurement of water activity in dehydrated fruits - Raisins, figs (dry), dried vegetable	Practical
3	Measurement of water activity in milk powder/instant coffee powder	Practical
4	Effect of packaging material on water activity	Practical

5	To see Osmosis in Raisins	Practical

UNIT II Controlled Atmospheric Storage & Freezing Preservation through temperature reduction, Storage of food at chilling temperature - behaviour, Refrigeration Controlled Atmosphere Storage (CAS), Modified Atmosphere Storage (MAS), Chilling defects Freezing-principles, fundamental aspects of freezing Freezing process-technological spects Freezing damage-osmotic damage, solute Structural damage Preservation by use of High Temperatures, Concentration of food Evaporation Freeze concentration, Membrane process for concentration.

(1 Credit)

Practical **(0.4 Credit)**

S. No.	Name of practical	Nature
1	Low Temperature processing (i) Processed food / fruits / vegetables Banana, Sapota, Potato, Leafy Vegetables (ii) Processing of fruits and vegetables and storage at low temperature using various packaging material (after giving appropriate pre-treatment)	Practical
2	Frozen food Processing (i) Fruit pulp processing, packaging and freezing (using various packaging material and methods)	Practical
3	High Temperature processing (i) Experiments on Blanching of vegetables (ii) Experiments on sterilization	Practical
4	Experiments on concentration	Practical
5	Quality analysis of the products during storage, storage studies	Practical

UNIT – III Dehydration of foods & Preservation Techniques Dehydration of food (Food Preservation through water removal), Transport of water in foods, Different methods of dehydration, Cabinet drying, sun / solar drying, Osmo drying, Osmo-vac drying, micro-vac drying, vacuum drying,.Recent advances in dehydration of food. Freeze drying: Introduction, principles, process and preservation. Preservation using high Sugar-Jam, Jellies, Squashes, syrups, marmalades, cordials, concentrate etc. Salting preservation Use of common salt, principle, process Fish salting Pickling Pickle salting (sauerkraut, cucumber, Kim chi) Vegetable salting Acidified - brined pickles (vegetables-onion, garlic).

(1 Credit)

Practical **(0.2 Credit)**

S. No.	Name of practical	Nature
1	Dehydration :Cereal/Pulse based products (including comparative studies on packaging) Banana powder, Potato and Sweet Potato powder appropriate pre-treatment)	Practical
2	Sugar based products: Jam making	Practical
3	Sugar based products – Jelly making	Practical
4	Salting: Salting of vegetables, Brining / preservation of vegetables in brine using variouscontainers	Practical
5	Effect of chemical preservatives (Benzoate, So2, salts (KMS, NaMs)	Practical

Recommended Text Books:

1. Giridhari Lal, G.S. Siddappa and G.L. Tondon Preservation of Fruits and Vegetables, CFTRI, ICAR, New Delhi -12.
2. Diane M. Barrett, Laszlo Somogyi, HoshahalliRamaswamyProcessingFruits,lledition,ScienceandTechnology,CRCPress

Reference Books:

1. B. Sivasankar, Food Processing & Preservation, PHI Learning Private Limited, 2002

2. Norman N. Potter, Joseph H. Hotchkiss. Food Science, Springer, 1998

References/Correlation with Ancient Indian Literature:

- Maitrayani Upanishad (VI. 9)https://www.yousigma.com/religionandphilosophy/maitrayani.html
- Arunika Upanishad (Taitt. Up. II. 2)https://archive.org/stream/EssentialsOfUpanishadsKashyapR.L.SAKSI/Essentials%20of%20Upanishads%20%20Kashyap%20R.L.%20SAKSI_djvu.txt
- (MahabharathaAnu.65-46)https://sanskritdocuments.org/mirrors/mahabharata/mbhK/mahabharata-k-01-sa.html
- Atharva Veda (2-13-1).http://www.sacred-texts.com/hin/av/index.htm

Biostatistics

Credits-3

Course Outcomes- Students will learn about basic of biostatistics, classification of data, tabulatin of data, correlation coefficient, regression, measures of dispersion and measures of central tendancy. This course will give students knowledge about vital statistics, life tables, sampling techniques, hypothesis testing, large sample test, small sample test and analysis of variance.

UNIT I Classification and Tabulation of Data Classification and tabulation of data ,Frequency distribution Histogram , Frequency polygon and frequency curve ,Cumulative frequency curves, Measures of central tendency:arithmetic mean geometric mean harmonic mean median, mode;Measures of dispersion:range, quartile deviation, mean deviation, variance and standard deviation; Correlation:karl Pearson's correlation coefficient, Spearman's rank correlation coefficient, Spearman's rank correlation coefficient, Regression: Lines of regression and regression coefficient.

(1 Credit)

Practical **(0.5 Credit)**

Sr. no.	Name of practical	Nature
1.	To find out Mean	Practical
2.	To find out Median	Practical
3.	To find out Mode	Practical
4.	To draw Bar Graph	Practical
5.	To draw Pie diagram	Practical

UNIT II Vital Statistics Vital statistics: Concept, importance, Vital index,Birth rates:CBR,GFR,SFR,TFR,Death rates:CDR,SDR,STDR,Life tables:introduction,Description and uses, Sampling: concept of population and sample, Sampling distribution and standard error of sample mean and sample proportion, Hypothesis testing, type I& II errors, Level of significance, Critical region, acceptance region, p-values of the statistics, confidence limits.

(0.5 Credit)

Practical **(0.5 Credit)**

Sr. no.	Name of practical	Nature
1.	To draw Histogram	Practical
2.	To draw line graph	Practical

3.	To find out correlation	Practical
4.	To find out rank correlation	Practical
5.	To draw Histogram	Practical

UNIT-III ANOVA and sampling Large sample tests (normal test): Test for one sample proportion and two sample proportion test, Small sample tests : t-test (test for one and two sample means): F-test, Chi square test (goodness of fit test, test of independence, homogeneity of samples), Analysis of variance (ANOVA);One way and two way analysis of variance, Application of these tests to analyze the biological data.

(0.5 Credit)

Recommended Text Books:

1. Elements of Biostatistics; S. Prasad; Rastogi Publications, Merrut
2. Elements of Mathematical Statistics; S.C.Gupta and V.K. Kapur; Sulatanchand& Sons, New Delhi

Reference books:

1. Statical methods in Biology; T.I. Norman; Bailey,3rd edition
2. Fundamentals of Mathematics; S.C. Gupta and V.k. kapur; Sultan Chand& sons , New Delhi

References/Correlation with Ancient Indian Literature:

1. Sankhyā: The Indian Journal of Statistics Published by: Indian Statistical Institutehttps://www.springer.com/statistics/journal/13171
2. The Sulba Sutras http://www-history.mcs.st-and.ac.uk/Projects/Pearce/Chapters/Ch4_2.html
3. "History of Hindu Mathematics, Asia Publishing House, Bombay, 1962"https://link.springer.com/article/10.1007/BF02836134

Food Microbiology & Safety **Credits-3**

Course Outcomes- Students would be able to acquaint the knowledge of the important genera of microorganisms associated with food and their characteristics. They would be able to explain the role of microbes in fermentation, spoilage and food borne diseases. Gain Knowledge of Food safety and hygiene, types of hazards associated with food and understand the current Food Regulations.

UNIT I Introduction to food microbiology & food Borne Diseases Introduction to Food Microbiology, History of food Microbiology, Scope of Food Microbiology, and Types of organisms associated with food: Bacteria, Fungi, Yeast, and Mold. Growth Kinetics and factors affecting growth of microorganisms. Sources of Microbial contamination on foods, Sources of Microbial contamination in food and its control .Food Microbiology and Public Health- Food Poisoning, Food Poisonings due to pathogens, important features. Bacterial Agents of food borne illness- a brief account of various organisms related with food poisoning. Food Borne Diseases.

(0.5 Credit)

UNIT II Role of Microorganisms & Techniques in Microbiology Beneficial Role of microorganisms in foods. Introduction to Biotics & Probiotics. Screening, Detection and enumeration techniques including rapid detection techniques for food micro flora including pathogens, Requirement of Microbiology laboratory for food analysis, preparation & maintenance of cultures, media, sterilization techniques, disposal of used cultures and media detection and detection techniques of microorganisms in

foods: culture, microscopic examinations, physical, chemical and immunological methods of microbial detection.

(0.5 Credit)

Practical **(0.5Credits)**

S. No.	Name of practical	Nature
1	Preparation of common laboratory &Special media for cultivation of bacteria, yeast & molds	Practical
2	Staining of bacteria: Gram's Staining, Acid- Fast, Spore, Capsule and Flagellar Staining, Motility of Bacteria	Practical
3	Study of environment around us as sources of transmission of microorganisms in foods- assessment of surface sanitation of food preparation units- swab and rinse techniques	Practical
4	Isolation of Microorganisms- different methods & maintenance of cultures of microorganisms	Practical
5	Bacteriological analysis of foods	Practical
6	Bacteriological Analysis of water: MPN	Practical
7	Bacteriological Analysis of Milk: MBRT	Practical
8	To perform various tests used in Identification of commonly found bacteria in foods: IMVIC, Urease	Practical
9	To perform various tests used in Identification of commonly found bacteria in foods: H2S, Catalase	Practical
10	To perform various tests used in Identification of commonly found bacteria in foods: Coagulase, Gelatin & Fermentation (Acid/ Gas)	Practical

UNIT III Quality Control & Assurance Quality Control/Quality Assurance, Legislation for food safety- national & International criteria, sampling Schemes. Records, risk analysis, risk management. CC-Microbial source, code indicators of food safety and quality: Microbiological criteria of foods and their significance. The HACCP system and Food Safety Management Systems used in controlling microbiological hazards.

(1 Credit)

Practical **(0.5 Credits)**

S. No.	Name of practical	Nature
1	To study the implications of HACCP in relation to a food industry	Practical
2	To study the available rapid methods & diagnostic kits used in identification of microorganisms or their products.	Practical
3	To study a food processing unit dealing with advanced methods in food microbiology	Practical

Recommended Books:

1. James M.J. (2000) Modern Food Microbiology, 5th edition, CBS Publishers.

Reference Books:

1. Adams M. R. & Moss, M.O (1995) Food Microbiology, New age International Pvt. Ltd Publishers.

References/Correlation with Ancient Indian Literature:

- Gita14.17http://en.krishnakosh.org/krishna/Gita_14:17
- Chandogya Upanishad VI.6.5https://www.chinfo.org/images/userupload/Reflections/14_Chandogya_Chap_6-Tat_Twam_Asi.pdf
- Taittiriya Upanishad, III.vii.1https://www.hinduwebsite.com/taittiriya-upanishad.asp

Molecular Biology **Credits-4**

Course Outcomes- This course will give student a brief knowledge about molecular biology, nucleic acid structure, prokaryotic and eukaryotic replication, control of replication and nucleosomes. Students will learn about transcription in prokaryotes and eukaryotes, promoters for transcription, RNA processing, translation, mechanism, genetic code, mutation and DNA repair mechanisms.

Unit-I Synthesis of DNA and its mechanism Nucleic acids, DNA structure, central dogma; Replication: eukaryotic and prokaryotic replication, mechanism and control, replication of double stranded and single stranded circular DNA, the end-replication problem and telomerase; Nucleosomes: eukaryotic and prokaryotic genome packing, heterochromatin, euchromatin.

(1 Credit)

Practicals **(0.4credit)**

S. No.	Name of practical	Nature
1	To isolate genomic DNA from E.coli. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate DNA from E.coli.	practical
2	To prepare Agarose gel for gel electrophoresis (i) Preparation of agarose solution (ii) Gel casting	Practical
3	To separate and visualize genomic DNA of E.coli. (i) Loading of DNA into agarose gel (ii) Visualization of DNA	Practical

Unit II Mechanism of Transcription Transcription: mechanism of RNA transcription in prokaryotes and eukaryotes; model systems of transcriptional control: lac operon, lambda phage; promoters, enhancers, repressors; RNA processing: processing of heterogeneous nuclear RNA: splicing, capping, polyadenylation; Translation: universal genetic code, degeneracy of codons.

(0.5 Credit)

Practicals **(0.3 credit)**

S. No.	Name of practical	Nature
1	To isolate genomic DNA from blood. (i) Reagent preparation. (ii) Blood collection. (iii) Isolation of DNA.	practical
2	To isolate DNA from plant sample. (i) Grinding of plant sample (ii) Isolation of DNA	Practical
3	To determine the concentration of DNA.	Practical

Unit-III Mechanism of Translation Mechanisms of initiation, elongation and termination of translation, wobble hypothesis, genetic code in mitochondria; Mutations: nonsense, missense, frameshift and point mutations; intragenic and intergenic suppression; DNA repair: photoreactivation, excision, mismatch and SOS repair; Recombination: mechanism of homologous recombination in prokaryotes, site specific recombination, insertion sequences, transposons.

(0.5 Credit)

Practicals **(0.3 credit)**

S. No.	Name of practical	Nature

1	To isolate genomic DNA from cheek cells. (i) Reagent preparation. (ii) Separation and lysis of cells. (iii) Precipitation of DNA.	Practical
2	To isolate RNA from bacteria. (i) Grow colonies of E.coli. (ii) Make suspension of E.coli. (iii) Isolate RNA from E.coli.	Practical
3	To determine the concentration of RNA.	Practical

Recommended text book

1. Lehninger's principles of biochemistry.

Reference book

1. Genes by Benjamin Lewin
2. Molecular biology of the cell by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.

References/Correlation with Ancient Indian Literature:

- "Rig-Veda 1-163 Rig-Veda 1-163http://xn--j2b3a4c.com/rigveda/1/163/1
- The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi. Hindi translation of Rigveda by Ramgovind Tripathhttp://voiceofdharma.org/books/rig/

IV SEMESTER

Environmental Biotechnology
TOTAL- 4(3T+1P)

Course Outcomes- Students will learn about basic concept of environment, environmental pollution, pollution, control, pollution monitoring, air pollution and water pollution. This course will give students knowledge about waste water treatment, solid waste, sludge waste disposal, bioremediation, biostimulation, bioaugmentation, hazardous waste management and biological detoxification.

UNIT-I (Pollution)
Theory (1)
Environment –Basic concepts**.** Environmental Pollution- sources and nature**.** Pollution monitoring and biotechnological methods for management of pollution**.** Air pollution and Control**.** Water pollution and sewage**.**

Practicals(0.4credit)

Sr. no.	Name of practical	Nature
1	**Isolation and Characterization of Bacteria from Crude Petroleum Oil.** (i) Collection of sample (ii) Media preparation (iii) Spreading/streaking (iv) Incubation and identification	**Practical**
2	**Isolation and Characterization of Bacteria from Contaminated Soil.** (i) Collection of sample (ii) Media preparation (iii) Spreading/streaking (iv) Incubation and identification	**Practical**

UNIT-II (Management of Pollution)
Theory (1)
Waste water treatment :Preliminary treatment , primary treatment , secondary treatment (Aerobic attached growth treatment process & Anaerobic attached Growth treatment) and Tertiary treatment. Sludge and Solid wastes- Sources, characteristics and treatment of sludge. Disposal of sludge.

Practicals(0.4credit)

Sr. no.	Name of practical	Nature
1	**To determine DO of water sample.** (i) Reagent preparation and sample collection. (ii) Mixing of reagents in water. (iii) Titration.	**practical**
2	**To determine hardness of water** (i) Sample collection (ii) Analytic procedure	**Practical**

	(iii) Titration	
3	**To determine the BOD in water sample.** (i) Sample collection (ii) Mixing and titration	**Practical**

UNIT-III (Bioremediation)
Theory (1)
Bioremediation: Introduction, constraints and priorities of Bioremediation, Biostimulation of Naturally occurring microbial activities, Bioaugmentation, in situ, ex situ, intrinsic & engineered bioremediation.Hazardous Waste Management- Xenobiotic compounds, recalcitrance. hazardous wastes - biodegradation of Xenobiotics .Biological detoxification - market for hazardous waste management.

Practicals(0.2credit)

Sr. no.	Name of practical	Nature
1	**To determine the BOD in water sample.** (i) Sample collection (ii) Mixing and titration	**Practical**
2	**Detection of streptomycin producing bacteria.** (i) Sample collection (ii) Media preparation (iii) Streaking/spreading (iv) Incubation and observation	**Practical**
3	**To perform water potability of water sample.** (v) Sample collection and media preparation (vi) Incubation and observation	**Practical**

Recommended text book:
Biotechnology- U.Satyanarayan
Reference book:
Environmental biotechnology by S.N. Jogdand.

References/Correlation with Ancient Indian Literature:

1. N.J. Lockyer, The dawn of Astronomy, Massachusetts, Institute ofTechnology, p. 432.http://bhupendravidya.blogspot.com/2013/12/the-concept-of-environmental.html
2. Raja Ram Mohan Roy, Vedic Physics, Scientific Origin of Hinduism,Golden Egg Publishing, Toronto, 1999, p.6.https://www.scribd.com/doc/79678937/Vedic-Physics
3. Yudhishthira Mimansaka, Vaidika Siddhanta Mimansa, Sonipata, 1976,p. 40.http://ignca.bestbookbuddies.com/cgi-bin/koha/opac-search.pl?q=ccl=su%3A%7BHinduism%7D&sort_by=relevance_dsc&expand=se

Course Name:Recombinant DNA Technology
TOTAL- 4(3T+1P)
Course Outcomes- This course will give student a brief knowledge about recombinant DNA technology, basic steps of gene cloning, restriction enzymes, tools of RDT and vectors for gene cloning. Students will learn about methods of gene transfer, preparation of molecular probes, blotting methods, preparation of genomic library and DNA sequencing.

UNIT-I (Tools of RDT)
Theory (1)

Basic steps in gene cloning, Enzymes: Restriction endonuclease enzymes, DNA ligase, etc. Cloning Vectors**:**Plasmids, Lambda phage, Phagemids, Cosmids, Artificial chromosomes (BACs, YACs), Shuttle vectors, and virus based vectors.

Practicals: (0.4 credit)

Sr. no.	Name of practical	Nature
1	**To isolate plasmid DNA from*E.coli.*** (i) To grow colonies of E.coli. (ii) To make suspension of E.coli. (iii) Isolation of Plasmid DNA	**practical**
2	**To quantify plasmid DNA in given sample.**	**Practical**
3	**Digestion of lambda DNA by EcoRI and HindIII.** (i) Mixing reagents (ii) Incubation and observation	**Practical**

UNIT-II (Techniques of RDT)

Theory (1)

Methods of gene transfer**:**Micro-injection, microprojectile, Electroporation, *Agrobacterium* mediated gene transfer. Preparation and application of molecular probes**:**DNA probes, RNA probes, radioactive labeling, Non radioactive labeling, use of molecular probes, DNA fingerprinting, Southern blotting, Northern blotting, Western blotting, In-situ hybridization, Colony and plaque hybridization.

Practicals: (0.4 credit)

Sr. no.	Name of practical	Nature
1	**Introduction of new DNA into E.coli. by the technique of transformation.** (i) Make suspension of E.coli. (ii) Making competent cells	**Practical**
2	**To perform electroporation for introduction of DNA into plant cell**	**Practical**
3	**To perform Southern blotting.** (i) Separation of DNA fragments (ii) Blotting of DNA fragments (iii) Autoradiography	**Practical**

UNIT-III (Application of RDT)

Theory (1)

Gene libraries- CDNA library, Genomic DNA libraries, Amplification of gene libraries,Techniques of DNA sequencing. Polymerase Chain reaction **(**PCR**):**Basic principles, modifications, applications.

Practicals: (0.2 credit)

Sr. no.	Name of practical	Nature
1	**Amplification of interferon gene from human genome.** (i) Isolation of genomic DNA from cheek cells (ii) Amplification of genome by PCR (iii) Observation of result	**Practical**
2	**To perform nothern blotting.** (iv) Separation of RNA fragments (v) Blotting of RNA fragments (vi) Autoradiography	**Practical**
3	**To perform western blotting.** (vii) Separation of proteins (viii) Blotting of proteins (ix) Autoradiography	**Practical**

Recommended text books

1. Genetic engineering by Smitha Rastogi and Neelam Pathak.

Reference books

1. Gene cloning and DNA analysis by T. A. Brown

References/Correlation with Ancient Indian Literature:

Ganguli, K.M. (1883-1896) "Adi Parva" in The Mahabharata of Krishna-Dwaipayana Vyasa (12 Volumes).Calcuttahttps://archive.org/stream/TheMahabharataOfKrishna-dwaipayanaVyasa/MahabharataOfVyasa-EnglishTranslationByKMGanguli_djvu.txt

Course Name:Medical Biotechnology

TOTAL- 3(2T+1P)

Course Outcomes- Students will learn about basic concept of medical biotechnology, role of biotechnology in healthcare, tissue engineering and stem cell therapy. This course will give students knowledge about sign, symptoms, diagnosis, treatment and prevention of communicable and non-communicable diseases, disease diagnosis techniques, microbial culture techniques and monoclonal antibody production.

Unit I: (Biomedical engineering)

Theory (1)

Biomedical engineering: Introduction and applications of medical Biotechnology, Biotechnology in health care, Regenerative medicines- Tissue engineering, Characteristics of cells involved in Tissue engineering, Types and characteristics of various biomaterials used in Tissue engineering, Applications of Tissue engineering, Stem Cells-Types and characteristics, history and scope of stem cell therapy.

Practicals(0.4 credit)

S. no.	Name of practical	Nature
1	**Determine the lethal effect of temperature on micro-organisms** (iv) To prepare culture media for microorganisms (v) Evaluation of temp effect on growth of Microorganisms	**practical**
2	**Blood collection from given animal** (i) Manage necessary initial requirement and surgical needs (ii) Animal handling and blood collection	**Practical**
3	**Serum separation from given animal** (i) Animal handling cleaning with disinfectant (ii) Blood collection and serum isolation	**Practical**
4	**Effect of batch and fed batch culture condition** (i) Media preparation and standard stock preparation (ii) Observation of culture after complete incubation	**Practical**
5	**Study of Microbial production** (i) Culture media preparation, inoculation, seed flask (ii) Observation of result	**Practical**

Unit II: (Communicable &Non- Communicable diseases)

Theory (0.5)

Communicable & non- Communicable diseases: Sign, Symptoms, Diagnosis, Treatment and Prevention of Tuberculosis, AIDS, Typhoid, Pneumonia, Dysentery. Atherosclerosis/ Hyperlipidaemia , Coronary Heart Diseases, Hypertension and Diabetes.

Practicals(0.4 credit)

Sr. no.	Name of practical	Nature
1	**Demonstration of Bacterial Flora of the skin** (vi) To prepare culture media for microorganisms (vii) Evaluation of growth of microorganism	**practical**
2	**Microbial flora of mouth/oral** (iii) Culture media for microorganisms (iv) Observation of plates and result	**Practical**
3	**Determination of Blood stream Infection (Bacteremia)** (iii) Blood collection and smear preparation (iv) Microscopy of smeared slide	**Practical**
4	**Testing of Antimicrobial activity** (iii) Media preparation and standard drug disc preparation (iv) Activity observation of culture after complete incubation	**Practical**
5	**To perform the gram staining of given bacterial culture** (iii) Culture media preparation, inoculation (iv) Smear preparation and observation of result	**Practical**

Unit III: (Disease diagnosis techniques)
Theory (0.5)
Disease diagnosis techniques: Advancement of diagnosis, Hybridoma techniques and monoclonal antibody production and applications of monoclonal antibodies in diseases diagnosis, Diagnostic Immuno Assay, Widal Test- diagnosis of Typhoid, Culture Techniques, Antibiotic sensitivity

Practicals(0.2 credit)

Sr. no.	Name of practical	Nature
1	**Enzyme Linked Immuno Sorbent Assay** (viii) Initial requirement (ix) Evaluation of out come on the basis of principle	**practical**
2	**Polymerase Chain reaction** (v) Mastermix preparation (vi) Observation via electrophoresis and staining by Etbr	**Practical**
3	**Widal test** (v) Blood collection **(vi)** Separation of serum and observation	**Practical**
4	**Hemoglobin estimation** (v) Collection of sample (vi) Activity observation	**Practical**
5	**RBC count** (v) Sample collection (vi) Microscopic examination and observation	**Practical**

Recommended text books:
1. Pratibha Nallari, V. Venugopal Rao; Medical Biotechnology, oxford University press, 2010.
2. Text Book of Social and Preventive medicine by Park and Park-Bhanot edition MP
3. F.C. Hay, O.M.R. Westwood, Practical Immunology, 4th Edition-, Blackwell Publishing, 2002
4. Short Text book of Medical Microbiology by Satish Gupta
Reference text books:
1. James W. Goding , Monoclonal antibodies; Principles and Practice , 3rd Edition , Academic Press 1996
2. George Patrinos and Wilhelm Ansorage, Molecular Diagnostics, 1st Edition , Academic Press, 2005

References/Correlation with Ancient Indian Literature:

- Sharma PV, editor. Caraka Samhita of Agnivesha(Text with English Translation) Sutra Sthana. Ch. XX, Ver. 1-25. I. Varanasi: Chaukhambha Orientalia; 1981. pp. 137–43. [Google Scholar]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688840/
- Sharma PV, editor. Susruta Samhita of sushruta. First edition. Sutrasthana, Ch. I, Ver. 1-41. I. Varanasi: ChaukhambhaVisvabharati; 1999. pp. 3–28.file:///C:/Users/jvwu/Downloads/182-Article%20Text-545-1-10-20151215.pdf
- RudrasAdhityashttps://sreenivasaraos.com/2012/09/29/the-rudras-eleven/

Course Name:Waste Management of Food Industries
TOTAL-3
Course Outcomes- By the end of semester students will be able to understand and analyze different types of food industry wastes their Classification, their special characteristics and management of wastes from different food processing industries. The students will also acquaint knowledge about food industry waste by products.

UNIT – I (Classification and characterization of food industrial wastes)
Theory (1)
Introduction: Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry; Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal.
UNIT – II (Treatment methods for liquid wastes from food process industries)
Theory (1)
Treatment methods for liquid wastes from food process industries; Design of activated sludge process, Rotating biological contactors, Trickling filters, UASB, Biogas plant.Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system:
Landfill digester, Vermicomposting pit.
UNIT – III (Biofilters and bioclarifiers)
Theory (1)
Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by different methods.
Recommended Text Books:
1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.

Reference Books:
1. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.
2. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill Internationaleditions.
3. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

References/Correlation with Ancient Indian Literature:

- Ganguli, K.M. (1883-1896) "Adi Parva" in The Mahabharata of Krishna-Dwaipayana Vyasa (12 Volumes). Calcuttahttps://archive.org/stream/TheMahabharataOfKrishna-dwaipayanaVyasa/MahabharataOfVyasa-EnglishTranslationByKMGanguli_djvu.txt
- Dutt, M.N. (1895) The Mahabharata (Volume 1): Adi Parva. Calcutta: Elysium Presshttps://www.wikizero.com/en/Adi_Parva

- Debroy, B. (2010) The Mahabharata, Volume 1. Gurgaon: Penguin Books India, pp xxiii - xxvihttps://www.wikizero.com/en/Anushasana_Parva

- "Book 1: Adi Parva: Jatugriha Parva". Sacred-texts.com. Retrieved 1 September 2010https://wikivisually.com/wiki/Mahabharata

Course Name: Fruits & Vegetable Processing Technology
TOTAL-4 (3T+1P)
Course Outcomes- The course would furnish and acquaint a student with knowledge and understanding of the basic post harvest biological, chemical, physiological and metabolic processes and changes in fruits and vegetables. They would even learn the basic steps, application and operation of selected technologies and principles used to process, preserve and extend shelf life and value addition.

UNIT – I (Post Harvest Technology)
Theory (1)
Fruits and vegetables as living products: Current status of production and processing of fruits and vegetables. Chemical composition; pre and post harvest changes, harvesting and maturity standards for storage, and desirable characteristics of fruits and vegetables of processing. Post harvest treatments to enhance shelf-life, conditions for transportation and storage. Pre- cooling

UNIT – II (Types of Processing Treatments)
Theory (1)
Cold chain & low temperature preservation: Types of cold preservation; Types of freezers and freeze concentrators, Cooling above freezing point, Cooling below freezing point. Control & modified atmosphere storage. Thermal processing: Canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control. Dehydration of Fruits & Vegetable: Thermal, Osmotic. Products processing: Juice extraction and preparation of syrups, squashes, cordials, nectars; Jam, jelly, marmalade, preserves and candies; ketchup, pickles, chutneys and sauces; fruit juice concentrates and powders; fortified soft drinks, tomato product, vinegar; cut fruits and vegetable, fruit toffee; fruit flavors and essences.
Practical (1 Credit)

S. No.	Name of practical	Nature
1	**Estimation of benzoic acid**	**Practical**
2	**Estimation of So2 in processed fruit products**	**Practical**
3	**Pectin determination in fruits and vegetable products**	**Practical**
4	**Preparation fruit juices and its concentrate**	**Practical**
5	**Preparation of tomato products- ketchup**	**Practical**

UNIT – III (Packaging & By- Products)
Theory (1)
Basics of Packaging materials & containers: Tin, glass, plastic and other packaging materials used in fruits and vegetables preservations. Modified atmosphere and active packaging, By-products utilization: Fruit & vegetable processing industry waste treatment, disposal and reuse. Emerging technologies for fruit and vegetable processing.
Recommended Books:
1. Fruits and Vegetables. A.K Thompson. Blackwell publishing S. Ranganna, Hand Book of Analysis and Quality Control for Fruits and Vegetable Products, Tata McGraw Hill, 2002.
2. L. Somogyi, Processing Fruits: Science and Technology, Vol I: Biology Principles and Applications, Woodhead Publishing, 1996.

References/Correlation with Ancient Indian Literature:
- **Mantra (4-21-6) of the Atharva veda http://www.sacred-texts.com/hin/av.htm**

- **Atharva Veda's Mantra 18-4-16**http://dahd.nic.in/hi/related-links/annex-v-ii-2-superiority-cow-milk-paper-sh-ik-narang

Rigveda (10-179-3) http://www.gatewayforindia.com/vedas/rigveda/rigveda10.shtml

Course Name: Principles of Immunology
TOTAL- 3(2T+1P)
Course Outcomes- Students will be able to understand the basic concepts of immunology including introduction of immunology, molecular patterns of pathogen, types of immunity, components and processes of innate and acquired immunity, antigen and antibody interaction, antibody structure,MHC molecules, B Cell and T Cell activation, cytokines and vaccines**.**

UNIT-I (Cells and Organs of Immune system)
Theory (1)
Natural immunity, defensins, pathogen associated recognition motifs, Toll receptors, complement system, applications of complement proteins in rapid clearance of pathogens, acquired immunity: immune cells, antigens haptens, B and T cell.
Practicals(0.4 credit)

Sr. no.	Name of practical	Nature
1	**To separate serum from blood** **(i) Withdrawal of blood** **(ii) Incubation** **(iii) Centrifugation**	**Practical**
2	**To identify different leukocytes by making blood smear.** (i) **Pricking of figure tip** (ii) **Making slide** (iii) **Observation**	**Practical**
3	**To determine the blood group** (iv) **Pricking of figure tip** (v) **Mixing with anti-serum** (vi) **Observation**	**Practical**
4	**To learn about antigen- antibody interaction**	**Practice**

UNIT-II (Adaptive and Innate Immunity)
Theory (0.5)
Antibodies: structure and function, monoclonal antibodies, single chain antibodies, domain antibodies, antigen antibody reactions, genetics of immunoglobulins and antibody diversity, Major Histocompatibility Complex, structure and functions of class I and class II MHC molecules, antigen presentation by MHC and non MHC molecules.
Practicals(0.3 credit)

Sr. no.	Name of Practical	Nature
1	**To perform RID** **(i) Solution making** **(ii) Incubation and observation**	**Practical**
2	**To perform Ouchterlony double diffusion.** (i) **Solutions making** (ii) **Preparation of Agarose layer** (iii) **Loading and incubation**	**Practical**
3	**To demonstrate antimicrobial activity of skin** **(i) To prepare media** **(ii) Making suspension of two strains of bacteria.** **(iii) Incubation and observation**	**Practical**

UNIT-III (Organ transplant)

Theory (0.5)

Cytokines, in vivo regulation of immune responses, B and T cell activations, hypersensitivity, mucosal immunity, introduction to transplantation immunology tolerance, tumor immunology and vaccines.

Practicals(0.3 credit)

Sr. no.	Name of practical	Nature
1	**To perform dot ELISA** **(iii) Solution making** **(iv) Incubation and observation**	**Practical**
2	**To learn about the technique of RIA**	**Practical**
3	**To perform sandwich ELISA** **(iv) Solution making** **(v) Loading and incubation** **(vi) Observation and plotting graph**	**Practical**

Recommended text books

1. **Immunology: concepts and mechanics by Asha Sharma and Rajendra Kaushik. Oxford book company.**

Reference book

1. **Kuby immunology by Richard A. Goldsby, Thomas J. Kindt and Barbara A. Osborne.**

References/Correlation with Ancient Indian Literature:

- **Suśruta 600 BC, SS. Sū chaps. 4, 15, 21 edited by Singhal et.al. ChoukhambaSurbharati 2nd edition Varanasi/ Delhi, India, 2002"https://pdfs.semanticscholar.org/68ec/5838cad4c40baf2563699c8e1d2514249fea.pdf**
- **"Suśruta 600BC, SS Ci Chap. 27-30 edited by Singhal et al ChoukhambaSurbharati 2nd edition Varanasi/Delhi, India 2002"https://ayushdhara.in/review/pdf/ayush_5218193.pdf**
- **"Sarangdhara 1300AD, SarandharasamhitaChoukhamba publications Varanasi/Delhi, India"http://www.carakasamhitaonline.com/mediawiki-1.32.1/index.php?title=Rasayana**

V SEMESTER

Course Name: Enzyme Technology
4 (3T+1P)
Course Outcomes - Students will be able to understand the basic concepts of Enzyme technology including introduction of enzyme and enzyme kinetics, enzyme inhibition and regulation, Enzyme immobilization techniques and their applications, free and immobilized enzymes, extraction and application of commercially important enzymes in medicine and industrial purposes**.**

UNIT I (Introduction to Enzyme kinetics)
(Theory- 1)
Kinetics of single substrate enzyme catalyzed reactions, Michaelis-Menten equation, turnover number, Enzyme inhibition kinetics- competitive, non-competitive, and uncompetitive, allosteric enzyme inhibitiors and their kinetics and determination of Ki. General mechanisms of enzyme regulation.

UNIT II (Concept of Immobilization and its applications)
(Theory- 1)
Types of reactors used for enzyme catalysis for free and immobilized enzymes, Immobilized enzymes: Physical and chemicalmethods of immobilization, immobilization supports, kinetics of immobilized enzymes. effects of inhibitors, temperature and pH on immobilized enzyme catalysis and deactivation, Therapeutic, Diagnostic and Industrial applications of Immobilized enzymes.

Practicals: (0.5 credit)

Sr. No.	Name of practical	Nature
1	**Enzyme Immobilization** (i) Preparation of Reagents (ii) Practice (iii) To perform the assay (iv) Observation and calculations	**practical**
2	**To study physical and chemical method of Immobilization** (i) Preparation of Reagents (ii) To perform the assay (iii) Observation and calculations	**practical**
3	**Preparation of urease entrapped in alginate beads and determination of percent entrapment** (i) Preparation of Reagents (ii)To perform the assay (iii)Observation and calculations	**practical**

UNIT III (Application of Enzyme and Enzyme Biosensors)
(Theory- 1)
Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes. Use of enzymes in analysis types of sensing-gadgetry and methods. Case studies on application – chiral conversion, esterification etc.Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment, Immunoenzyme techniques, Concept of Isozymes, Ribozymes and Multienzyme substrate complex.
Practicals: (0.5 credit)

Sr. no.	Name of practical	Nature

11.	**Determination of β-amylase activity in germinating barley seeds** (i) Preparation of Reagents (ii) Practice (iii) To perform the assay (iv) Observations and calculations	**Practical**
22.	**Degradation of organic carbon compounds by enzymatic reactions** (i)Reagent preparation (ii)Practice (iii)To perform the assay and observe for the results	**Practical**
33.	**To detect degraded enzymatic product by TLC** (i)Reagent preparation (ii)Practice (iii)To perform the assay and observe for the results	**Practical**

Recommended Text Books :

1. N.S. Kulkarni -General Enzymology

Suggested Reference Books:

1. Travor and Palmer - Enzymology
2. A.L. Lehninger, D.L. Nelson, M.M. Cox, " Principles of Boichemistry", 3rd Edn., Worth Publishers.

References/Correlation with Ancient Indian Literature:

1. **AsvalayanaGrhya Sutra II 7**

   https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol24_1_5_Supplement.pdf

2. **Atharva Veda. X. 3**http://www.sacred-texts.com/hin/sbe42/index.htm
3. Yajurvedahttp://www.sacred-texts.com/hin/yv/index.htm

Course Name: Plant Biotechnology
4(3T+1P)

Course Outcomes Students will be able to understand the basic concepts of plant biotech with introduction of plant tissue culture, various types of tissue culture media in plants and techniques of plant tissue culture for preparation oof disease free plants, production of secondary metabolites, construction of mapping, physical methods of gene transfer for the production of transgenic plants and Application of plant tissue culture**.**

Unit-I (Introduction to Plant tissue culture)
(Theory-1)

Historical perspectives, laboratory organization and tissue culture media. Cell, tissue and organ culture, cryopreservation, protoplast culture and applications. Plant regeneration and hardening, micropropagation of disease free plants

Practical- (0.4 credit)

Sr. no.	Name of practical	Nature
1.	To clean glassware and accessories used in plant tissue culture.	Practical
2.	Preparation of different types of tissue culture medium. (i) Prepararion of stock solutions and Growth hormones. (ii) MS media preparation and autoclave (iii) Inoculation explain in media	Practical
3.	In Vitro Multiplication of medicinal plant.	Practical

	(i) Preparation of media and autoclave. (ii) Inoculation of explants	

Unit-II (Techniques of tissue culture)
(Theory-1)

Somaclonal variation, production of haploid plants, biotransformation, production of secondary metabolites. Molecular markers and construction of maps, molecular breeding and DNA fingerprinting and IPRs and biosafety guidelines

Practical- (0.4 credit)

Sr. no.	Name of practical	Nature
1	Optimization of medium and explants for callus induction. (i) Preparation of media and autoclave. (ii) Inoculation of explants	Practical
2	**To regenerate callus into disease free plant.** (i) Preparation of media and autoclave. (ii) Inoculation of explants	Practical
3.	Root initiation of invitro multiplicated shoots (i) Preparation of rooting media and autoclave (ii) Inoculation of explant	Practical
4	To maintain media for cell suspension culture so those to obtain disease free plants from single cells. (i) Preparation of liquid media for single cell culture. (ii) Inoculation and its incubation	Practical

Unit-III (Applications of Tissue culture)
(Theory-1)

Physical methods of transfer of genes to plant, vectorless and vector mediated transformation, transgenic plants and their commercialization, development of insect resistance, herbicide, salt and draught resistance plants

Practical- (0.2 credit)

Sr. no.	Name of practical	Nature
1	To acclimatize the cultured plants in growth room so that they may able to grow in field/green house (i) Sterilization of soil (ii) Preparation of soil for plant transfer (iii) Transfer of tissue cultured plant in green house for acclimatization.	Practical
2	**To produce haploid plant- Anther culture** (i) Preparation of Nistch media (ii) Extraction of anther and microspore (iii) Inoculation of anther in media	Practical

Recommended text books:

1. Introduction to plant biotechnology- H.S. Chawla

Reference Books:

1. Plant biotechnology- M.K. Razdan

References/Correlation with Ancient Indian Literature:

Atharva Vedas http://www.sacred-texts.com/hin/sbe42/index.htm

Aitareya Brihmana.https://insa.nic.in/writereaddata/UpLoadedFiles/IJHS/Vol24_1_5_Supplement.pdf

Course Name: Cereal, Pulse & Oilseed Technology
4(3+1P)
Course Outcomes- Students would be able to understand basic composition & structure of food grain and understand the basics of milling operations. They would learn processing of food grains into value added products and how to manage production, distribution & storage of grains and even understand the principle of alcoholic beverage preparation.

UNIT – I (Cereals Processing)
Theory (1)
Wheat Processing: Wheat classification, wheat grain structure quality and milling Functionality of wheat flour components and bakery ingredients. Rice Processing: Classification, paddy Processing and treatment for quality improvement, Milling and sorting, By product utilization e.g. Bran: Novel product development – Instant Rice, puffed products etc. Coarse Cereals Products: Maize, sorghum, pearl millet and small millets processing and value addition

Practicals(0.4 credit)

Sr No.	Name of practical	Nature
1	Milling of wheat with emphasis on quality and recovery.	Practical
2	Milling of rice with emphasis on quality and recovery.	Practical
3	Milling of sorghum with emphasis on quality and recovery.	Practical
4	Milling of maize with emphasis on quality and recovery.	Practical
5	Milling of pearl millet with emphasis on quality and recovery.	Practical

UNIT – II (Pulse Processing)
Theory (1)
Pulses: Pretreatment of pulses for milling, Methods of pulse milling, milling of major pulses. Methods to improve recovery. Oil seeds Processing: Groundnut, Mustard, Soybean, Sunflower, Safflower, Sesame and other oil bearing materials, By products of oil milling

Practicals(0.4 credits)

Sr No.	Name of practical	Nature
1	Pulses: Milling characteristics and effect of treatments on recovery.	Practical
2	Determination of triglyceride composition of oils	Practical
3	Milling of oilseeds	Practical
4	Pretreatment of pulses for milling	Practical

UNIT – III (Soyabean & Extrusion Technology)
Theory (1)
Special Topics: Processing & Utilization of Soya bean for value added products, Innovative products from cereals, pulses and oilseeds. Extrusion technology for cereals

Practicals(0.2 credit)

Sr No.	Name of practical	Nature
1	Preparation of Soy-Milk	Practical
2	Preparation of tofu	Practical
4	Preparation of soy-snacks	Practical
5	Preparation of Soy-Milk based products	Practical
6	Development of Bakery and other products	Practical

Recommended Text Books:
1. Wheat Chemistry and Technology by Y. Pomeranz

Reference Books:
1. Post Harvest Technology of Cereals by Chakraborty AC

References/Correlation with Ancient Indian Literature:

1. **Arthasastra**https://sanskritdocuments.org/doc_z_misc_sociology_astrology/artha.html?lang=sa
2. **Manusmrti**https://sanskritdocuments.org/sanskrit/samajashastra/
3. **Kasyapasamhita**https://sanskritdocuments.org/sanskrit/vedanta/

Course Name: Basic Food Engineering
3(2T+1P)
Course Outcomes- Student would learn to Emphasis the various properties of the raw material used in food processing, different processing technologies required in transforming them into quality food products and material handling equipment involved in food processing operations.

UNIT – I (Materials Handling)
Theory (0.5)
Material Handling- Theory, Classification of various material handling equipments- conveyors (gravity & powered conveyors), elevators (bucket & screw type elevators), trucks) high lift & pallet trucks), cranes and hoists. Cleaning- types of contaminants found on raw foods, aims of cleaning, methods of cleaning- dry, wet and combination methods, Dry cleaning methods: screening, aspiration, magnetic cleaning and abrasive cleaning, Wet cleaning methods: soaking, spray washing, floatation washing and ultrasonic washing.

UNIT – II (Sorting & Grading) (2-0.5)
Theory (1)
Sorting & Grading- Advantages of sorting & grading, grading factors, methods of sorting and grading, Size Reduction: reasons/ Benefits of size reduction, nature of forces used in size reduction, criteria of size reduction, equipment selection (hardness of feed, mechanical structure of feed, moisture content and temperature sensitivity of feed), mode of operation of size reduction equipment – open circuit and closed circuit grinding, free crushing, choke feeding and wet milling.

Practical (0.5 Credit)

S. No.	Name of practical	Nature
1	Sieve Analysis of mean particle diameter	Practical
2	Sorting & Grading of foods	Practical
3	Energy Requirement for size reduction using different mills	Practical

UNIT – III (Mixing & Conveying)
Theory (0.5)
Mixing Terminology (agitating, kneading, blending, and homogenizing), Mixing equipments- mixers for blending and homogenizing). Mixing Equipments- mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators), mixers for high viscosity pastes (Pan mixers, horizontal mixer and dough mixer), mixers for dry solids (tumbler mixer & vertical screw mixer), effects of mixing on foods.

Practical (0.5 Credit)

S. No.	Name of practical	Nature
1	Mixing indices for mixing solids	Practical
2	Power consumption for mixing of liquids using different impellers	Practical

Recommended Books:
1. Earle, R. L. (1983) Unit Operations in Food Processing, 2nd edition, Pergamon Press, Oxford, U.K

Reference Books:

1. Introduction to Food Engineering (Food Science and Technology), by R Paul Singh, Dennis R. Heldman, 2013

References/Correlation with Ancient Indian Literature:

- **Raghuvamsa,**https://sanskritdocuments.org/sanskrit/major_works/
- **Kumarasambhava**https://sanskritdocuments.org/sanskrit/major_works/
- **Malavikagnimitra**https://archive.org/stream/cu31924022967578#page/n9/mode/2up

Course Name: Food Storage & Transport Engineering
Total Credit-2
Course Outcomes- The course would help students in acquiring and applying basic knowledge of Food storage and transport technologies. Course will emphasize on the characteristics of fresh produce, important environmental factors affecting produce quality, optimum storage conditions and harvesting**.**

UNIT – I (Food Science & Transport of Foods)
Theory (0.5)
Food science and the transport of food: Composition of food, Chemical reactions in foods, Physical changes in foods: crystallization phenomena, Microbiology and food transportation. Food Transport: Controlled Atmosphere: The Biology of Controlled Atmospheres, Techniques in Controlled Atmosphere Storage, Modified Atmosphere Packaging. Food Storage, Handling & Transportation: Bulk storage system: Metallic bins, silos,

UNIT – II (Modes of Transport of Foods
Theory (1)
Transport of food stuffs by sea: Cooling of cargo in transit, Conventional refrigerated ships, Container ships, Need for refrigeration. Air transport of perishables: Cargo space, Unit load, devices: containers and pallets, Transport of fruit and vegetables :Post-harvest behavior of fruit and vegetables, Pre-cooling and the cold chain, Product requirements during transport, Storage temperature management. Product deterioration, Land transport, Shipping, Air freight. Insurance

UNIT – III (Legislation & Hygiene) (0.5)
Theory (0.5)
Hygiene in food transport :Basic hygiene requirements, Shipping container loading, Inspection of incoming carriers, Quality systems in food transportation, Quality and safety in food transportation, History of quality management in food transportation, Standards for quality systems, Benefits of implementing a quality management system, Clauses of ISO9002,HACCP: A food safety management system.

Recommended Books:

1. IGNOU-2006 Food Processing and Engineering -II, Practical Manual, www.ignou.ac.in.
2. Norman N. Potter, Joseph H. Hotchkiss. Food Science, Springer, 1998

Reference Books:

1. Marcus Karel,Owen R.FernnemaPhysicalprinciplesFoodScience,PartIandIIMarcelDekkerinc

References/Correlation with Ancient Indian Literature:

- **Matsyapurana**https://sanskritdocuments.org/sanskrit/purana/
- **Markandeypurana**https://sanskritdocuments.org/sanskrit/purana/
- **Agnipurana**https://sanskritdocuments.org/sanskrit/purana/

Course Name: Food Laws Standards & Regulations
Total credit- 3
Course Outcomes- Students would be able to understand the concept of food safety, types of hazards and their control measures. They would be able to identify and prevent potential sources of food contamination. Understand the need of hygiene and sanitation for ensuring food safety, knowledge of Food Safety Management tools and understand National and International Food Safety Laws and Regulations.

UNIT – I (Food Hazards & Contamination and their prevention)
Theory (1)
Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution /chemicals) and physical factors. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of microbiological and chemical hazards. Food safety aspects of novel methods of food processing such as PEF, high pressure processing, thermal and non thermal processing, irradiation of foods.

UNIT – II (Different Acts of Food Safety)
Theory (1)
Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization

UNIT – III (Quality Marks & Standards)
Theory (1)
Introduction to OIE & IPPC, Other International Food Standards (e.g.European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labeling, Health claims Voluntary Quality Standards and Certification: GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

Recommended Text Books:
1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, 3. London. Winton AL (1999). Techniques of food analysis, Allied Science Publications New Delhi.

Reference Books:
1. Pomeranze Y (2004). Food analysis - Theory and Practice CBS, Publications, New Delhi.

References/Correlation with Ancient Indian Literature:
- Maitrayaniyasamhitahttps://sanskritdocuments.org/sanskrit/purana/

Rasa-]ala-Nidhi or Ocean of Indian chemistry and alchemy/vol.vIEd.1984/AvaniPrakashan,Ahmedabad,India;CharakSamhitahttp://www.carakasamhitaonline.com/mediawiki-1.28.2/index.php?title=Main_Page

- **AvS'5/23/5;Medicine in the Veda IkennethZysk**http://www.new.dli.ernet.in/handle/2015/201547

Course Name: Modern Baking & Confectionary Technology
4(3T+1P)
Course Outcomes- Upon successful completion of the course, the student will be able to identify and explain baking terms, ingredients, equipment and tools and employ safe food handling practices using contemporary guidelines. They would acquire the knowledge of the technologies behind bakery products and understand trends in bakery industry.

Unit-I (Traditional Bakery Products)
Theory (1)
Introduction: Status of bakery and confectionery industries in India- Raw materials for bakery and confectionery products-Essential and optional. PFA Specification of raw materials. Bakery products technology: Dough rheology – Bread making- methods process-specification for various types of breads-Biscuit manufacturing process-Cookies- Crackers- Cakes- Buns-Petties preservation of bakery products.
Practical (0.4 Credit)

S. No.	Name of practical	Nature
1	Production of bread in pilot plant.	Practical
2	Production of biscuits in pilot plant.	Practical
3	Production of cookies in pilot plant	Practical
4	Production of cake in pilot plant	Practical
5	Production of petties in pilot plant	Practical

Unit – II (Bakery Machinery & Equipment)
Theory (1)
Bakery machinery and equipment: Weighing Equipment- Manual scale, Automatic weigh, liquid measuring. Mixing- blenders, Horizontal and vertical planetary, continuous. Make up equipment-Divider, Rounder, Proofer, Moulder. Baking equipment – different oven, slicer.
Practical (0.4 Credit)

S. No.	Name of practical	Nature
1	Visit & Study of Bakery pilot plant of the University.	Practical

Unit – III (Confectionary products)
Theory (1)
Confectionery products: chocolate, fondant, caramels, fudge and toffee. Equipment and process. Safety and sanitation: Health and safety- safety rules- safe practices in the work places- sanitationduties of the sanitation equipments- Code for hygiene condition in bakery and biscuit
manufacturing unit
Practical (0.2 Credit)

S. No.	Name of practical	Nature
1	Production of toffee.	Practical
2	Production of chocolate.	Practical

Recommended text books

1. Textbook of Bakery and Confectionery, by Ashokkumar Y Prentice Hall India Learning Private Limited; 2 edition(2012)

Reference Books:

1. Theory of Cookery,Oxford University Press,1st Ed, by Parvinder S. Bali 2017
2. A Professional Text To Bakery And Confectionary, John Kingslee, New Age International, 2006

References/Correlation with Ancient Indian Literature:

1. **Atharvaveda**http://www.sacred-texts.com/hin/sbe42/index.htm
2. **Taittiriyasamhita**http://www.sacred-texts.com/hin/#other
3. **V¡jasaneyisamhita**http://www.sacred-texts.com/hin/#other
4. **Maitrayaniyasamhita**http://www.sacred-texts.com/hin/#other

Course Name: FERMENTATION TECHNOLOGY
Total Credit- 3
Course Outcomes - Students will be able to understand the basic concepts of fermentation technology**.** Students will learn about introduction of fermentation, Introduction of microbial process, alchoholic fermentation, microbial food products, production of fermented food like citric acid, gluconic acid, production of amino acids, organic acids and antibiotics from microorganisms by fermentation

UNIT-I (Introduction of Fermented Microbial Process)
Theory (1)
Introduction and scope of microbial processes. Sources of industrial cultures and maintenance. Alcoholic fermentation: Production of Industrial Alcohol – Fermentation mechanism. Recent developments, brewing and malting, manufacture of wine and other distilled liquors. Microbial Foods – Food, Fodder and Bakers yeast, applications of the nonconventional raw materials (cellulosic material and hydrocarbons) .
UNIT-II Production of fermented foods)
Theory (1)
Organic acids: Production of acids, viz., citric, lactic and gluconic acid. Mechanism of each fermentation, their uses. Nutritional characteristics of food yeast, mushroom production. Vitamins- Vitamin B-2, Riboflavin, Soya-sauce & cheese production.
UNIT-III Production of Amino acids & Antibiotics)
Theory (1)
Production of Amino acids (Lysine and glutamic acid) and Antibiotics (Penicillin, Streptomycin and Tetracycline) and its new Developments. Production of Organic Acids (Acetic acid and vinegar) its spoilage and prevention.
Recommended books:

1. Biotechnology: a textbook of industrial microbiology. Crueger and Crueger. 2nd ed. 2003. Panima publications.
2. Fermentation microbiology and biotechnology. Ed. El-mansi. 2nd ed. 2007. Taylor

References/Correlation with Ancient Indian Literature:

1. **Brhadaranayakopanisat**http://www.sacred-texts.com/hin/#other
2. **Matsyapurana**https://sanskritdocuments.org/sanskrit/purana/
3. **Ramayana**http://www.sacred-texts.com/hin/#other

Course Name: Advances In Cereal Science And Technology
Course Outcome- On successful completion of the subject, the students will be able to:
1. Comprehend the recent advancement in the major cereal grains quality and processing aspects.
2. Understand the mechanism underlying the interaction of various flour components and their role in end use quality.
3. Grasp the basic and advanced milling methods for wheat, rice, maize.
4. Know about by-product utilization of various grains.

UNIT-I (Status & Future of Cereal Grains in India) (1)
Present status and future prospects of cereal grains in India, food grain production and consumption trends. Coarse grain processing.Wheat kernel structure, wheat grading, roller flour milling, influence of wheat type and grain quality on flour yield, grain hardness and its relevance to end product quality, advances in wheat cleaning, conditioning and milling, wheat flour component interactions (protein-starch, protein-lipid and starch-lipid) and their influence on end product quality, advances in isolation, biochemical characterization, micro-structural and functionality of wheat gluten proteins.
(Practical 0.4)

S.No.	Practicals	Nature
1	Grading of wheat varieties, milling quality of hard and soft wheat varieties	Practical
2	effect of conditioning on the flour extraction rates	Practical
3	effect of grains parameters on the flour yield and quality	Practical
4	quality assessment of wheat gluten	Practical

UNIT-II (Advances in role of wheat proteins) (0.5 Credit)

Advances in role of wheat proteins in dough and gluten visco-elasticity, micro-structure of dough, conversion of dough foam structure to bread sponge structure during bread baking, concept of gas retention in wheat dough during fermentation and baking, advances in bread making processes, effect of wheat components and ingredients on the growth of yeast during fermentation operation, bread staling and its prevention, production of variety biscuits, breads and pasta products.

(Practical 0.4)

S.No.	Practicals	Nature
1	damaged starch and bread flour quality	Practical
2	effect of damaged starch of flour on biscuit quality	Practical
3	factors affecting water absorption of wheat flour	Practical
4	effect of ingredients and processing parameters of yeast growth	Practical

UNIT-III (Paddy, Rice & Barely varieties, their composition) (0.5 Credit)

Paddy varieties, their composition and quality characteristics, advances in methods of paddy parboiling, advantages and limitation of parboiling, paddy dehusking processes, Rice ageing, accelerated ageing, modern rice milling, factors affecting head rice yields and losses at different stages of milling, rice mill machinery, Rice based products and their quality. Methods of rice bran oil extraction and refining.

Dry and wet milling of maize, modern methods of maize processing, gluten and starch separation, maize starch conversion into value added products, acid hydrolysis, enzyme hydrolysis, processing for dextrose, malto-dextrin and other products, Barley varieties, composition and quality characteristics, malting process and industrial applications of barley malt and malt products.

(Practical 0.2)

S.No.	Practicals	Nature
1	assessment of dough rheology using doughLab and mixolab, bread, biscuits, noodles making potential of different wheat flours	Practical
2	quality assessment of bakery products	Practical

Recommended text books:

1. Kulp K. & Ponte J. G. (2014).*Handbook of Cereal Science & Technology,2nd edition*: CRC press.

Reference Books

2. Wrigley C.W. &Batey I. L. (2010).*Cereal grains, assessing and managing quality*, CRC press.

3. Dendy D. A. V. &Dobsasoczyk B. J. (2001).*Cereal and Cereal Products, Chemistry and Technology*: An ASPEN publication.

4. Owens G. (2000).*Cereal Processing Technology*: CRC Press.

References/Correlation with Ancient Indian Literature:

- **Matsyapurana**https://sanskritdocuments.org/sanskrit/purana/
- **Markandeypurana**https://sanskritdocuments.org/sanskrit/purana/
- **Agnipurana**https://sanskritdocuments.org/sanskrit/purana/

Course Name: food additives and contaminants

Total Credits- 03 (2T +1 P)

Course Outcomes- Students would be able to acquire knowledge tools of the most important classes of chemical food additives, their technological use for the adding in certain food preparations and for a sustainable use. In addition students will have notions on food contaminants, their presence or delivery in food approaches to limit and control them.

UNIT-I (Properties & Functions of Additives)

(Theory 1)

Additives in food processing and preservation: Classification, need, properties, functions and safety, quality evaluation of additives, Food labeling, Laws and regulations for food additives

Chemistry, uses and functions: Chemical preservative, bio-preservatives, fortification, antioxidants, emulsifiers, humectants, stabilizers, chelating agents, pH control agents and acidulants, texturizing agents, plasticizers, flavor enhancers, enzymes, coloring agents, sweeteners, flavoring agents

UNIT-II (Food contaminants)

(Theory 0.5)

Food contaminants: biological, chemical, physical and environmental contaminants, Inorganic and organometallic food contaminants, Sources and their impact on human health

(Practical 0.5)

S.No.	Practicals	Nature
1	Detection of non-permitted food additives in market food samples, sweets, ice-creams and beverages products	Practical
2	estimation of antioxidants	Practical
3	Estimation of residual sulphur dioxide in beverages	Practical
4	Estimation of benzoic acid in tomato sauce and fruit beverage	Practical

UNIT-III (Food contaminants from industrial wastes)

(Theory 0.5)

Food contaminants from industrial wastes: Heavy metals, polychlorinated polyphenyls, dioxins, Toxicants formed during food processing polycyclic aromatic hydrocarbons, nitrosamines, veterinary drug residues and melamine contaminations, Pesticide residues in food

(Practical 0.5)

S.No.	Practicals	Nature
1	Analysis of edible common salt for moisture content and total chlorides	Practical
2	Identification of natural colors, Isolation and estimation of synthetic food colors	Practical
3	Estimation of contaminants, chemical residues and aflatoxins, pesticides and heavy metals contaminants in foods	Practical
4	Estimation of pesticide residues in food/water	Practical

Recommended text books:

1. Branen, A. L., Davidson, P. M. and Salminen, S. (2002). *Food Additives*: Marcel Dekker, New York.

Reference Books

2. Wood, R., Foster, L., Damant, A. and Pauline, K. (2004). *Analytical Methods for Food Additives*: Boca Raton, New York.
3. Watson, D. H. (2014). *Food Chemical Safety*: Additives: WP, New Delhi.
4. Steinhart, E., Doyle, M. E. and Cochrane, B. A. (1995). *Food Microbiology and Toxicology*: Marcel Dekker, New York.

References/Correlation with Ancient Indian Literature:

1. **Atharvaveda**http://www.sacred-texts.com/hin/sbe42/index.htm
2. **Raghuvamsa**http://www.sacred-texts.com/hin/sbe42/index.htm
3. **Kumarasambhava**http://www.sacred-texts.com/hin/#other
4. **Brhadaranayakopanisat**http://www.sacred-texts.com/hin/#other

VI SEMESTER

Course Name: MOLECULAR THERAPEUTICS
4 (3T+1P)
Course Outcomes Students will be able to understand the basic concepts of molecular therapeutics**.** Students will learn about gene therapy, gene delivery, gene transfer technology, gene delivery, stem cell therapy**.** Students will also learn about recombinant therapy and application of recombinant technology, gene silencing technology and ethical issues in cloning**.**

Unit I: (Gene therapy)
(Theory-1)
Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery. Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells & Concept of tissue engineering.
Practical (1.0 credits)

S. No.	Name of practical	Nature
1	Restriction digestion and mapping of DNA	Practical
2	Isolation of total RNA from various sources and gel electrophoresis	Practical
3	Design of primers and PCR	Practical

Unit II: (Recombinant Therapy)
(Theory-1)
Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors.
Unit III (Gene Silencing)
(Theory-1)
Gene silencing technology; Antisense therapy; si RNA; Tissue and organ transplantation; Transgenics and their uses; Cloning; Ethical issues
Texts/References:
1 Bernhard Palsson and Sangeeta N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.
2 Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Sringer, 2008.
References/Correlation with Ancient Indian Literature:
The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi.

http://www.sacred-texts.com/hin/rigveda/index.htm

Yajurvedahttp://www.sacred-texts.com/hin/yv/index.htm

AsvalayanaGrhya Sutra II 7 https://www.hinduwebsite.com/sacredscripts/hinduism/grihya/asva.asp

Course Name: SENSORY EVALUATION
Total Credit-3
Course Outcomes- Students would be able to have an insight of 4 basic tastes and derived tastes in food, basic understanding of flavors, colors and texture in foods and concept of sensory panels and various instruments used in assessing the quality parameters of food.

UNIT – I (Packaging and Labelling)
(Theory-1)
Packaging and Labelling of the product, Packaging design, graphics and labeling nutritional evaluation (estimation of relevant parameters), Shelf life testing of the product (testing for appropriate quality parameters- chemical, microbiological and nutrient content, acceptability studies).
UNIT – II (Overview of Sensory evaluation)
(Theory-1)
Subjective & Objective evaluation, Overview of sensory principles and practices: General consideration in sensory testing, flowcharts of sensory evaluation. Psychological methods Selection and screening of panel: Types of panel(Trained panel, discriminative and communicative panel).
UNIT – III (Methodology for sensory evaluation)
(Theory-1)
Methodology for sensory evaluation: Discriminative test - difference test: paired comparison, Duo-trio, triangle, ranking, Sensitivity Test, Descriptive test - category scaling, ratio scaling, flavor profile analysis, texture profile analysis, quantitative descriptive analysis
Effective Tests: paired performance test, ranking test, rating scale: hedonic rating, food action scale rating. Maintaining suitable environmental conditions: laboratory setup and equipments.
Recommended Text Books:
1. Lyon, D.H.; Francombe, M.A.; Hasdell, T.A.; Lawson, K. (eds) (1992): Guidelines for Sensory Analysis in Food Product Development and Quality Control. Chapman and Hall, London.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B. (1965): Principles of Sensory Evaluation. Academic Press, New York.
Reference Books:
1. Kapsalis, J.G. (1987): Objective Methods in Food Quality Assessment. CRC Press, Florida.
2. Martens, M.; Dalen, G.A.; Russwurm, H. (eds) (1987): Flavour Science and Technology. John Wiley and Sons, Chichester
References/Correlation with Ancient Indian Literature:
Rasa-]ala-Nidhi or Ocean of Indian chemistry and alchemy/vol.vIEd.1984/AvaniPrakashan,Ahmedabad,India;CharakSamhitahttp://www.carakasamhitaonline.com/mediawiki-1.28.2/index.php?title=Main_Page
Rigveda1/191/9http://www.sacred-texts.com/hin/rigveda/index.htm

Atharva Veda. X. 3http://www.sacred-texts.com/hin/sbe42/index.htm

Course Name: MODELLING AND SIMULATION OF BIOPROCESSES
Total Credit- 3
Course Outcomes - Students will be able to understand about general approach of modeling, modeling fundamentals, chemical kinetics, microbial growth kinetics**.** Students will also learn about heat transfer, energy balance conversion and selectivity of energy, numerical techniques in modeling, simulation tools and softwares and modeling of bach, fed-batch and continuous culture reactors**.**

Unit-I (General approach of Modelling)
(Theory-1)
Modelling Fundamentals, General Aspects of the Modelling Approach ,General Modelling Procedure, Material Balance Equations , Chemical Kinetics, Rate of Chemical Reaction, Reaction Rate Constant, Chemical Equilibrium and Temperature, Microbial Growth Kinetics
Unit-II (Mass Transfer Theory)
(Theory-1)
Mass Transfer Theory, Heat Transfer, Total Material Balance Equation, Energy Balance Equation,Momentum Balances, Yield, Conversion and Selectivity, Time Constants
Unit-III (Parameters)
(Theory-1)
Numerical Integration techniques, trapezoidal rule, Parameter estimation, Least square method, Simulation Tools, Simulation Software, Modelling of batch, fed-batch andContinuous Stirred-Tank Reactor

Recommended Text Book :

1. Biological reaction engineering: dynamic modelling fundamentals By Irving J. Dunn

References/Correlation with Ancient Indian Literature:

1. V¡jasaneyisamhitahttp://www.sacred-texts.com/hin/#other
2. Vishnu Puranahttps://sanskritdocuments.org/sanskrit/purana/
3. Shabdhakalpadrumahttp://www.sacred-texts.com/hin/#other

Course Name: RESEARCH METHODOLOGY

Total Credit- 3

Course Outcomes - Students will be able to understand the basic concepts of research methodology including meaning and objectives of research, types of research, various research criterial, research problem, research design, measurement and scaling techniques in research, various scaling techniques in research, methods of data collection in research and report writing of research**.**

UNIT – I (Introduction & Types of research)

(Theory-1)

Research methodology: Introduction & meaning of research, Objectives of research, motivation in research. Types of research & research approaches. Research methods vs. methodology, Criteria for good research.

Research problem: Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem.

UNIT – II (Research design)

(Theory-1)

Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.

Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.

UNIT – III (Methods of data collection)

(Theory-1)

Methods of data collection: collection of primary data, collection data through questionnaires& schedules, Difference between questionnaires & schedules. Report Writing

Recommended Text Books:

1. Kothari CR (2004). Research Methodology: Methods and Techniques, New Age International.
2. Bhattacharya DK (2009). Research Methodology, Excel Books.

Reference Text

1. Annals of Food Science & Technology
2. Journal of Nutrition
3. Journal of Food Science & Technology

References/Correlation with Ancient Indian Literature:

1. V¡jasaneyisamhitahttp://www.sacred-texts.com/hin/#other
2. Vishnu Puranahttps://sanskritdocuments.org/sanskrit/purana/

3.Shabdhakalpadrumahttp://www.sacred-texts.com/hin/#other

Course Name: Food Business Management

Total Credit- 3

Course Outcomes- Students would be able to introduction, theories and functions of Business Management, food industry management; marketing management and human resource development, personal management.

UNIT – I (Business Management)

(Theory-1)

Business management; introduction, theories and functions, food industry management; marketing management and human resource development, personal management. Sectors in food industry and scale of operations in India. Human Resource Management Study the basics about HR and related policies and capacity mapping approaches for better management. Consumer Behavior towards Food Consumption, Consumer Surveys by various Institutes and Agencies, Various Journals on Consumer Behavior and Market Research, Internet based data search

UNIT – II (International trade)

(Theory-1)

International trade; basics, classical theory, theory of absolute advantage. theory of comparative, modern theory, free trade- protection, methods of protection, quotas, bounties, exchange control, devaluation, commercial treaties, terms of trade, balance of payments, EXIM policy, foreign exchange, mechanics of foreign exchange, GATT, WTO, role of WTO, International Trade in agriculture. World trade agreements related with food business, export trends and prospects of food products in India.

UNIT – III (World consumption of food)

(Theory-1)

World consumption of food; patterns and types of food consumption across the globe. Ethnic food habits of different regions. Govt. institutions related to international ad trade; APEDA, Tea board, spice board, wine board, MOFPI etc. management of export import organization, registration, documentation, export import logistics, case studies. Export and import policies relevant to horticultural sector.

Project: Consumer Survey on one identified product -both qualitative and quantitative analysis (say, Consumer behavior towards Pickles and Chutneys).

Recommended Text Books:

1. Principles of Agri Business Management - D. David and S Erickson 1987. Mc Graw Hill Book Co., New Delhi.
2. Agricultural Marketing in India - Acharya S S and Agarwal N L 1987. Oxford & ISH Publishing Co., New Delhi.

Reference Books:

1. Marketing in the International Environment - Cundiff Higler 1993, Prentice Hall of India, New Delhi.
4. GAD implications of Denkel proposals - G S Batra &Narindevkumar(1994) Azmol Publications Pvt., New Delhi.
5. Marketing Management - Phill Kottler. 1994. Prentice Hall of India, New Delhi

References/Correlation with Ancient Indian Literature:

1. Atharvavedahttp://www.sacred-texts.com/hin/sbe42/index.htm
2. V¡jasaneyisamhitahttp://www.sacred-texts.com/hin/#other
3. Vishnu Puranahttps://sanskritdocuments.org/sanskrit/purana/

Course Name: FOOD PROJECT PLANNING AND ENTREPRENEURSHIP

Total Credit- 3

Course Outcomes- Students would be able to develop an insight of Entrepreneurs and Entrepreneurship development and understand the basics of Business project report and SWOT analysis. Develop insight for different types of Fund raising. Understand the different support system for business development.

UNIT – I (Indian Economy)

(Theory-1)

Indian Economy and contribution of various sub-sectors in the economy. Structural base of Indian economic Life. Contribution of MSME sectors in the national economy. Impact of globalization and liberalization on MSME sectors. Agricultural sector and food processing industry-problems and opportunity. Self employment need and various mode open in Food Processing and Agri- sector

UNIT – II (Fundamentals of marketing principles and marketing)

(Theory-1)

Fundamentals of marketing principles and marketing mix, Sales and distribution management, Costing and cost management, pricing methods, fundamentals of operations and supply chain management, organization structure and human resource management , capital structure and methods of raising fund. Opportunity identification and feasibility studies, financial analysis, technical entrepreneurship. Project sizing, fund management and enterprise management issues.

Problem solving, decision making processes and tools, conflict and change management in a new industrial enterprise, Systems approach and consideration in an entrepreneurial venture. Management reporting and information system for monitoring and control of the new enterprise, managing Innovation. Marketing challenges and approaches for new productsand services. Sustaining in a competitive environment

UNIT – III (Entrepreneurship Development)

(Theory-1)

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by Individual entrepreneurs. Globalization and the emerging business/entrepreneurial environment. Concept of entrepreneurship: entrepreneurial and managerial characteristics managing an enterprise; motivation and entrepreneurship development; importance of planning, Budgeting monitoring, evaluation and follow up; managing competition.

Entrepreneurship Development Programs (EDP). SWOT analysis; Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on small and Medium Enterprises (SMEs)/ Small Scale industries (SSls). Export and Import Policies relevant to Food Processing Sector. Venture capital, contract farming and joint ventures. Public-private partnership (PPP). Over view of Food Process Industry. Characteristics of Indian Food Processing Industry. Social Responsibility of Food Processing Business.

Recommended Text Books:

1. Entrepreneurship - Thomas W Zimmer and Norman M Scarborough 1996. Prentice Hall, New Jersey, USA.

2. Entrepreneurship Strategies and Resources - Mark J Dollinger 1999. Prentice hall, Upper Saddal River, New Jersey, USA.

Reference Books:

1. Entrepreneurial Development - Khanks SS 1999. S. Chand and company New Delhi.

References/Correlation with Ancient Indian Literature:

Atharvavedahttp://www.sacred-texts.com/hin/sbe42/index.htm

Taittiriyasamhitahttps://sanskritdocuments.org/sanskrit/purana/

V¡jasaneyisamhitahttps://sanskritdocuments.org/sanskrit/purana/

Course Name: Dairy Engineering

Total Credit- 4(3T+1P)

Course Outcomes- Students would be able to describe the engineering principles used in dairy processes responsible for evaporation, drying and refrigeration and other related processes. They would be able to evaluate the integration of engineering concepts required for the optimized processing of milk streams.

UNIT I (Market milk)

Theory (1)

Market Milk- definition, composition. Physio- chemical properties of milk and other dairy products. Milk reception and storage. Processing of milk- pasteurization, sterilization, homogenization, standardization. Fortification of milk and milk products.

Practical (0.4 credit)

Sr. no.	Name of practical	Nature
1	Moisture & ash estimation of milk and milk products	Practical
2	Sensory evaluation of milk	Practical
3	Acidity estimation in milk	Practical
4.	Rapid platform tests	Practical

UNIT II (Production & preservation of milk products)

Theory (1)
Production and preservation of cream butter, ghee, butter oil, condensed & powdered milk, ice-cream. Technology of yogurt, paneer, cheese spread.
Practical (0.4 credit)

Sr. no.	Name of practical	Nature
1	Preparation of ghee	Practical
2	Preparation of shrikhand	Practical
3	Preparation of fruit yoghurt	Practical
4.	Preparation of cheese product	Practical
5	Preparation of khoya product	Practical

UNIT-III (Packaging & distribution of milk & its products)
Theory (1)
Packaging and distribution of milk and milk product. Utilization of milk industry by- products. Milk & milk product standards. Process flow chart for product manufacture, Batch & Continuous drying systems, Freezing and Low Temperature Preservation of Food.
Practical (0.2 credit)

Sr. no.	Name of practical	Nature
1	Study of packaging material of milk and milk products	Practical
2	Preparation of whey based products	Practical

Recommended text books

1. Dairy Engineering: Advanced Technologies and Their Applications
2. 1st Edition by Murlidhar Meghwal, Megh R. Goyal, Rupesh S. Chavan,Apple Academic Press,2017

Reference Books:

1. Dairy Science and Technology, 2nd Edition, by P. Walstra, Pieter Walstra, Jan T. M. Wouters, Tom J. Geurtsm,Apple Academic Press, 2005
2. Handbook of Farm, Dairy and Food Machinery by Kutz & Myer, 2007, Springer Netherlands

References/Correlation with Ancient Indian Literature:

- **Matsyapurana**https://sanskritdocuments.org/sanskrit/purana/
- **Markandeypurana**https://sanskritdocuments.org/sanskrit/purana/
- **Agnipurana**https://sanskritdocuments.org/sanskrit/purana/

Course Name: Applied Recombinant DNA technology
Total Credit- 3(2T+1P)
Course Outcomes - Students will be able to understand the basic concepts of recombinant DNA technology including transgenic animals, methods of production of transgenic animals and animal cloning**.** Students will be able to understand advanced technique in recombinant technology including FISH, RAPD, RFLP, gene silencing gene transfer technology and gene therapy, DNA chips mutagenesis and gene knockout techniques**.**

Unit I (Transgenic animals)
Theory (0.5)
Brief idea about tools of recombinant DNA technology. Transgenic animals: methods for production (microinjection method, embryonic stem cells method and retrovirus mediated method), applications of transgenic animals. Animal cloning: methods for production and significance of clones.
Unit II(Advanced techniques in recombinant DNA technology)
Theory (1)

Gene augmentation, oligonucleotide synthesis, FISH, RAPD, RFLP, DNA fingerprinting and their applications for diagnosis of disease, site-directed mutagenesis, Gene silencing, Gene transfer technologies, Gene therapy; Molecular basis of genetic diseases, genetic counseling.

Practicals(1credits)

Sr. no.	Name of practical	Nature
1.	**To learn about FISH**	**Practice**
2.	**To perform the technique of RAPD** (i) Isolation of genomic DNA (ii) Amplification of genome (iii) Gel electrophoresis of amplified product	**Practical**
3.	**To perform the technique of RFLP** (i) Isolation of genomic DNA (ii) Restriction digestion of genome (iii) Gel electrophoresis of digested product (iv) Blotting (v) Autoradiography	**Practical**
4.	**To learn principle and operating procedure of microprojectile.**	**Practice**

Unit III(Advanced techniques in recombinant DNA technology)

Theory (0.5)

Functional genomics: DNA chips, microarray and gene screen technology; site directed mutagenesis, gene knockout techniques, cell culture based techniques. Genetically modified organisms and their significance.

Recommended text books

1.Genetic engineering by Smitha Rastogi and Neelam Pathak.

Reference books

2. Gene cloning and DNA analysis by T. A. Brown

References/Correlation with Ancient Indian Literature:

Sharma PV, editor. Caraka Samhita of Agnivesha(Text with English Translation) Sutra Sthana. Ch. XX, Ver. 1-25. I. Varanasi: Chaukhambha Orientalia; 1981. pp. 137–43. [Google Scholar] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688840/

Sharma PV, editor. Susruta Samhita of sushruta. First edition. Sutrasthana, Ch. I, Ver. 1-41. I. Varanasi:ChaukhambhaVisvabharati; 1999. pp. 3–28.

file:///C:/Users/jvwu/Downloads/182-Article%20Text-545-1-10-20151215.pdf

RudrasAdhityas https://sreenivasaraos.com/2012/09/29/the-rudras-eleven/

Course Name Novel Food Packaging

Course Outcome-

On completion of the course the student will be able to:

- Apply and examine the knowledge of properties for selection of packaging materials for foods & food products
- Select between different techniques of food packaging.

UNIT-I (Active and intelligent packaging techniques)

(Theory 1)

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: Oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

Advantages of non-migratory bioactive polymers, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds, defining and classifying time temperature indicators (TTIs), requirements for TTIs, development of TTIs, maximizing the effectiveness of TTIs to monitor shelf-life during distribution, use of freshness indicator in packaging: Compounds indicating the

quality of packaged food products, pathogen indicators, moisture regulation: Silica gel, clay, molecular sieve, humectants, irreversible adsorption.

UNIT-II (Modified atmosphere packaging)

(Theory 0.5)

Developments in modified atmosphere packaging (MAP): Novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, Applying high O2 MAP. Combining MAP with other preservation techniques, packaging-flavour interactions: Factors affecting flavour absorption, role of the food matrix, role of differing packaging materials.

(Practical 0.5)

S.No.	Practicals
1	Testing of properties of different packaging materials (paper, plastic, glass and metal)
2	Study of symbols and labels used on food packages
3	Vacuum packaging, form-fill- seal packaging
4	Determination of changes in packaged foods

UNIT-III (Modern packaging systems)

(Theory 0.5)

Modern packaging systems: Green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, Integrating intelligent packaging**:** role of packaging in the supply chain, creating integrated packaging, storage and distribution: alarm systems and time temperature indicators, traceability: radio frequency identification, recycling packaging materials: recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, methods for testing consumer responses to new packaging concepts.

(Practical 0.5)

S.No.	Practicals
1	Packaging of foods under different conditions
2	Preparation and application of edible coatings
3	Comparative evaluation of different packages for fragile foods
4	Estimation of shelf life of food under different packaging materials

Recommended text books:

1. Jung, H. H. (2014). *Innovations in Food Packaging*: Oxford, London.

Reference Books

2. Ahvenainen. R. (2003). *Novel Food Packaging Techniques*:CRC Publications.
3. Robertson, G. L. (2010). *Food Packaging and Shelf Life*: CRC Publications, New York.
4. Robertson, G. L. (2006). *Food Packaging: Principles and Practice* (2 ed.): CRC Publications, Boca Raton.

References/Correlation with Ancient Indian Literature:

The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi.

http://www.sacred-texts.com/hin/rigveda/index.htm

Yajurvedahttp://www.sacred-texts.com/hin/yv/index.htm

AsvalayanaGrhya Sutra II 7 https://www.hinduwebsite.com/sacredscripts/hinduism/grihya/asva.asp

VIITH SEMESTER

Traditional and fermented food **Credits-3**

Objective : On successful completion of this course the students will be able to learn the importance of fermentation in traditional as well as in Commercial Food Industries. They will learn to isolate strains of microorganisms to be used in the preparation of a pure culture, its use in fermentation techniques, and usage in the processing of food products.

Unit-I Indian traditional sweet, savory and snack food products: Sweetmeats, Namkins, PapadsIdli and Dosa. Preparation and Maintenance of Bacterial, Yeast and
Mold cultures for food fermentations. Lactic acid bacteria-activities and health-promoting effects. Mushrooms: Cultivation and preservation.

(0.5 Credit)

Unit-II Fermented Dairy Products: Cheeses, Curd and Yoghurt, Butter milk and the fermented milks. Spoilages and defects of fermented dairy products and their control. Fermented meat and fish products.

(0.5 Credit)

Unit-III Fermentative Production of Beer, Wines, Cider and Vinegar. Fermented Vegetables (Pickles). Production of Baker's Yeast, Microbial Proteins and fats, Food enzymes, and Food additives. Oriental fermented foods.

(1 Credit)

Practicals(1Credit)

S. No.	Name of practical	Nature
1	Preparation and maintanence of bacterial culture for fermented foods.	Practical
2	Preparation and maintanence of yeast culture for fermented foods.	Practical
3	Preparation and maintanence of mold culture for fermented foods.	Practical
4.	Preparation of buttermilk	Practical
5.	Preparation of curd	Practical
6.	Preparation of yoghurt	Practical

Recommended Text Books:

1. Traditionally Fermented Foods**:** Innovative Recipes and Old-Fashioned Techniques for Sustainable Eating, by Shannon Stonger Page Street Publishing, 2017
2. Fermented Vegetables By Kristen Shockey, Christopher Shockey, Storey Publishing LLC, 2014

Suggested Readings:

1. Salt, Fat, Acid, Heat **:**Mastering the Elements of Good Cooking By Samin Nosrat, Michael Pollan, Wendy Macnaughton,Canongate Books Ltd,2017
2. Foods Facts and Principles by N**.** Shakuntala Manay, NEW AGE Publisher, 2008

References/Correlation with Ancient Indian Literature:

1. Atharvedahttp://www.sacred-texts.com/hin/av.htm
2. Yajurvedahttp://vedicheritage.gov.in/science/
3. Chandogya Upanishad VI.6.5https://www.wisdomlib.org/hinduism/book/chandogya-upanishad-english/d/doc239250.html

Course Name: Food Plant Design
Total Credit-3
Course Outcomes- Students would be able to gain detailed knowledge of design of food plant and food processing equipments, principles of Process Design and Principles of spreadsheet aided process design.

UNIT – I (Principles of Process Design)
Theory (1 Credits)
Principles of Process Design, Principles of spreadsheet aided process design. Identification: Identification of design, operating and performance parameters in mechanical, thermal and mass transfer operations carried out in food processing. Mathematical Modeling: Developing mathematical relationship between the independent and dependent variables affecting the food processing operations by using physical and chemical principles governing the processes for, homogenization, centrifugation, mixing, extrusion, heating, cooling, freezing, distillation, extraction, concentration and drying.

UNIT – II (Equipment Design)
Theory (1 Credits)
Design of Equipment: High pressure vessels, Storage tanks for liquid and gases design procedures, Optimum tank proportions. Tall vertical vessels, Distillation columns, Evaporators Stress evaluation, Heat exchangers Flow arrangement and design procedure. Cost Analysis: Comparison of alternatives Depreciation Fixed capital, working capital, Break even analysis Payout period, Rate of return, Maintenance of equipments Pipe lines for process equipments Mechanical design Optimum diameter of pipe line for gases, liquids, steam.

UNIT – III (Plant Layout)
Theory (1 Credits)
Plant Layout :Layout of different types of food industries and process equipments: paddy milling, bread and biscuit manufacturing, fruits and vegetables processing, and dairy industries; shell and tube heat exchanger, evaporator, distillation column, dryer, pressure vessel, and storage tank, agitator, fermenter, pasteurizer, cold store, freezer, centrifuge, homogenizer, filtering devices, baking oven, canning equipment. Considerations for location of food processing plants. Flow process charts. Selection criterion of processing and handling machines.

Recommended Text Books:
1. Food Processing Operations Analysis. By H. Das, (2005) Asian Books publication, New Delhi.

Reference Books:
1. Food Process Design by Z B. Maroulis and G D. Saravacos, Marcel Dekker.

References/Correlation with Ancient Indian Literature:

1. Caraka Samhita of Agnivesha(Text with English Translation) Sutra Sthana. Ch. XX, Ver. 1-25. I. Varanasi: Chaukhambha Orientalia; 1981. pp. 137–43. [Google Scholar]http://www.jahm.in/index.php/JAHM/article/view/21
2. Susruta Samhita of sushruta. First edition. Sutrasthana, Ch. I, Ver. 1-41. I. Varanasi: ChaukhambhaVisvabharati; 1999. pp. 3–28.http://ispub.com/IJPS/4/2/8232
3. Charakahttp://www.jahm.in/index.php/JAHM/article/view/21

Course Name: DAIRY PLANT MANAGEMENT
Toatl Credit-3
Course Outcomes- Students would be able to define management, production planning and control. They would learn about energy conservation, auditing, financial and managerial efficiency and will be able to know about safety hazards, prevention and breakdown maintenance, and food hygiene.

Unit I (Production Management) (1)
Production Management: Definition, Function and structure of Production Management, Production planning & Control, Work study and measurement moiton and time study, Plant Operations.

Unit II (Managerial Efficiency) (1)
Efficiency factors losses, Financial and Managerial efficiency, Provision for Industrial Legislation in India, Particularly in dairy industry, Personal Management. Manpower planning, recruitment, training, transfer, promotions policies, Job specifications, Job evaluation, Job enhancement, Job enrichment, MBO, working conditions.

Unit III (Safety hazards & Prevention) (1)
Safety hazards, hazards prevention security for plant machinery and the employees, Plant Maintenance. Prevention & Break-down maintenance Spare parts inventory, tools & lubricants etc. Food hygiene, personnel hygiene, plant hygiene, water quality etc. Cleaning and Sanitation – different type of cleaning and sanitizing agents, Effluent treatment: Type, degree and treatment of waste.

Recommended Text Books:

1. Dairy Plant Engineering and Management by Tufail Ahmad, Kitab Mahal Publication,Allahabad, India
2. Dairy Process Engineering by J.B. Upadhyay & Sunil M. Patel, Agrimoon Publication

Suggested Readings:

1. Dairy Plant Management, by PH Tracy, McGraw-Hill Books publisher, 1958
2. Dairy Plant Management by D.B.Puranik, NIPA, 2013

References/Correlation with Ancient Indian Literature:

1. Charaka Samhita https://www.wisdomlib.org/definition/navanitaka
2. Sushruthttp://www.varanasi.org.in/sushrut
3. Vaghbhatifile:///C:/Users/jvwu/Downloads/INDIAN%20COW%20(BOS%20INDICUS)%20.pdf

Course Name: IMMUNOTECHNOLOGY
Total Credit- 4(3T+1P)
Course Outcomes - Students will be able to understand the basic concepts of immunology including introduction of immunology and types of immunity, components and processes of innate and acquired immunity, cytokines, MHC molecules, antigen and antibody interaction, immunoassays for diagnosis, concepts of transplantation and various types of autoimmune diseases.

UNIT – I Introduction to Immunity, Immunization and Immune Response
Theory (1Credits)
Innate and acquired immunity, active, passive and adoptive immunization, clonal selection theory, humoral and cellular Immunity, Regulation of Immune response. Cellular responses, activation and function of T and B cells, General properties and functional categories of cytokines, Role of Major Histocompatibility Complex (MHC) in the human response.

Practicals: (0.5 credit)

S. no.	Name of practical	Nature
1	**Handling of animals, immunization and raising antiserum.** (x) To learn handling of animals (xi) Stimulation of antiserum Production	**practical**
2	**Identification of cells in blood smear.** (vii) To prepare Blood smear slide (viii) To set up of microscope and Observation of slide	**Practical**
3	**Identification of blood group** (vii) To explain the principle of Blood Typing (viii) Preparation of slide and observation	**Practical**
4	**Radial Immunodiffusion** (i)To learn principle of RID (ii)To perform assay and observe result	**Practical**

UNIT – II Immunity against pathogens and Immunological Techniques

Theory (1Credits)
Infection and immunity, host defense against various classes of pathogen, mechanism by which pathogen invade immune responses, preparation of human immune serum globulins, Applied immunology-antigen and antibody interactions, affinity and avidity, agglutination and precipitation reactions, immunoassays, immunofluorescence, fluorescence activated cell sorting analysis
Practicals: (0.5 credit)

S. no.	Name of practical	Nature
1	**Immuno Electrophoresis** (i)Preparation of Agarose gel (ii) Electrophoresis unit setting (iii)Run electrophoresis unit and observation of result	**practical**
2	**Dot ELISA** (i)To perform assay (ii)Observation for presence of Antigen	**Practical**
3	**Ouchterlony double diffusion** (i)Preparation of agarose plate (ii)Addition of Ags and Abs (iii)observation	**practical**
4	**Separation of serum from blood** (i)withdrawling of blood (ii)incubation and centrifugation	**practical**

UNIT – III Concept of Transplantation and Autoimmunity
Theory (1Credits)
Transplantation a- relationship between donor and recipient, role of MHC molecules in Allograft rejection. Autoimmunity, criteria and causes of autoimmune diseases-Autoimmune hemolytic anemia, myasthenia gravis, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis
Recommended Text Books :
1. Kuby, J., "Immunology", W.H. Freeman & Co.

Reference Books
1. Roitt, I. and Male, B., "Immunology", Mosby Publ
2. Tizard- Immunology

References/Correlation with Ancient Indian Literature:
5. Atharvaveda http://www.sacred-texts.com/hin/av.htm
6. Yajur Ved 32.8https://www.sacred-texts.com/hin/wyv/index.htm
7. Mahabharata https://sanskritdocuments.org/mirrors/mahabharata/mbhK/mahabharata-k-06-itx.html

Course Name: INDUSTRIAL BIOTECHNOLOGY
Total credit 4(3T+1P)
Course Outcomes - Students will be able to understand the basic concepts of industrial processes including bacterial, fungal and yeast fermentation, downstream processing, production of primary and secondary metabolites from industrial bioprocess, various types of primary and secondary metabolites and their production process, production of industrial important bioproducts, mushroom and single cell protein production**.**

UNIT I :INTRODUCTION TO INDUSTRIAL BIOPROCESS
(Theroy-1)
Fermentation – Bacterial, Fungal and Yeast, Biochemistry of fermentation. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation.
Practical(0.2)

Sr.	**Name of practical**	**Nature**

No.		
1.	Detection and quantification of siderophores produced by *Psuedomonas*sps. (i) Preparation of media (ii) Inoculation (iii) Observation	**Practical**

UNIT II :PRODUCTION OF PRIMARY & SECONDARY METABOLITES

(Theroy-1)

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids, alcohols and vitamins.

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics and Steroids.

Practical(0.4)

Sr. No.	Name of practical	Nature
1.	Isolation of antibiotic producing microbes from soil. (i) Preparation of media and inoculation (ii) To isolate antibiotic producing microbes. (iii) Identification of antibiotic producing microbes.	**Practical**
2.	Estimation of alcohol determination of total acidity and volatile acidity.	**Practical**

UNIT III: PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS

(Theroy-1)

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers, Biodiesel, Cheese, Beer, SCP & Mushroom culture.

Practical (0.4)

Sr. No.	Name of practical	Nature
1.	Production of SCP by Spirullina and yeast and Estimation of SCP protein 1. Media preparation and Autoclave 2. Inoculation of algae. 3. Incubation and observation. 4. Estimation of Protein by Lowry's method	**Practical**

Recommended Text Books:

- Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
- Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt.Ltd., 1998.
- Balasubramanian, D. etal., "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.

Suggested Readings:

- A.H. Patel " Industrial Microbiology" Macmillan
- Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios(India), 2005.
- Cruger,Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
- Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
- C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.

References/Correlation with Ancient Indian Literature:

4. Atharva Veda http://www.sacred-texts.com/hin/av.htm
5. Rigveda https://www.sacred-texts.com/hin/rvsan/rvi10.htm
6. Yajurveda http://vedicheritage.gov.in/science/

Course Name: Pharma Biotechnology and Drug designing

Total Credit (3)

Course Outcomes - Students will be able to understand the general introduction of drugs, scope and importance of crude drugs, classification of drugs, cultivation and utilization of medicinal plants**.** Students will also be able to learn about vaccines and their types, production of therapeutic proteins and hormones, introduction of pharmacogenomics and pharmacogenetics in various disciplines

UNIT-I(Introduction of drugs)
Theory (1 credits)
History and definition of drugs, crude drugs- Scope and Importance, Classification (Taxonomical, Morphological, Chemical Pharmological). Cultivation and utilization of medicinal and Aromatic Plants in India. Genetics as applied to Medicinal Herbs.
UNIT-II (Vaccines)
Theory (1 credits)
Vaccines; definition, classification of vaccines **(**synthetic, multi- subunit, bacterial, viral, cancer vaccine**)**, future development scope of vaccines, super vaccine, immunomodulators, vaccines against cancer**.**Production of therapeutic proteins, hormones, cytokines – interferon, interleukins.
UNIT-III(Pharmacogenomics and pharmacogenetics)
Theory (1 Credits)
Introduction to Pharmacogenomics and pharmacogenetics, clinical trials in pharmacogenomics, Basics of Drug pharmacokinetics and pharmacodynamics. Pharmacophore modeling, pharmacophore mapping, pharmacophore generation, Hiphop and Hipogen theories
Recommended Text Books:
1. Pharmacognacy, C.K. Kokate, A. P. Purohit, S.P. Gokhle(1996), Nirali Prakashan, 4th edition.
2. Natural Products in Medicine :A Biosynthetic Approach (1997), Wiley.
3. Biopharmaceuticals :Biochemistry and Biotechnology, Gari Walsh, 1998, John Wiley and Sons Limited.

Suggested Readings:
1. Burger, A., Med. Chem.
2. Wilson and Gisvold, Organic Med. Pharmaceutical Chem.
3. Ariens, Drug Design, Academic press, NY, 1975.
4. Schueler, Chemobiodynamic and Drug Design

References/Correlation with Ancient Indian Literature:
1. Ayurvedahttps://www.livescience.com/42153-ayurveda.html
2. Garuda Puranahttps://www.sacred-texts.com/hin/gpu/index.htm
3. Samavedahttp://www.sacred-texts.com/hin/sv.htm

Course Name: Quality Control in Food Processing Industries

Total Credit-3

Course Outcomes- Student would learn organization and management of food quality, quality control methods, identification of adulteration in food, preparation of series data probability testing, instrument methods and statistical methods of quality control.

Unit I (Organization and management)
Theory (1 credits)
Quality, quality assurance, quality control, total quality management; good manufacturing practices, safety, hazards, risk; HACCP: principles of HACCP, overview of biological, chemical and physical hazard in foods, designing safety into food and processes; grades and standard of identity, Codex Alimentarius, ISO:9000 series and ISO:14000 series, national laws and regulations: PFA, FPO, BIS and Agmark and international laws and regulations, Food Safety Act; Quality testing – objective analysis, sensory assessment, rapid microbiological techniques; acceptance sampling; operational characteristics, risks, attributes sampling plan, variables sampling plan, administration of acceptance sampling;
Unit II (Adulteration of food)

Theory (1 credits)

Identification of adulterants both qualitative and quantitative; additives in foods; types, names, uses, maximum permissible limits; sanitation in food processing facilities; definition, important and application; laws and regulation governing sanitation; establishment of SOPs; personal hygiene and hygienic food handlings, employee health, cleaning compounds; choosing of cleaning compounds, handling and storing of cleaning compounds, sanitization methods; waste disposal; solid and liquid; waste control; quality control aspect of processing plant for milk, meat, fish, poultry, foods, vegetables and cereals; customers service; complaint handling, product recall.

Unit III (Statistical Quality Control)

Theory (1 credits)

Introduction, Types of data; variation, series data, randomness, definition of probability, sampling, summary statistics. Frequency distributions; histogram, normal distribution curve, probability plots, capability indices. Basic rules of probability, binomial &poisson distributions. Control chart concept, mean chart and range chart for variables, runs tests, p chart and c chart for attributes, cusum control charts, discussion of time weighted charts. Identify the importance of measurement, relationship between standards and measurement in a quality process, Identification of quality characteristics of a product or service, effect of instrument characteristics on measurement results, GR&R studies

Recommended Text Books:

1. A. V. Sathe, A First Course in Food Analysis, New Age International Pvt. Ltd. 1999
2. S. S. Nielsen, Food Analysis, 3rd ed., Kluwer Academic Publishers, 2003
3. R.E.Wrolstad, T.E. Acree, E.A.Decker, M.H.Penner and D.S.Reid, Handbook of Food Analytical Chemistry, John Wiley & Sons, 2004

Suggested Readings:

1. I. Ali, Food Quality Assurance: Principles and Practices, CRC Press, 2003
2. J. A. Vasconcellos, Quality Assurance in Food Industry: a Practical Approach, CRC Press, 2003
3. M. R. Hubbard, Statistical Quality Control for the Food Industry, Kluwer Academic/ Plenum Publishers, 2003
4. A. M. Pearson and T.R. Dutson, Kluwer HACCP in Meat, Poultry and Fish Processing, Academic Publishers, 1995

References/Correlation with Ancient Indian Literature:

1. Sushrut http://www.varanasi.org.in/sushrut
2. Manusmrtihttps://hindi.webdunia.com/sanatan-dharma-article/historicity-of-manusmriti-manu-smriti-116031100024_1.html
3. Kasyapasamhitahttp://agris.fao.org/agris-search/search.do;jsessionid=9DE5025A03FF2C15254847EFB03B3403?request_locale=es&recordID=IN2006001860&sourceQuery=&query=&sortField=&sortOrder=&agrovocString=&advQuery=&centerString=&enableField=

VIII SEMESTER

Protein Engineering **Credits-4**

Objective: Students will be able to understand the general introduction of protein, structure of protein, determination of protein structure by various techniques, thermal properties of proteins, Various properties of proteins, protein functionality in various biological foods, protein modification and its design by various techniques and enzyme engineering

Unit-I Protein: General introduction, forces that determine protein structure and physicochemical properties. Mechanisms of protein folding, molten globule structure, characterization of folding pathways. Determination of protein structure: Various spectroscopic techniques for protein structure determination. Background and basic principles, Absorption and Fluorescence, Circular Dichroism, FT-Raman, FT-IR, NMR, X-ray crystallography, MALLS.

(2 Credit)

Unit-II Thermal properties of proteins: Application of DSC. Protein denaturation, aggregation and gelation. Flow properties of proteins and sensory properties of proteinaceous foods. **Protein functionality.** Protein raw materials- cereals, legume, oil seeds and pseudo cereals. Muscle protein, Milk protein, Egg protein.

(1 Credit)

Unit-III Protein modification and its design Protein modification as result of technological processes: Thermal, enzymatic, physical, pressure, solvents, interactions. Design and construction of novel proteins and enzymes. Site directed mutagenesis for specific protein function, Basic concepts for design of a new protein/enzyme molecule, Specific examples of enzyme engineering.

(1 Credit)

Recommended Text Book

Carl, Branden and Tooze, John. Introduction to Protein Structure, Garland Publishing (Taylor and Francis Group). New York.

Reference Book:

Yada, R. Y.; Jackman, R. L.; Smith, J. L. Protein Structure-Function Relationships Blakie Academic and Professional: London

References/Correlation with Ancient Indian Literature:

1. Sushrut http://www.varanasi.org.in/sushrut
2. Manusmrtihttps://hindi.webdunia.com/sanatan-dharma-article/historicity-of-manusmriti-manu-smriti-116031100024_1.html
3. Samavedahttp://www.sacred-texts.com/hin/sv.htm

Advances In Food Engineering **Credits-4**

Objective: On successful completion of the subject, the students will be able to

1. Apply knowledge of food engineering to design new process.
2. Understand pump selection and velocity of flowing fluids.
3. Able to calculate through different dimensions.
4. Able to calculate freezing time.

UNIT-I Overview of Food engineering Engineering properties of foods, their significance in equipment design. Constraints and need of innovation. Challenges for food engineering. Tools and concepts in process design microbial survivor curves, general method for process calculation. Sterilization of continuous flowing fluid. Fluid flow handling systems for Newtonian liquids, force balance on a fluid element flowing in a pipe, derivation of Bernoulli equation. Measurement of viscosity, capillary tube viscometer. Flow characteristics of non Newtonian fluids. Properties of non-Newtonian fluids. Velocity profile of a power law. Pumps-characteristics, types and selection.

(2 Credit)

UNIT-II Thermal Properties of Foods Thermal properties of foods. Steady state and unsteady state heat transfer: Conduction in multilayered systems. Estimation of convective heat-transfer coefficient. Forced and free convection. Estimation of overall heat-transfer coefficient. NTU method for designing heat changers. Design of a plate heat exchanger, Design of a tubular heat exchanger.

(1 Credit)

UNIT-III Frozen Properties of Foods Pressure-sure-enthalpy charts. Frozen-food properties. Freezing point curves, phase diagrams, methods of freeze concentration, design problems. Freezing o foods, freeze concentration and drying , freezing time: plank's equation and Pham's method, theory of ultra-filtration and reverse osmosis, selection and types of membranes and properties, Properties of steam. Steam traps Methods of estimating steam consumption.

(1 Credit)

Recommended text books:

1.Rao, M. A., Rizvi, S. S. H. and Datta A.K. (2005). Engineering Properties of Foods: CRC Press.
2. Heldman, D. R. (2007). Food Process Engineering:AVI Publications.

Reference Books

1. Toledo, R. T. (1997). Fundamentals of Food Process Engineering (2 ed.): CBS Publications, New Delhi.
2 Rizvi, S. S. H. and Mittal, G. S. (1992). Experimental Methods in Food Engineering: Van Nostrand Reinhold.
3. Chanes J.W., Gustavo (2002) Engineering and Food for the 21st Century CRC Press.
4. Theodoros V.C., Food Engineering Handbook (2011) CRC Press

Agricultural Biotechnology **Credits-8**

Objective: Students will be able to understand the general introduction of agriculture development in India, trends and status of agriculture commodities in India for various fields, post harvest issues. Students will also learn about transgenic plants for crop improvement, molecular farming, biosafety regulation, production and development of stress resistant plant and pesticides and pesticide interactions.

UNIT I Brief idea of Agriculture Histrory of agricultural development in India. Current production , utilization and growth trends of agricultural commodities in India and abroad. Status of Indian Horticulture, fruits, vegetables, floriculture, post- harvest quality issues, value chain, quality seed production.

(1.5 Credit)

UNIT II Transgenic plants: Utility of transgenics in basic studies and in crop improvement (resistance for herbicides, viruses, insects and abiotic stresses; molecular farming for production of foreign proteins and edible vaccines; Use of antisense RNA and other technologies, biosafety issues including risks associated with transgenic crops; biosafety regulations.

(1.5 Credit)

UNIT III Stress Resistance Plant: Salt tolerance, freezing tolerances, chilling tolerance, and drought. Modern approaches of management of pest and diseases. Pesticides: groups, mode of action, application methods and pesticide interactions.

(1.5 Credit)

Recommended text book:

1. Plant biotechnology by K. G .Ramavat

References Books:

1. Swaminathan, MS (1991). Biotechnology in Agriculture – A dialogue. MacMillan India, New Delhi.
2. Gupta, PK (2004). Biotechnology and Genomics. Rastogi Publications, Meerut

References/Correlation with Ancient Indian Literature:

1. Sushrut http://www.varanasi.org.in/sushrut
2. Manusmrtihttps://hindi.webdunia.com/sanatan-dharma-article/historicity-of-manusmriti-manu-smriti-116031100024_1.html
3. Samavedahttp://www.sacred-texts.com/hin/sv.htm

Advances In Food Analysis **Credits-4**

Objective: On successful completion of the course students will be able to:

1. Apply valid sampling techniques to food materials having widely diverse properties and volumes;
2. Select appropriate analytical techniques for specific food components;
3. Compare advanced and conventional techniques and instruments to analyze chemical and physical properties of foods;
4. Apply a range of chemical analyses of food components;
5. Analyze, interpret and report on results obtained in a scientific format.

UNIT-I Overview of Spectroscopy & Chromatography Spectroscopy: UV-Visible spectroscopy, Atomic absorption spectroscopy, Flame photometry, Fluorescence spectroscopy, Emission spectroscopy, Mass-spectroscopy, Fourier Transform Infra-Red. Methods of separation and analysis of biochemical compounds and macromolecules:Principles and applications of Gas Chromatography, High Performance Liquid Chromatography, Thin layer chromatography.

(1 Credit)

(Practicals 0.4)

S.No.	Practicals	Nature
1	Determination of titratable acidity in foods using a potentiometric titration	Practical
2	Diastatic activity of honey, determination of hydroxymethyl furfural in honey	Practical
3	UV-Visible Spectro-photometric analysis of a carotenoid	Practical

UNIT-II Overview of instrumentation Microscopic techniques: Light microscopy, Scanning electron microscopy, Transmission electron microscopy, particle size analysis, Thermal techniques in food analysis: Differential scanning calorimetry and Thermo gravimetric analysis.

(1 Credit)

(Practicals 0.4)

S.No.	Practicals	Nature
1	thin layer chromatography (TLC) of food colors,	Practical
2	Microstructural and partical size analysis of starch	Practical
=3	Determination of thermal properties of food samples	Practical

UNIT-III Molecular Analysis Electrophoresis: Different kinds of electrophoresis, western blotting, gel documentation, DNA analysis: DNA purification, PCR-based analysis, DNA fingerprinting.

(1 Credit)

(Practicals 0.3)

S.No.	Practicals	Nature
1	Extraction of different types of proteins and identification using electrophoresis	Practical
2	DNA Extraction of Plant Tissue	Practical

Recommended text books:

1. Pare, J. R. J. and Bélanger, J. M. R. (2015). *Instrumental Methods of Food Analysis*: Elsevier
2. Pomeranz, Y. and Meloan, C. E. (1996). *Food Analysis: Theory and Practice* (3 ed.): CBS Publications, New Delhi

Reference Books

1. Winton, A. L. (2001). *Techniques of Food Analysis:* Agrobios, Jodhpur.
2. Sharma, B. K. (1994). *Instrumental Methods of Chemical Analysis*: Krishna, Meerut.
3. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). *Principles of Instrumental Analysis* (5 ed.): Harcourt, Singapore.
4. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). *Elements of Analytical Chemistry*: Sultan Chand & Sons

References/Correlation with Ancient Indian Literature:

1. Rig Veda https://www.sacred-texts.com/hin/rvsan/rvi10.htm
2. Yajurveda http://vedicheritage.gov.in/science/
3. Post-Vedic period (600 BC- 1 st century CE onwards) https://www.newworldencyclopedia.org/entry/Vedic_Period

IX SEMESTER

Advanced milk and milk products technology **Credits-4**

Objective: Students will be able to understand the basic concepts of milk and milk product processing in India, various standard for market milk, different techniques used in dairy industries, milk products and their technology integration, technology of condensed and dried milk, legal standards for dry milk, introduction of traditional dairy products, manufacturing of traditional dairy products, dairy plant sanitization and cleaning systems in dairy**.**

UNIT-I Technology of Market Milk & fat rich dairy products Technology of Market Milk:Dairy Industry in India: present status and scope; Milk: definition, composition and nutritive value; grading of milk; factors affecting composition of milk; physico-chemical properties of milk; FSSAI standards and legislations for market milk. Liquid milk processing: filtration/clarification; bactofugation; standardization; homogenization; pasteurization (LTLT, HTST); sterilization; UHT processing; aseptic packaging; storage and distribution. Technology of special milks: Technology of sterilized/ flavored milk, acidophilus milk, bulgarian milk, kumis, kefir; reconstituted & recombined milk, toned, double toned milk. Technology of fat rich dairy products: Cream: definition and legal standards, consumer cream products, standardization & production of cream, processing of cream (neutralization & pasteurization), butter: definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream & butter, defects in cream & butter. Ice-cream: definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

(1 Credit)

UNIT-II Technology of condensed and dried milk, yoghurt and cheese Technology of condensed and dried milk: Definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, concept of heat stability & its control, defects in condensed and evaporated milks, Quality of raw milk for dried milks, definition and legal standards for dried milks, milk drying system (film, roller, drum, spray, foam spray drying), method of manufacture of dried milks (WMP & SMP), defects in dried milk,Technology of yoghurt and cheese: Yoghurt - Definition and technology of yoghurt manufacturing, technology of different varieties of cheese manufacturing (cheddar &mozarella), changes during ripening of cheese, yield of cheese; manufacture of processed cheese, defects in cheese, accelerated ripening of cheese.

(1 Credit)

Practical: (0.5 credit)

S. No.	Practical
1	Determination of SNF (Solids Not Fat), specific gravity, total solids of milk.
2	Determination of moisture & fat content of milk powder
3	Study of familiarization with various parts and working of cream separator

UNIT-III Technology of indigenous dairy products Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets, miscellaneous traditional dairy foods, Dairy industry by-products and sanitation: By-products: introduction, definition, composition, Importance and food applications,whey protein

concentrates&isolates,Dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

(1 Credit)

Practical: (0.5 credit)

S. No.	Practical
1	Preparation of ice cream
2	Determination of fat by garber method
3	Detection of adulterants in milk like water, urea, neutralizers, preservatives sucrose storch

Recommended text Books*:*

1. Winton, A. L. and Winton, K. B. (2000). *Milk and Milk Products*: Agrobios, India.
2. Kutty, C. I. and Khamer, S. (2004). *Milk Production and Processing*: Daya, Delhi.

Reference books:

1. Fox, P. F. and McSweeney, P. L. H. (1998). *Dairy Chemistry and Biochemistry*: Kluwer Academic, New York.

References/Correlation with Ancient Indian Literature:

1. Vaghbhatifile:///C:/Users/jvwu/Downloads/INDIAN%20COW%20(BOS%20INDICUS)%20.pdf
2. Sushrut http://www.varanasi.org.in/sushrut
3. Charaka Samhita https://www.wisdomlib.org/definition/navanitaka

Nutraceuticals and Functional Foods **Credits-4**

Objective: Students will be able to understand the general introduction of Nutraceutical, Classification of Nutraceutical compounds, Introduction of functional food, use of functional food ingredients in various diseases treatment, extraction of phytochemicals from functional food, effect of environmental factors on functional food ingredients, probiotic and prebiotics introduction, types of probiotics and regulatory issues for nutraceuticals & functional foods**.**

UNIT-I Basics of Nutraceuticals and functional foods Nutraceuticals and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension etc. Photochemical and their usefulness: Antioxidants and Flavonoids, Omega-3 Fatty Acids, Carotenoids, Dietary fibres, Phytoestrogens,Glucosinolates,Organosulphur Compounds etc. their effectiveness in specific disease conditions; other functional ingredients in foods such as peptides, fatty acids, Cereal products as functional foods – oats, wheat bran, rice bran etc, Functional vegetable products, oil seeds, sea foods and sea weeds, antimicrobial compounds, Coffee, tea and other beverages as functional foods/drinks and their protective effect, Effects of processing, storage and interactions of various environmental factors on the potentials of such foods, health benefits.

(1.5 Credit)

UNIT-II Phyto-chemicals and development of functional foods Extraction of Phyto-chemicals and development of functional foods: Extraction methods for maximum recovery, Stability studies, Developing functional foods, Use of bioactive compound in appropriate form with protective substances and activators, Effect of environmental conditions in food matrix on activity of bioactive compound, Effects of processing conditions and storage, Development of biomarkersto indicate efficacy of functional ingredients, delivery of immune-modulators/vaccines in functional foods.

(1.5 Credit)

UNIT-III Prebiotics and Probiotics Prebiotics and Probiotics: Usefulness of Probiotics & Prebiotics in gastrointestinal health and other benefits, Examples of useful microbes and their benefits, Prebiotic ingredients in foods, types of prebiotics and their effects on gut microbes, Probiotic foods and their functional role, Marketing and regulatory issues for functional foods and nutraceuticals.

(1.5 Credit)

Recommended text Books:

1. Mine, Y and Fereidoon, S. (2006). Nutraceutical Proteins and Peptides in Health and Disease: TF, Bocaraton.
2. Bagchi, D. (2008). Nutraceutical and Functional Food Regulations in United States and Around the World: Elsevier, London.

Reference books

1. Shi, J. (2007). Functional Food Ingredients and Nutraceuticals:Processing Technologies: CRC Press, London.
2. Guo, M. (2009). Functional Food: Principles and Technology: WP, New Delhi.

References/Correlation with Ancient Indian Literature:

1. Rig Veda (c.1500 BC) https://www.sacred-texts.com/hin/rvsan/rvi10.htm
2. Yajurvedahttp://vedicheritage.gov.in/science/
3. Garuda Puranahttps://www.sacred-texts.com/hin/gpu/index.htm

Food Rheology and Texture **Credits-4**

Objective: Students will be able to understand the basic concepts of Rheology, food texture and various parameters of food textures, determination of rheological measure, rheological properties of liquid food, viscosity parameters of food fluids, deformation of materials, transition in solid food and various methods for the analysis of texture of food**.**

UNIT-I Food rheology Food rheology concept, scope of food rheology, texture of foods – type of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson's ratio, definition and importance of texture, texture-related concepts. Determination of rheological properties and measuring methods: destructive and non-destructive measurements, creep recovery and stress relaxation, dynamic mechanical tests, Modeling food texture: introduction, factor affecting texture, models to predict texture.

(1 Credit)

UNIT-II Rheological properties of fluid food Rheological properties of fluid food: viscosity, factors affecting viscosity, flow of material- Newton's law of viscosity, viscous fluids (Newtonian fluids, non-Newtonian fluids), plastic fluids (Bingham plastic, non-Bingham plastic fluids), fluid behavior in steady-shear flow: time dependent and time independent material function, viscosity measurement- capillary flow viscometers, orifice type viscometers, falling ball viscometers, rotational viscometers- concentric cylinder (coaxial rotational) viscometers, cone and plate viscometers, parallel plate viscometers, single-spindle viscometers (brookfield viscometer).

(1 Credit)

Practical: (0.5)

S. No.	Practical
1	Determination of viscosity of liquid foods, guminess, chewiness, springiness
2	Determination of hardness of various fruits, vegetables and processed foods using texture profile analysis.

UNIT-III Rheological properties of solid food Rheological properties of solid food: deformation of material, viscoelastic behavior, Failure and glass transition in solid foods: failure in solid foods, glass transition of solids foods (measurement, factors affecting, importance), Texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis, dough testing instruments-farinograph and mixograph, extensograph and alveograph, amylograph.

(1 Credit)

Practical: (0.5)

S. No.	Practical
1	Determination of force-distance relationship.
2	Sensory evaluation/ subjective measurement and correlation between subjective and objective measurements of foods.

Recommendedtext Books*:*

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. *Engineering Properties of Foods*: CRC Press.
2. Heldman, D. R. (2007). *Food Process Engineering*:AVI Publications.

Reference books:

1. Faridi, H. and Faubion, J. M. (1997). *Dough Rheology and Baked Products*: CBS Publications, New Delhi.
2. Rao, M. A. (2007). *Rheology of Fluid and Semisolid Foods: Principles and Applications* (2 ed.): Springer, USA.

References/Correlation with Ancient Indian Literature:

1. Atharva Vedas http://www.sacred-texts.com/hin/av.htm
2. The Rigveda, A Historical Analysis, by Shrikant G. Talageri, Aditya Prakashan, New Delhi. http://xn--j2b3a4c.com/rigveda/1/163/1
3. Charaka http://www.jahm.in/index.php/JAHM/article/view/21

Advanced Meat, Fish, Poultry and Egg Technology **Credits-4**

Objective: Students will be able to understand the basic concepts of meat food industry, consumption trends of meat industry, spoilage of meat products, preservation of meat products, quality analysis of meat products, quality characters of poultry products, poultry meat products and their preservation, production and maintenance of egg food products, introduction of commercial marine products, transportation of fish products and preservation of fish products.

UNIT-I Introduction about Meat Technology Production, Processing and consumption trends, Prospects of meat industry, Meat spoilage, Endogenous and exogenous infections, Hygiene and sanitation, Meat composition from different sources, Post-mortem muscle chemistry and composition, Intramuscular fat, Rigor mortis, The conversion of muscle into meat: Animals' stunning methods, ante-mortem and post-mortem examination, Design of handling facilities: Slaughtering and dressing, Consequences of circulatory failure, Proteolytic and other chemical changes, Operational factors affecting meat quality, Effects of processing on meat tenderization, Chilling, freezing and preservation, prepared meat products, intermediate moisture and dried meat products, The eating quality of meat: color, flavors and retention, water holding capacity, juiciness, texture and taste, meat eating and health, Inedible by-products.

(1.5 Credit)

UNIT-II Quality characteristics of poultry products Quality characteristics of poultry products, Lay-out and design of poultry processing plants, Plant sanitation, Poultry meat processing operations and equipment for de-feathering, bleeding, scalding etc., Poultry meat products, Refrigerated storage of poultry meat, by-products

Egg structure, structural abnormalities, functions of egg in food system, egg products, whole egg powder, egg yolk products, by-products, their packaging and storage, eating quality of eggs, Inspection and grading, preservation and safe handling.

(1.5 Credit)

UNIT-III Commercially important marine products Commercially important marine products from India, Product export and its sustenance, Processing operations, Basic biochemistry, Preservation of postharvest fish freshness, Transportation in refrigerated vehicles, Deodorization of transport systems, Design of refrigerated and insulated trucks, Grading and preservation of shell fish, pickling and preparation of fish protein concentrate, fish oil and other by-products.

(1 Credit)

Recommendedtext Books*:*

1. Lawrie, R. A. (1998). *Lawrie's Meat Science* (6 ed.): Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). *Meat and Meat Products: Technology, Chemistry and Microbiology*: Champan& Hill, London.

Reference books:

1. Carmen, R. O. and George, J. M. (1997). *Poultry Meat and Egg Production*: CBS Publications, New Delhi.
2. Winton, A. L. and Barberwinton, K. (1999). *Fish and Fish Products*: Agrobios, Bikaner.
3. Winton, A. L. and Winton, K. B. (1993). *The Structure and Composition of Animal Product*: Agro Botanical, Bikaner.

References/Correlation with Ancient Indian Literature:

1. Manusmrithi5.51https://www.wisdomlib.org/hinduism/book/manusmriti-with-the-commentary-of-medhatithi/d/doc200427.html
2. Atharvaveda 6.140.2 http://www.sacred-texts.com/hin/av.htm
3. Yajurveda 1.1http://vedicheritage.gov.in/science/

Research Methodology **Credits-4**

Objective: Students will be able to understand the basic concepts of research methodology including meaning and objectives of research, types of research, various research criterial, research problem, research design, measurement and scaling techniques in research, various scaling techniques in research, methods of data collection in research and report writing of research.

UNIT I Introduction & Types of research Research methodology: Introduction & meaning of research, Objectives of research, motivation in research. Types of research & research approaches. Research methods vs. methodology, Criteria for good research. Research problem: Statement of research problem, Statement of purpose and objectives of research problem, Necessity of defining the problem.

(1.5 Credit)

UNIT II Research design Research design: Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design.

Measurement & scaling techniques: Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, important scaling techniques.

(1.5 Credit)

UNIT III Methods of data collection Methods of data collection: collection of primary data, collection data through questionnaires& schedules, Difference between questionnaires & schedules. Report Writing

(1 Credit)

Recommended Text Books:

1. Kothari CR (2004). Research Methodology: Methods and Techniques, New Age International.
2. Bhattacharya DK (2009). Research Methodology, Excel Books.

Reference Text

1. Annals of Food Science & Technology
2. Journal of Nutrition
3. Journal of Food Science & Technology

X SEMESTER

Details of Training/Visit/Dissertation/Internship: Applicable (Dissertation)