

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR****Course Structure and Syllabi for Pre Ph.D
FOOD TECHNOLOGY (2009-10)****PART-I**Choose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1	Chemistry of Foods.	09PH53101
2	Analysis of Foods. Including Instrumentation	09PH53102
3	Food Preservation Technology	09PH53103
4	Technology of Fruits and Vegetables	09PH53104

PART-IIChoose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1	Technology of Milk and Milk Products.	09PH53201
2	Technology of oils and fats.	09PH53202
3	Sugar and Confectionary and Bakery technology.	09PH53203
4	Technology of Meat, Poultry and Fishery Products	09PH53204
5	Food Biochemistry and Nutrition	09PH53205
6	Food Microbiology	09PH53206
7	Plantation Products and Flavor Technology.	09PH53207
8	Food Processing Engineering	09PH53208
9	Packaging Technology Including Food Laws.	09PH53209
10	Management of Food Processing Industries.	09PH53210

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR
Pre-Ph.D - FOOD TECHNOLOGY

(09PH53101) CHEMISTRY OF FOODS

UNIT I

CARBOHYDRATES-I

Introduction – Classification of Carbohydrates - Determination of the configuration of the monosaccharide. Ring structure of the monosaccharide. Glucose and fructose. Methods for determining the size of sugar rings. Conformational analysis. *iso propylidene* derivatives of the monosaccharide.

UNIT II

CARBOHYDRATES-II

Disaccharides. Structure and synthesis of Sucrose, Maltose and Cellobiose.

Trisaccharides. Polysaccharides. Photosynthesis. Glycosides.

UNIT III

AMINO-ACIDS

Classification of amino-acids. General methods of synthesis Amination of alpha halogenated acids, Gabriel's phthalamide synthesis, Striker's synthesis, Masonic ester synthesis. Isolation of amino-acids. General properties of amino-acids. Thyroxine.

UNIT IV

PROTEINS

General nature of proteins. Structure of proteins. Polypeptides. Peptide bonds, Primary, Secondary, Tertiary, Quaternary. Biosynthesis of amino-acids and proteins.

UNIT V

OILS, FATS, WAXES

Introduction – Occurrence – Glycerides – Chemical composition of Fats – General Physical and Chemical properties – Hydrolysis – Hydrogenation – Hydrogenolysis – Trans esterification – Auto oxidation – Rancidification – Acid Value – Saponification value – Iodine value –Reichert. Meissl value – Uses of Oils/fats – Fixed and volatile oils – Mineral Oils – Drying Oils Waxes.

UNIT VI

VITAMINS

Introduction. Vitamin B complex. Vitamin E group. Vitamin K group. general study- detailed study – Chemistry of thiamine (Vitamin B1) - Ascorbic acid (Vitamin C) – Pantothenic acid, biotin (Vitamin H) and tocopherol (Vitamin E) Biological importance of Vitamins. Carotenes. Vitamin A. Xanthophylls. Carotenoid acids.

UNIT VII

PURINES

Introduction. Uric acid. Purine derivatives. Xanthine bases. Biosynthesis of purines.

UNIT VIII

NUCLEIC ACIDS

Introduction-definitions -RNA, DNA, three components of phosphoric acid ,pentose sugar and nitrogen, modified bases .

References:

1. **Chemistry of organic natural products vol.1&vol.2** by O.P..AGARVAL

1. **Organic natural products vol 2** by I.L.FINAR

2. **Rama Rao, A.V.S.S. (1986)** – Text Book of Biochemistry, 5th edition (L.K. and S. Publishers).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53102) ANALYSIS OF FOODS INCLUDING INSTRUMENTATION

UNIT-I

Proximate constituents: preparation of samples, detection of moisture content in food samples, ash and mineral matter, acid insoluble ash, alkali insoluble ash, titratable acidity. Estimation of crude fiber, dietary fiber. Estimation of total sugars, reducing sugars, estimation of organic and inorganic proteins. Estimation of starch.

UNIT-II

Estimation of pectin, measurement of jelly strength, estimation of tannins, estimation of vitamins - ascorbic acid, thiamin, riboflavin, folic acid. Minerals-calcium, magnesium, phosphorous, iron, potassium, sodium, copper, tin, zinc, lead, arsenic.

UNIT-III

Edible oils: physical characteristics - specific gravity, refractive index, melting point of fat, measurement of odour, chemical characteristics – Saponification value, iodine value, thio nitrogen value, impurities – volatile, insoluble and mineral matter.

UNIT-IV

Flavoring materials: sampling, extraneous matter, volatile and non volatile extracts, nitrogen in non volatile ether extracts, alcoholic extract, detection of added starch, estimation of starch. Determination of volatile oils, tannins estimation, pungency rating, test for adulterants. Extraction of oleo resins, estimation of oleo resins, peroxide value.

UNIT-V

Preservation in food: estimation of sulphur dioxide, sodium benzoate, sorbic acid, anti oxidants, estimation of B.H.A, BHT, TBHQ (Tertiary Butyl Hydro Quinone), stabilizing agents. Additives used in food analysis.

Sensory analysis: laboratory set of equipments, selection of panel member, training of panel member. Judging of quality, difference test, ranking test, sensitivity test, descriptive flavour profile test, threshold value, dilution number, paired comparison test, ANOVA test, dunnet test, hedonic rating test.

UNIT-VI

Analysis of water: colour, odour, taste, turbidity, chemical characteristics-total solids, organic matters, hardness, alkalinity, acidity, pH, chlorides, sulphates, free carbon di oxide, oxygen absorption BOD (Biological oxygen demand), COD (chemical oxygen demand).

UNIT-VIII

Food microbiology: determination of microbial load, microbial content, microbial count, isolation of micro organism from spoiled fruits and vegetables. Isolation of bacteria from idly, butter and stored foods. Enumeration and identification of E-coli from food samples. Preparation of media for culturing of autotrophic and heterotrophic micro organisms.

Unit-VIII

uv-visible and infrared spectroscopy

Absorptivity – Apparent deviations from Beer's law – Double beam spectrophotometer operation – Sources of radiation – Detectors – Photo metric accuracy – Instrumentation, - Chemical applications – Qualitative analysis – determination of ligand/metal ratio in a complex Quantitative analysis – photo metric titration. Introduction-origin of IR spectra-instrumentation, group frequencies, applications of IR spectra analysis spectral data of alcohols-aldehydes and ketones –carboxylic acids –amines –amino acids –proteins.

References:

- 1) **Hand book of Analysis & Q.C. for Fruits & Vegetables products** by Ranganna.
- 2) **Food microbiology** by Frazier.
- 3) **Instrumental methods of analysis** by B.K Sharma
- 4) **Spectroscopic analysis** by Y.R. Sharma
- 5) **Instrumental methods of analysis** by chatwal

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53102) FOOD PRESERVATION TECHNOLOGY

UNIT-I

Food and its preservation –source of problems, nature of food – plant and animal origin, cereals pulses grains , dry fruit seeds , legumes , nuts , and tubers, vegetables, fruits milk and dairy products, meat and poultry egg and egg products, fish and shell fish, animal by-products benefits of industrial food preservation .

UNIT-II

Principles of fresh food storage-nature of hazardous, decaying of foods – metabolism , crating energy , determine the refrigerated load needed ,specific heat foods , animal products storage , quality control, effect of cold storage on quality , preservation of food in micro nutrients, storage of grains bulk storage control of insects and mites chemical aspects. Nature of food hazardous- cases of food spoilage, food poisoning, food toxications, mycotoxins, chemicals in food preservation.

UNIT-III

Principles of refrigerated gas storage of foods-gas packed refrigerated dough , gases storage of refrigerated fruits and vegetable , sub -atoms sphere storage, gas atmospheric storage of meat , quality parameters, gas storage of grains , flours , under water storage , under ground storage, principles of freezing – freezing point of foods , volume changes during freezing methods of freezing –direct, in direct, immersion type of freezing , freezer burnt, packing require mint in frozen foods effect of freezing on micro organism, thawing damages to frozen foods freezing of dairy products , bakery products.

UNIT-IV

Principles of food preservation by canning drying- spoilage caused micro organisms, heat resistant microbes, processing of canning, heat resistant of enzymes in food, inoculated pack studies ,spoilage of canned foods ,storage of canned foods, corrosion of cans, misconceptions relating to canned foods, improvement in canning technology , retard pouches – optimizing thermal processing HACCP in

canning, dehydration and drying types of dryers used in food preservation, influencing of dehydration on nutritional value of foods influencing of drying on micro organism, enzymes, pigments dehydration of fruits and vegetables, animal products, grains .

UNIT –V

Principles of food concentrate- concentration high solid and high acid foods, pectin and gel formation, invert sugar, jellies. Other fruit products, sweetened condensed milk manufacture peanut butter and its important principles of semi moisture foods – canned white bread, fungistatic and bactericidal Agent, semi moist pet foods processing water activity, problems in semi moist foods other product develop developed, storage stability of semi moist foods .

UNIT-VI

Principals food preservation by fermentation – ferments of carbohydrates, types of fermentation, ferment action order, fermentation control, wine preservation, beer preservation, vinegar fermentation, cheese fermentation, HACCP in analysis of cheese, mycotoxins principles of pickling –salt pickling of fruits and vegetable, sweet pickling, dill pickles Sauer kart, olives fermented pickles products, control of fermentation in commercial brining tanks, brine recovering principles, fish salting, smoking, curing, meat curing and smoking, pickling of meat, preparation of dry sausages .

UNIT-VII

Principles chemical preservation of foods – additives and their uses , importation of chemical additives, safety of food additives, functional chemical additives application, chemical preservatives microbial antagonistic, antibiotics, antioxidants, other chemical additives. Principles of food irradiation – introduction, types of irradiation, dosimetry, mode of action, radiation effects on enzymes, parasites, insects, packing materials dose requirements for the sterilization of foods, factors influencing of survival of micro organism, public health aspects of irradiated food , concern over mycotoxins.

UNIT-VIII

Principles of food storage- test quality of stored foods, longer term storage of preserved foods, values of excluding air, storage stability of frozen foods principles of quality assurance – need, role of government, microbiology standards, design of company, Q.A program, finished product assurance. Application of technology – product development tools, research, guide of panel members, type of new products, and industrial application of new technology.

References:

1. **Preservation and canning of fruits and vegetables** by EIRI board of consultants and engineers India research institutes, Delhi.
2. **Hand book of food dehydration and drying**, by EIRI board of consultants and engineers India research institutes, Delhi.
3. **Technology of food preservation, 4th edition**, by N.W. Desrosier and Desrosier, AVI publishing company, New york.

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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53103) TECHNOLOGY OF FRUITS AND VEGETABLES

UNIT – I

Introduction of Fruits and vegetables Definition structure, origin, classification Fruits

General properties of Fruit & Vegetables chemical composition, Nutritive value its importance their stability in processing. Introduction of Fruit ripening , ripening agents & their effects, ripening changes, enzymatic action, deterioration Factors & their control. Desirable characteristics of Fruits & vegetables for processing,

UNIT –II

Preservation of Fruits and Vegetables – Introduction to preservation, Principles of Preservation, Factors effect in preservation.

Types of preservation, by products from Fruits & Vegetable waste & their utilization, transport of Fruits Vegetables.

UNIT – III

Preservation by Drying & Dehydration of Fruits & Vegetables – principles of drying, various types of equipments, Drying methods, changes in drying & Dehydration. Humidity & temperature control problem in drying process of Fruits & Vegetables.

Preservation by Freezing, Refrigeration of Fruits & Vegetables, Metabolic function of Refrigeration principles of Freezing, Methods of Freezing.

Technology of cold storage, equipments for Freezing, Freezing techniques & problems encountered in Freezing of Food & Vegetables.

UNIT – IV

Preservation by Heat & canning of Fruits & Vegetables –Fruits & Vegetable canning introduction – principle in canning, Method of canning, problems in canning, Nutritive changes in canning.

Chemical preservation-Preservatives used for storage of Fruits & Vegetables and its products by chemical ,additives acids, salt, sugar, SO₂, benzoic etc.,

Preservation by Fermentation – Types, importance special preservation methods – control atmosphere storage, modified atmospheric storage, pickling, irradiation, combined preservation methods

UNIT – V

Fruits & Vegetable juices, syrups, squashes, cordials & nectars, fruit concentrates, jams & jellies, marmalades, preserves, butter & candied fruit preparation & manufacturing. pickles and chutneys – introduction, types, pickling process of Fruit & Vegetables and its methods, quality control and its related problems.

UNIT –VI

Pectin – chemistry, its related compounds, manufacturing process and various uses in food industry.

Vinegar – General properties, types, preparation, industrial method of manufacturing, various uses of Vinegar.

UNIT-VII

Tomato products – Types, preparation of various Tomato products.

UNIT -VIII

Genetically Modified Fruits and vegetables. Quality control / quality assurance of Food & Vegetables, FPO, PFA specification, Hygienic requirements.

References:

1. **Fruits & Vegetables processing** by FAO Agricultural service bulletin – 119
2. **Fruit & Vegetables preservation principles & practices 3rd revised Edition** by R.P.Srivasta
3. **Processing, dehydration, canning preservation of Fruit & Vegetables.** By international book distribution co.lukno

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53201) TECHNOLOGY OF MILK AND MILK PRODUCTS

UNIT-I

Advances in milk processing Milk procurement – Buying methods- Transportation-Raw Milk Reception Dock- Chilling methods- Storage of milk – Standardization- Homogenization- Types of pasteurization- Packaging of milk-Distribution of milk

Unit-II

UHT milk- Aseptic packing of milk – Membrane Technology in milk processing- Bactofugation- Anti- microbial systems in milk

Unit III

Cream- Construction of cream separators- yield of cream- Preservation of cream- Defects in cream-Consumer cream products

Unit-IV

Butter- Types of Butter- Preparation of Table butter- Continuous butter making- Butter oil- Preparation, Preservation and Defects- Fractionated Milk fats and their functional utility in various food products- Butter substitutes- Margarine and other spreadable butters.

Unit-V

Cheese- Advances in Cheese- Cheese Additives- Cheese flavor technology- Immobilized enzymes- Accelerated Cheese ripening- Mozzarella cheese, blue veined cheeses

Unit -VI

Sweetened Condensed milk –Preparation- Vacuum Pan- Defects- Evaporated milk- method of manufacture- Dried Milks- methods of Dehydration-preparation of Whole milk powder by spray drier- Properties of Milk powders- Defects in milk powders- preparation of Infant milk foods- Malted milk

Unit-VII

Advances in manufacture of Ice-Cream- substitution of sweeteners- utilization of artificial sweeteners – Fancy ice-creams- Sherbets- Milk Lollies- Kuflies- Milk by-products- edible casein- Sodium caseinate- Utilization of whey- Whey based products-Preparation of lactose-ghee residue

Unit- VIII

Advances in Traditional Dairy Products Technology - Khoa- Varieties of khoa- Khoa based sweets-Kalakhand- Gulabjamun- Milk cake- Chhana and Chhana based sweets- Rasogolla-Ras malai- Advances in Paneer- Shrikhand-Sandesh- Methods of preparation- Preservation- Fermented Milk Products-Dahi- Yoghurt- Lassi- Misti dhoi- Their composition -Changes in

constituents during formulation and flavor development – Ghee- Industrial production of ghee- Ghee adulterants- identification- Renovation of ghee- Ag Mark standards- ghee defects

References:

1. **Outlines of Dairy Technology** by Sukumar De
2. **Indian Milk and Milk products** by R.P.Aneja
3. **Milk and Dairy Technology** by Edgar spreer
4. **Technological Advances in market Milk** By j. David
5. **Advances in Milk processing Vol I** by R.K.Robinson
6. **Advances in Milk products Technology vol-II** by R.K.Robinson

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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53202) TECHNOLOGY OF OILS AND FATS.

UNIT - I

Sources and classification of Oils and Fats

Glyceride - Structure and composition of oils and fats :

Definition, distinction between oils and fats – Simple and mixed triglycerides, mono-and di-glycerides

UNIT - II

Non-glyceride components of oils and fats:- Phosphatides ,sterols, carotenoid pigments – Tocopherols and other antioxidants – Vitamin A, D and E.

UNIT - III

Chemical reactions of fats and fatty acids:- Hydrolysis, esterification and inter-esterification, saponification with alkalies, hydrogenation of the carboxyl group, formation of nitrogen derivatives, formation of acid chlorides, dehydration, pyrolysis. Hydrogenation and halogenation reactions in the fatty acid chain, sulfation and sulfonation, atmospheric oxidation (rancidity). Polymerization, isomerization and reactions of hydroxyl groups.

UNIT - IV

(a) Classification of oils and fats.

(b) Glycerides composition and important characteristics of the oils of the following oils:- Coconut, Cottonseed, peanut, palm, sunflower, sesame, safflower, rice bran, rapeseed and mustard. Linseed, soybean, tung, castor oils, lard and tallow

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UNIT - V

a) Post harvesting technology of oil seeds

b) Storage and pretreatment of oilseeds ,position of oilseeds and oils in India

c) Packaging of edible oils

UNIT - VI

- (a) Oil seed milling
- (b) Mechanical expression of oil
- (c) Solvent extraction

UNIT - VII

- (a) Fat splitting (Twitchell and Autoclave methods)
- (b) Distillation of fatty acids

UNIT - VIII

- (a) Refining and Bleaching :- Degumming, alkali refining, (Batch process), Miscella refining, Refining losses – Bleaching by Absorption – Continuous bleaching.
- (b) Hydrogenation :- Mechanism – Selectivity – continuous process – preparation of Raney Nickel catalyst.
- (c) Lipids:- Composition and processing.

References:

Bailey's Industrial Oils and Fats products, Volume 1- 5 by Ed. D. Sworn, Wiley-Inter Science Publications, N.Y., John Wiley & Sons (1982)

Bailey's Industrial Oils and Fats products, by Ed. D. Sworn, Wiley-Inter Science Publications, N.Y., John Wiley & Sons (1982).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53203) SUGAR AND CONFECTIONARY AND BAKERY TECHNOLOGY.

UNIT- I

Introduction to sugar confectionery, Types of sugar and their manufacturing process.

Ingredients of confectionery- sugars, starch, Glucose syrups and starch hydrolysates, –fats – modification of oils and fats.

Colour and flavour- colours for the sugar confectioner, Flavorings flavor strength, functions of carrier solvents and powders, factors affecting stability of flavoring compounds, refined glucose syrups, Gums , gelling agents and thickenings – properties and its applications.

UNIT- II

Manufacture of high-boiled sweets, ingredients, prevention of recrystallization and stickiness, product types. Caramel, toffee and fudge, ingredients, structure of toffee, formulation, processing, toffee stability, fudge.

Cocoa, chocolate and related products: Cocoa beans, cocoa fruit, pulp, fermentation, drying Sequence of processes chocolate receipts, cocoa powder, mixing, refining, conching and tempering of chocolate.

UNIT- III

Gums and jellies, technology and chemistry of hydrocolloids, hydrocolloid pretreatment processes, liquor preparation, shaping drying finishing treatments, re-work, common faults, causes and cures.

Liquorices paste and liquorice allsorts, cream paste and aerated confectionery: ingredients and manufacturing of liquorices paste, cream pastes and aerated confectionery- methods of aeration, marshmallow, Nougat.

UNIT - IV

Tablets, Lozenges and sugar panning, Tableting, granulation, ingredients, compression, Lozenges, sugar panning, Hard panning, Soft panning, polishing, Additional panning techniques.

Chewing gum technology: Gum base, sugars, flavors, humectants, fruit acids, sugar-free chewing gum ingredients, formulation and chewing gum mixing. Count line components, manufacturing of count lines and cereal bars.

UNIT –V

Rice- Chemical composition and storage. Methods of quality assessment, Methods of parboiling, milling operations, changes during ageing, cooking quality, methods for accelerated ageing rice, drying of rice.

Wheat- Nature of Grain, Chemical constituents and processing quality. Milling, Operations, and utilization of products of milling.

Dough rheology. Chemistry and related technology (double baking, chapatti making etc.).

Chemistry and Processing Legumes and pulses.-Storage, handling and transportation.

UNIT – VI

Bakery Raw materials-General ingredients-Wheat flour-Manufacturing and Characteristics of wheat flour for Bakery industry ,ISI standards for Wheat atta, Maida and suji,Sugar and its uses, Shortenings, Milk, yeast-Uses and specifications-Salt and its uses-Egg and Egg Products-Chemical Leavening Agents, Cocoa Chocolate, Flavors, Emulsifiers, lecithin, Bread improvers, Enriching agents, Water and miscellaneous Ingredients,

Bread making process –straight doughs -quantity of yeast, quantity of water, quantity of salt. Leaven process, baking.

UNIT – VII

Biscuits- Classification, dough consistency, baking techniques and Packaging.

Cookies and Crackers -ingredients, formulation aspects, baking, decoration, sugar, cookies and sugar wafers.

Cereal and Legume based foods –raw materials, preparation of wheat products-dalia –Karah-parathas-and- maize fried products -golgappas-popcorn-bhelpuri-expanded and extruded snacks-papads, vadia, besan laddoos, chikki, sevian

UNIT – VIII

Health food snacks - introduction –Shelf life-Short shelf life snacks-Savory snacks, sweet snacks, Long Shelf life snacks-Granola bars, Crunchy bars, chewy bars, gluten free snacks,

Low calorie snacks-Diabetic products.

Convenience foods- Pasta products-. Extruded foods– snacks, noodles-processing and formulation.Machinery and equipments for snack foodsReady to eat processed cooked foods-introduction and processing of instant mixesHeath food snacks-savory, tofu ,sweet snacks, diabetic products.

Namkeen –introduction and processing

References:

- **Text Book of Food Science and Technology** by Vijaya Khade, ICAA, New Delhi.2001
- **Manufacturing of snacks food** by namkeen, pappad and potato products-EIRI

Publications, Delhi

- **Cereal Technology** by Kent Jones.
- **Technology of Cereals** by Kent.
- **Sugar Confectionery Manufacture** by (Ed) E.B. Jackson, 2nd Ed., Blackie Academic and Professional , Glasgow (1996).
- **Sugar Confectionery and Chocolate Manufacture** – by R.Loos , Leonard Hill Books, International Text Book Company Limited (1973).
- **Drying of Cereal Grains** by Brookers.
- **Flour Milling Process** by Scott.
- **Bread Spicer.**
- **Snack food** by R.Gordan Booth- CBS publications
- **Hand book of bakery industries-EIRI.**
- **Food preparation-A scientific approach** by Meera Rao Patankar, Anmol Publications New Delhi.
- **Biscuit, cracker and cookies recipes for the food industry** by Duncan Manley, Wood head Publishes- Cambridge, England.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53204) TECHNOLOGY OF MEAT, POULTRY AND FISHERY PRODUCTS.

UNIT – I

Introduction on meat and poultry industry. Development of meat and poultry industry in India. Its needs in national economy. Glossary of market terms for meat animals and birds. Effect of feed, breed and environment on production of meat and its quality. and desi- birds

UNIT – II

Slaughtering, inception, grading- Ant mortem examination of Meat Animals. Slaughter of meat animal cattle, buffalo, sheep, goat and pigs. Dressing carcasses. Modern abattoir practices. Post-mortem examination of meat, retail and whole sale cuts, grading, factors influencing quality of fresh and cured most. Preparing poultry for consumption-ready to cook chicken.

UNIT - III

Meat preservation by refrigeration and freezing, thermal processing, dehydration, irradiation, chemicals and antibiotics. meat by products. Cold storage and freezing, canning, smoking, curing-bacon, ham, sausage products. and pickling of marine products – fish pastes, sauces, oils, protein concentrates, meal and other products. Preservation and processing of shrimp, lobsters.

UNIT – IV

By-products-meat fat, feeds, hides, skins natural casings and feathers, miscellaneous by-products.

Egg and Egg products: the egg factory, its techniques of working, structure, composition, nutritional value Preservation and measures of Egg quality. Dehydrated egg powder, frozen egg, poultry processing's.

UNIT- V

Preservation of eggs by different methods-refrigeration, freezing, dehydration, coating and industrial use if egg products, postmortem change of meat and its quality grading and marketing of shell eggs.

Meat hygiene, quality control of meat production, processing, specification of meat products

UNIT- VI

Methods of analysis of meat products- chemical, physical, panel, microscopic, bacteriological
Introduction of fisheries resources in world, preservation of fish-cold storage, freezing canning, drying and dehydration, smoking curing and pickling. Fish products-fish past ,sauces, fish oil fish protein concentrates ,fish meal by-products of fish processing quality control of fish and fish products, food standards, fish processing sanitation.

UNIT- VII

Selection of meat animal and its transportation, pre –slaughtering transportation and its care, slaughter house and its design, mechanical deboning, ageing of meat, meat tenderization, meat emulsions restructured meat products, meat plant sanitation and safety.

UNIT- VIII

Bio chemical composition of fish, prawn marine products. Postmortem changes and quality assessment, processing of marine products and spoilage of fish, preservation methods without retention of freshness. Modern preservation methods such as vacuum packaging gas packaging, ethanol vapour generation, hurdle barrier concept, value added fish products, HACCP, EU hygienic regulations, ISO 9000 standards and new quality, safety parameters in sea food processing and preservation.

References:

- 1) **Meat and meat products technology (including poultry products technology)**
BYBDsharma jaypee Brothes medical publishers pvtld, New Delhi.
- 2) **Modern abattoir practices and animal byproduct technology** by R.D.Sharma
- 3) **Fish technology Ronald** by J.Robert
- 4) **Meat science (latest edition)** by R.A.Lowrie, paragoan press, oxford and new York
- 5) **Fish processing and preservation** by Charles.L.Cutting, agro bios India.

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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53205) FOOD BIOCHEMISTRY AND NUTRITION.

UNIT - I

Introductory cell Bio-Chemistry :- Separation of Sub-cellular components and their biochemical functions.

Enzymes - General Properties, Classification, Co-enzymes and co-factors, Kinetics and Mechanisms of action Michaelis Menten reactions, factors responsible for catalytic efficiency of enzymes, examples inhibitors and activators.

UNIT - II

Carbohydrate metabolism: Digestion, absorption and biochemical functions of carbohydrates, glycolysis, TCA cycleoxidation, oxidative phosphorylation and elements of bioenergetics. Biosynthesis of starch and glycogen. Elements of Photosynthesis.

UNIT - III

Lipid Metabolism: Digestion, absorption and functions of lipids, Oxidation of fatty acids, Biosynthesis of fatty acids.

UNIT - IV

Protein metabolism: - Digestion, Absorption and functions. End products of protein metabolism. Intermediary metabolism of amino acids and the urea cycle.

Nucleic acids: - Bio-chemical functions. Elementary notions of Protein biosynthesis.

Biochemistry of Hormones.

UNIT - V

Mineral Metabolism:- Biochemical functions of minerals. Active transport and ion absorption. Calcium, Phosphorous and Iron metabolism.

UNIT - VI

Functions of Food, energy value of Food. Nutritive value of Foods nutritional significance of Carbohydrate, Proteins, Fats, vitamins and minerals. Deficiency diseases. Fortification of foods.

UNIT – VII

Nutritional requirements – Balanced diets – Food tables. Nutrition of weaned infants , preschool children and infant foods. Nutrition, feeding of adults, expectant and nursing, mothers and industrial workers.

UNIT – VIII

Supplementary and special dietetic foods. Effect of cooking and processing on the nutritive value of Foods. Causes and prevention of malnutrition. Social psychology and Philosophy of Food habits. Theoretical aspects of techniques in nutrition research. Activities of international Organizations in the field of nutrition. Blood composition and functions.

References:

1. Principles of Biochemistry by Vioet & Vioet
2. **Essentials of Food and Nutrition No.1** by Swaminathan M.(1991) The Bangalore Printing and Publishing Company
3. **Principles of Biochemistry** (CBS Publishers) by Martin et al (1990)
4. **Text Book of Biochemistry** by Rama Rao, A.V.S.S. (1986) – 5th edition (L.K. and S. Publishers).
5. **A biologist's Guide to principles and Techniques of Practical Biochemistry** by Ed. Wilson, K. and Goulding, K.H. (1986) 3rd Edition (Edward Arnold).
6. **Biochemistry** by 3M. Zubay, G. (1989) 2nd edition (Maxwell MacMillan)
7. **Davidson's Human Nutrition and Dietetics**, Passmore, R and East Wood, M.A., (1986) 8th Edition (Longman).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY
(09PH53206) FOOD MICROBIOLOGY

UNIT - I

Introduction to Biology-branches of biology-diversity among living organisms-classification system-(Two kingdoms, three kingdoms, five kingdoms) metabolism, catabolism, and anabolism.

UNIT- II

Origin of microbiology-definition, History, Scope of microbiology-Branches of microbiology. Microscopic Study of bacteria yeast molds, viruses, with respect to morphology, reproduction growth, and nutritional requirements. Growth curve and reproduction.

UNIT - III

Culturing of micro organisms –methods of sterilization, disinfection and sanitation (Maintenance of aseptic conditions) Isolation, preservation and maintenance of pure culture. General and selective media for different types of micro organisms.

UNIT - IV

Food microbiology - Microbes in manufacturing of important food ingredients. Factors affecting spoilage of foods; Micro flora associated with various food groups their spoilage potential & control. Microbiological spoilage problems associated with typical food products. Micro organisms in food fermentation.

UNIT - V

Harmful /deleterious effects –food borne infections, food poisoning, Microbial toxins, Newer pathogens. Detection methods for *E. Coli*, *Staphylococci*, *Yersinia*, *Campylobacter*, *B.cereus*, *Cl.botulinum* & *Salmonella* from food samples.

UNIT - VI

Microbiological quality assurance systems in food industry HACCP, Food standards, Rapid methods of microbial analysis.

UNIT - VII

Industrial productions – fermentations, machines, fermentation types, chemostat. Industrial production of alcoholic, distilled beverages, citric acid, lactic acid bread enzymes (amylase), acetic acid.

UNIT - VIII

Microbial food products, mushrooms, single cell proteins, dairy products-yogurt, cheese, flavoured milk.

References:

1. **Basic Food Microbiology** by Banwant.
2. **Modern Food Microbiology** by Jay
3. **Microbiology** by Frazier
4. **Atlas R.M1934: Basic and practical Microbiology** by MacMillan Publication Company, New York.
5. **Microbiology principles and applications** by Cruger J.G. Black J.G. and Davison V.E. 1990: Prentice Hall of India Pvt. Ltd.,
6. **Microbes in action – a laboratory manual of Microbiology** by Hary W.S. Paul J and Van Denmark 1972: Tarporwals d.B. & sons, & Co., Ltd., Bombay.
7. **Brock & Brock Basic Microbiology** by Prentice – Hall (India) Ltd., New Delhi. CBS Publishers & Distributors, 485, Bhola Nath Nagar, Shahdara, Delhi 110 032

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR
Pre-Ph.D - FOOD TECHNOLOGY

(09PH53207) PLANTATION PRODUCTS AND FLAVOR TECHNOLOGY

UNIT - I

Flavours and flavoring materials: Flavorings in foods, added flavorings, compound flavorings, flavoring materials, and selection of flavoring materials.

UNIT - II

Flavoring materials of natural origin: Natural flavors, sources of natural flavoring materials – Herbs and spices, standards of purity and sensory assessment of herbs and spices, classification of herbs and spices, Spice processing-milling, Microbiology of spices, gas sterilization of spices, gamma irradiation, Heat treatment, Distillation or Extraction. Distillation of volatile oils, Spice essential oils, Application of spice essential oils, Essential oil content of spices. Oleoresins-Extraction, Quality and, Application of oleoresins.

UNIT - III

Plants as source of essential oils Citrus fruits-Citrus essential oils, Composition of Citrus oils, processed citrus oils, methods of de-terpenization, Citrus leaf and Flower oils. The Mints: Peppermint - Cultivation and Distillation, Rectification. Corn mint- Cultivation and Distillation, Dementholisation. Spearmint-Blended Peppermint, Composition of Mint oils. Other Commercially Important Sources-Fruit, Fruit Juices and Concentrates,

Vanilla –Introduction, Curing Process, Classification, Flavor, The Chemistry of Vanilla flavor, Precursors and the Development of Flavor, Beverage flavors – Cacao, Chocolate, Coffee, Tea, and Aromatic vegetables.

UNIT - IV

Flavoring materials made by processing: Natural products made by roasting (cocoa/chocolate) Reaction flavors – Enzymatically derived flavorings (Butter and cheese) – Flavors made by fermentation – Biotechnological production of aroma chemicals – Flavors made by pyrolysis.

UNIT - V

Flavor potentiators: Chemical properties, sensory properties, flavour potentiation in foods – toxicity. Flavor Production: Liquid flavorings, emulsions, dry flavorings. Application of flavorings in food processing:, Achieving flavor balance, and criteria for application of flavorings, Available flavorings, processing parameters, specific flavoring applications.

UNIT - VI

Tea, Coffee, Cocoa and Cashew nuts: Production, processing and chemistry of tea manufacture. Tea products such as soluble tea, tea concentrate, decaffeinated tea and flavoured tea.

Production, processing, roasting and brewing of coffee. Soluble coffee manufacture. Chemistry, standards and specifications of coffee. Other coffee products and coffee substitutes monsoonal coffee, decaffeinated coffee, coffee brew concentrate and chicory.

Production, processing and chemical composition of cocoa products and quality standards. Chemistry and technology of cashew nut.

UNIT - VII

Food additives: Types of additives with examples – benefits of additives, risk of additives, balancing risks and benefits, methods of estimating dietary intake of food additives.

Nutritional additives: Units, requirements, occurrence and commercial forms of various vitamins, use and commercially available forms of mineral additives.

Antimicrobial agents: Application of benzoic acid and benzoates, sorbic acid and sorbates, short chain acids and salts.

UNIT - VIII

Sweeteners: Sugar substitutes in foods – properties and uses of non-nutritive sweeteners, nutritive sweeteners, choice of sweetener, alternative sugar substitutes.

Natural and synthetic coloring agents : Role and use of colorants, types of colorants, chemical classification and properties.

Emulsifiers: Emulsifier function and mechanism of action – applications in foods.

TEXT BOOKS

1. **Text Book of Food Science and Technology** by Vijaya Khade ICAA, New Delhi.2001
2. **Source Book of Flavours** - Eiri Publications
3. **Flavour Chemistry and Technology** by H.B.Heath and G.Reineccius,AVT Publishing Company Connecticut (1986)
4. **Food Additives** by A.L. Branen, P.M. Davidson and S.Salminen,Marcel Dekker Inc., W.Y (1990).

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR
Pre-Ph.D - FOOD TECHNOLOGY

(09PH53208) FOOD PROCESSING ENGINEERING

UNIT - I

FLUID FLOW

Types of flow, Reynolds number, Viscosity, Concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure. Material handling systems Liquid handling – Different types of pumps, Gas handling – Various types of fans, blowers and compressors, Solid handling – Bins, Bunkers, Conveyors, Air transport.

UNIT - II

HEAT TRANSFER

Sources of heat, Heat transfer by conduction, convection and radiation, with examples, steady state and unsteady state heat conduction individual and overall heat transfer co-efficient. Heat exchange equipments, types, relative merits and demerits.

UNIT - III

EVAPORATION

Types of evaporators, single effect and multiple effect evaporators. Freezing and thawing Principles, applications and equipment.
DISTILLATION

Simple, steam and flash distillations, principles of rectification, azeotropic and extractive distillation.
Extraction and Leaching Principles, equipment, types and applications.

UNIT -IV

DRYING

Moisture content and mechanism of drying, rate of drying and time of drying calculations. Classification and types of dryers, dryers used in food industries and special drying methods.

UNIT - V

SIZE REDUCTION & MIXING

Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of mill, types of mills including ball mill, hammer mill, fluid energy mill etc.

Properties of particulate solids, screening and industrial screening equipment-sieves and screens, magnetic separators, electrostatic separators, froth flotation

Theory of mixing, mixing time, power used in agitated vessels, powers consumption of mixing, rate of mixing viscous materials and pastes. Solid-solid, solid-liquid and liquid-liquid mixing equipments.

UNIT - VI

FILTRATION

Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter, etc. Factors affecting filtration.

CENTRIFUGATION

Introduction, Principles of centrifugation, equations for centrifugal force, equations for rate of settling in centrifuge, industrial centrifugal filters- tubular, disc bowl filters, gas-solid cyclone separators and centrifugal sedimentary.

UNIT - VII

CRYSTALLIZATION

Characteristics of crystals like, purity, size, shape, geometry, habit, forms size and factors affecting it. Super saturation theory and its limitations. Nucleation mechanisms, Crystal growth. Study of various types of crystallizers.

UNIT - VIII

ADVANCES IN FOOD TECHNOLOGY

Extrusion technology, Membrane processes, Supercritical fluid extraction, Cryogenic grinding and Ohmic heating.

References:

1. **Unit Operations of Chemical Engineering** by W.L.Mc Cabe, J.C. Smith and P. Harriot, 5th Edition, McGraw Hill Book Co., 1993.
2. **Chemical Engineering Handbook** by Ed. Robert H. Perry, Cecil H.Citon.
3. **Chemical engineering** by J.M. Coulson and J.F. Richardson
4. **Essentials of Food Processing Engineering** by C.Gopala Rao,
- 5 **Unit Operations in Food Processing** by R.L.Eave,

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR
Pre-Ph.D - FOOD TECHNOLOGY

(09PH53209) PACKAGING TECHNOLOGY INCLUDING FOOD LAWS

UNIT - I:

Introduction to packaging – Definition – used for packaging – Factors involved in the creation of food package, designing successful packaging – Packaging materials and forms – Testing of packaging materials, paper, paper board, plastics, glass containers, metal packaging.

UNIT - II:

Basic types of food processing for packaging – Heat processing (including irradiation), high barrier plastics packaging, Aseptic packaging, packaging for microwavable foods, Irradiation, UV – Light, Ultrasonic, High pressure techniques – Dehydration - Reduction of available water, Active packaging systems – Freezing, commercial freezing methods, protection needed by frozen foods.

UNIT - III:

Packaging of fresh and chilled foods : Meat, Shell fish and dairy products and the package requirements – vacuum and modified atmosphere packaging. Packaging of frozen foods – package requirements for frozen fish, and dairy products.

UNIT - IV

Packaging of fresh fruits and vegetables. Details of packaging of Fruits & Vegetables products packaging Materials, packaging methods, problems related in packaging & Quality control, testing of packaging materials and importance of packaging in Food & Vegetables.

UNIT - V

Packaging of whole grain products : milled grain produced prepared mixes, paste, biscuits, bread and backed foods. packaging styles, wrapping materials and methods.

UNIT - VI

Packaging Machinery Production and packaging line requirements – Bottling, layout of bottling line and details of individual steps on the automatic line – canning, details of individual steps in canning process – wrapping operations – form, fill and seal machines and labeling machines.

UNIT - VII

Biopackaging : Use of biopolymers in packaging, properties and applications of biopackaging, Recycling, reuse and disposal of food packaging materials.

UNIT - VIII:

Food laws development and enforcement. Prevention of Food Adulteration Act and Food Regulations. ISO-9000 Series HACCP. Codex Alimentarius protocols for export.

References:

1. **Principles of Food packaging** by Stanley Sacharow and Roger C. Griffin 2nd Edition, AVI Publishing Company, Estport, Connect
2. **Food packaging and preservation** by Ed. M.Mathlouthi, Blackte Academic Professional – Chapman & Hall (1994)
3. **A Hand Book of Food packaging** by EIRI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D - FOOD TECHNOLOGY

(09PH53210) MANAGEMENT OF FOOD PROCESSING INDUSTRIES

UNIT - I

Entrepreneurship – Definition – Concept – Qualities of an Entrepreneur – Selection of project – Selection of Location – Economics of Site Location – Urban Vs Suburban Location – Plant layout – Types of Lay out – Flow lines – Material handling Equipment – Selection of Handling Equipment for Food Processing Industries – Introduction to production systems. Types of business ownership such as Proprietorship, Partnership, Limited Company and Joint stock companies.

UNIT - II

Management – Definition – Functions – Principles – Planning – Organizing – Coordinating – Directing – Controlling. Objectives–Policies of Corporate Management – Organization Structures – types-advantages and disadvantages of each type.

UNIT - III

Brief description of Functional Management systems such as Financial Management, Personnel Management, Production Management and Marketing Management

UNIT - IV

Labor welfare and safety measures – Forecasting the demand for the product and demand analysis – Supply and demand relationships.

UNIT - V

Principles of Accountancy - Ledger and journal postings – Brief discussion of Balance sheet – trial balance – Profit and Loss accounts – Introduction to different types of accounts – Cost accounting – types – Methods of preparing cost sheet for the product manufactured.

UNIT - VI

Quality Control – Quality aspects of food – Quality control theory – Control of variables and attributes – Control charts – Sampling Theory – Problems related to quality control of food products – ISO 9000.

UNIT - VII

Introduction to Operations Research – Model building – Brief description with simple examples of Linear Programming – Resource allocation model – Transportation model – Assignment model – Brief treatment of Sequencing model, waiting line model.

UNIT - VIII

Inventory Management – EOQ model – ABC, JIT, FIFO, FILO, VED and FSN analysis .

References:

1. **Industrial Engineering and Management** by O.P. Khanna
2. **Operations Research** by V .K .Kapoor