Swami Ramanand Teerth Marathwada University, Nanded.

FACULTY OF SCIENCE

SYLLABUS

B.Sc. (Food Science)

First, Second & Third Year (CBCS Pattern)

(SEMESTER I - VI)

[Syllabus progressively effective from June 2016-17 onwards]

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc First Year

First Semester Food Science Syllabus

Semester Pattern effective from June 2016

Course No.	Course title	Periods/ Week	Total Period	Internal Evaluation	Marks 25/credit	Credits
	Theory Papers					
CCFS-IA	English & Science communication Skills-I	03	45	10	50	2
CCFS-IIA	Principles of food processing	03	45	10	50	2
CCFS-IIIA	Food Production Trends and Programmes	03	45	10	50	2
CCFS-IVA	Biochemistry	03	45	10	50	2
CCFS-VA	Food Chemistry I	03	45	10	50	2
CCFS-VIA	Fundamentals of Microbiology	03	45	10	50	2
CCFS-VIIA	Human Nutrition	03	45	10	50	2
CCFSP-1A	Practicals based on CCFS-II & IV A	03+03	20	20	100	4
CCFSP-2A	Practicals based on CCFS-V, VI &VII A	03+03	20	20	100	4
					500	22

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc First Year

Second Semester Food Science Syllabus

Semester Pattern effective from June 2016

Course No.	Course Title	Periods'/ Week	Total Period	Internal Evaluation	Total Marks	Credits
	Theory Papers					
CCFS-IB	English & Science communication Skills-II	03	45	10	50	2
CCFS-IIB	Food Chemistry II	03	45	10	50	2
CCFS-IIIB	Post Harvest Management of fruit and vegetable	03	45	10	50	2
CCFS-IVB	Cereal Processing	03	45	10	50	2
CCFS-VB	Food Microbiology	03	45	10	50	2
CCFS-VIB	Energy generation and Conservation	03	45	10	50	2
CCFS-VIIB	Heat and Mass Transfer	03	45	10	50	2
CCFSP-1B	Practicals based on CCFS-II,III & IVB	03+03	20	20	100	4
CCFSP -2B	Practicals based on CCFS-V,VI & VIIB	03+03	20	20	100	4
					500	22

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc Second Year

Third Semester Food Science Syllabus

Semester Pattern effective from June 2016

Course No.	Course title	Instruction Hrs/Week	Total Period	Internal Evaluation	External Evaluation	Total Marks	Credits
	Theory Papers						
CCFS-IC	English & Science communication Skills-III	03	45	10	40	50	2
CCFS-IIC	Legume & Oilseed Technology	03	45	10	40	50	2
CCFS-IIIC	Meat, Poultry & Fish Technology	03	45	10	40	50	2
CCFS-IVC	Wheat milling & Baking Technology	03	45	10	40	50	2
CCFS-VC	Confectionary Technology	03	45	10	40	50	2
CCFS-VIC	Techniques in Food Analysis	03	45	10	40	50	2
CCFS-VIIC	Food Processing Equipments	03	45	10	40	50	2
CCFSP-1C	Practicals based on CCFS-II,III & IV C	03+03	20	20	80	100	4
CCFSP-2C	Practicals based on CCFS V,VI & VII C	03+03	20	20	80	100	4
SEC-I	**Skill enhanced Course-1	03	45	20	10	50	2
						500	24

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc Second Year

Fourth Semester Food Science Syllabus

Semester Pattern effective from June 2016

Sr. No	Paper No.	Name of the Course	Instruction Hrs/Week	Total Period	Internal Evaluation	Marks of Semester	Total Marks	Credits
1	CCFS-ID	English & Science communication Skills-IV	03	45	10	40	50	2
	CCFS-IID	Fruit & Vegetable Processing	03	45	10	40	50	2
	CCFS-IIID	Fermentation & Industrial Microbiology	03	45	10	40	50	2
	CCFS-IVD	Processing of Milk & Milk Products	03	45	10	40	50	2
	CCFS-VD	Spice & Flavour Technology	03	45	10	40	50	2
	CCFS-VID	Food Additives	03	45	10	40	50	2
	CCFS-VIID	Food Quality	03	45	10	40	50	2
	CCFSP-1D	Practicals based on Section A & CCFS-II, III & IV D	03+03	20	30	80	100	4
	CCFSP-2D	Practicals based on CCFS-V,VI &VII D	03+03	20	30	80	100	4
	SEC-II	**Skill enhanced Course-2	03	45	10	40	50	2
							500	24

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc Third Year

Fifth Semester Food Science Syllabus

Semester Pattern effective from June 2016

Paper No.	Name of the Course	Periods/ Week	Total Period	Internal Evaluation	External Evaluation	Total Marks	Credits
DSEFS-IE	Environmental Studies	03	45	10	40	50	***
DSEFS -IIE	Food Biotechnology	03	45	10	40	50	2
DSEFS -IIIE	Product Development and Formulation	03	45	10	40	50	2
DSEFS -IVE	Food Industrial Byproducts And Industrial Waste Management	03	45	10	40	50	2
DSEFS -VE	Carbonated and Beverage Technology	03	45	10	40	50	2
DSEFS -VIE	Biochemical Engineering	03	45	10	40	50	2
DSEFS -VIIE	Instrumentation and Process Control	03	45	10	40	50	2
DSEFSP-1	Practical's based on DSEPFS II,III & IV E	03+03	20	20	80	100	4
DSEFSP-2	Practical's based on DSEPFS V, VI & VII E	03+03	20	20	80	100	4
DSEFSP-3	Industrial Training (Min. 1 Week)	--	--	--	--	--	2
SEC-III	Skill enhanced Course(III)					50	2
Total						500	24

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure (New Scheme)

Faculty of Science

B.Sc Third Year

Sixth Semester Food Science Syllabus

Semester Pattern effective from June 2016

Paper No.	Name of the Course	Instruction Hrs/Week	Total Period	Internal Evaluation	Marks of Semester	Total Marks	Credits
DSEFS-IF	Speciality Foods	03	45	10	40	50	2
DSEFS -IIF	Extrusion Technology	03	45	10	40	50	2
DSEFS -IIIF	*Food Hygiene and Sanitation	03	45	10	40	50	2
DSEFS -IVF	Food Safety and Microbiological Standards	03	45	10	40	50	2
DSEFS -VF	Quality Assurance and certification	03	45	10	40	50	2
DSEFS -VIF	Food Laws and Regulation	03	45	10	40	50	2
DSEFSP-1	Practicals based on Section A & Section B of CCFS-I, II & III F	03+03	20	20	80	100	4
DSEFSP-2	Practicals based on CCFS-IV, V & VI F	03+03	20	20	80	100	4
DSEFSP-3	Dissertation	04	20	10	40	50	2
Total Marks and credits of TY						500	24
Total Marks and credits of B.Sc. I, II and III year	Total Marks of B.Sc.Food Science Degree (Three years of course with dissertation, CBCS Pattern)					.	44+ 48+ 48= 140.

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure

B.Sc First Year

First Semester Food Science Syllabus

Effective from June 2016

Semester-I. CCFS-IA. COMMUNICATION SKILLS-I. Credit- 2

A) Language and communication Definition of language, characteristics of language,human and animal communication, non-verbal communication, barriers in communications, formal & informal language.

B) (Spoken Communication)

1) Meeting People, Exchanging Greeting and Taking Leave..
2) Introducing Yourself .
3) Introducing People to Others.
4) Giving Personal Information.
5) Talking about People, Animals,and Places.
6) Answering the Telephone and Asking for Someone .
7) Dealing with Wrong Number.
8) Taking and Leaving Massages.
9) Making Inquiries on the Phone.
l0) Calling for help in an Emergency.
11) Getting Peoples Attention and Interrupting.
12) Asking for Directions and Giving Directions.
l3) Thanking someone and Responding to Thanks.

C) Writing Communication.

l)Summarising
2) Note making and Note taking

D) OralCommunication

The art of Publice speaking situational English, (Various formal and informal situations to be understood and practices), group discussion, Debates, Interview technique, seminar and paper reading.

REFERENCE BOOKS:

1) EFF'ECTIVE COMMUNICATION SKILL, OMKAR N. KOUL AND KAMALAK.

Sharma, creative books _ 1995
2) developing communication skills
Srisfina mohan and fleerabanerji birla, institute of technology and science, Pilani, macmillan
3) engilish in sittiations., r.o.neill, oxford
University press.
4) practical english usage, susan, o)gord
5) spoken english, v. Sfianshikuma& p:v.dhamija, tmh, new delhi.
6) remedial english grammar for foreign students, f.t.wood1)
Written communication in english, sarah freeman.
8) communication skills in english, ed.by the dept of
English,osmania, university, Hyderabad

CCFS-IIA PRINCIPLES OF FOOD PROCESSING. Credits-2

1. Food Processing:-a) Introduction, scope.b) Sources of food.c) Perishable & non perishable food. d) Causes of food spoilage
2. Preservation by Salt & Sugar:-a) Principle.b) Methods.c) Equipments used
d) Effect on food quality.
3. Preservation by thermal Processing:-a) Principle.b) Equipments used.
C) Methods- Canning, blanching, sterilization, evaporation, pasteurization
4. Preservation by drying, dehydration and concentration:-a) Principle
b) Equipments and machineries used.c) Methods of drying, dehaydration
d) Methods of concentration- Thermal, freeze, membrane
e) Changes in food quality by drying dehydration & concentration
5. Preservation by radiation, chemicals & preservatives:-a) Principle
b) Methods of radiations) Effect on microorganisms) Physical, chemical & biological effects on quality of food
6. Use of low temperature:-a) Principle) Equipments' used
c) Methods - chilling. freezing, cold storage.d) Effect on food quality

Praticals:-

1) Study of various machineries used in processing.
2) Demonstration of effect of blanching on quality of foods.
3) Study of preservation of foods by heat treatment canning-Canning of fruits and vegetables.
4) Preservation of food by high concentration of sugar i.e., preparation of jam
5) Preservation of food by using slat-pickle.
6) Preservation of food by using chemicals
7) Preservation of bread, cake using mold inhibitors.
8) Drying of Mango/other pulp.

Reference Books:

1) Technology of Food preservation N.W. Dersoir and N.W. Dersoir
2) Introduction to Food Science and Technology. G.P. Stewart and M.A. Amerine

CCFS-IIIA **Food Production Trends and Programs** Credits-2

Unit 1: Food demand and supply- Qualitative and quantitative requirements

Unit 2: Expected technological advances to meet the needs

Unit 3: Future priorities in food production needs status of food industry in India and abroad

Unit 4: Magnitude and interdependence of food production and processing agencies

Unit 5: Food availability production – Types of foods like processed semi processed, ready to eat foods, fast foods, pet foods

Unit 6: Food characteristics and nutritional significance of major food groups

Unit 7: Present trends of consumption and further requirements

Unit 8: Consumers change of aptitude in food products consumption

Unit 9: New food products developed programs aimed for making more food availability to increasing population and their prospects merits and drawbacks, prospects for future growth in India

Unit 10: National and international trends and programs in food handing, processing and marketing

Unit 11: Potentials and prospects of developing food industry in India

Unit 12: Food losses-factors affecting- programs and strategies to eliminate the losses and meet the required demand.

Unit 13: Global demand of food

Unit 14: World food day – importance and action plans

Reference books:

1. Food Science 3rd Edition: N.N. Potter, AVI Publishing Co Lns west post. USA.
2. Caned Foods Thermal Processing and Microbiology: AC Herson & A.D. Null and J.A. Churchill Ltd.
3. Agricultural administration in India. K. Vijayaraghavan
4. Modern techniques field crops of raising : Chidda Singh, Oxford & IBH Pub co.
5. Agriculture Research systems & 21st : K.V. Raman, M.M. Anwer and R.D. Gaddagimeth, Management in the a NAARAM Alumni Association National Academy of Agril, Research management, Rajendranagar Hyderabad.
6. Food processing industries: B.M. Desai, V.K. Gupta, N.V. Namboodri. Oxford & IBH Publishing Company, PVT.Ltd. 66 Janpath, New Delhi.

CCFS – IVA. **BIOCHEMISTRY** Credit-2

1. Biochemistry-a) Introduction.b) Nature and scope
2. Cellular Biochemistry-a) Composition and tunction of cell organelle
b) Cell sttucture - plant and animal.c) Catbohydrates - outence, classification, slructutes,physiochemical and metabolic functions
d) Metabolism of catbonydrates - glycolysics, TCA cycle, HMP pathway, oxidative phosporylation and Gluconeogenesis
3. Proteins-a) Occurance.b) classification and structures
c) physicochemical and metabolic functions
4. Lipids -a) Occurance.b) Cassification and structures.c) Physicochemical and metobolic tunctions.d) Metabolism - degtadation of fats, B-oxidation
5. Nucleic Acids-a) Classification and structure.b) Biosynthesis of Nucleic Acid - RNA and DNA metabolism.
6. Vitamins-a) Classification and sources.b) Chemistrg and metabolic functions
c) Efficiency diseases syndromes
7. Enzymes-a)Chemical nature and nomenclature.b) Classification.c) Solutes and properties.d) Mechanism of action..e) Coenzyme and prosthetic groups

Practicals:-

1) Safety measures in the laboratory.
2) Preparation of various solutions and buffers
3) Qualitative and quantitative estimation of carbohydrates.
4) Qualitative and quantitative estimation of amino acids.
5) Qualitative and quantitative estimation of proteins.
6) Qualitative and quantitative estimation of Lipids.

Reference books:

1) Osner hawk's Practical Physiological Chemistry Hawk
2) Principles of biochemistry Lehninger
3) Principles of Biochemistry Voet
4) Practical Biochemistry Thamiah

CCFS-VA **Food Chemistry I** Credits-2

Unit 1: Nature Scope and development of food chemistry. Role of food chemist

Unit 2: Moisture in Foods

i) Role and type of water in foods, ii) Functional properties of water, role of water in food spoilage iii) Water activity and sorption isotherm iv) Molecular mobility and foods stability

Unit 3: Dispersed systems of foods

(i) Physicochemical aspects of food dispersion system a) Sol b) Gel c) Foam d) Emulations (ii) Rhology of diphase systems

Unit 4: Carbohydrates

(i) Functional characteristics of different carbohydrates (Sugar-water relationship and sweetness) (ii) Maillard reactions, caramelization, methods to control non enzymatic reactions. (iii) Modification of carbohydrates – unmodified and modified starches, Modified celluloses (iv) Dietary fibres – NDF, ADF, cellulose, hemicelluloses, pectin and carbohydrates digestibility – sugars and starch and their values (v) Functional properties of polysaccharides, natural vegetable gums, carbohydrate composition of various natural foods.

Unit 5: Proteins in foods

(i) Physicochemical properties – ionic properties, denaturation, gelation and hydrolysis (ii) Protein content and composition in various foods- cereal grains, legumes and oilseed proteins, protein of meat, milk, egg and fish. (iii) Functional properties of proteins in foods- water and oil binding, foaming and gelation, emulsification (iv) Effects of processing on functional properties of proteins-heat processing on functional properties of proteins-heat processing, alkali treatments, chilling, freezing, dehydration & radiations. (v) Unconventional sources of proteins-SCP, Fish protein concentrates, leaf proteins.

Unit 6: Lipids of Foods

(i) Role and Use of lipid/fat: Occurance, fat group classification (ii) Physicochemical aspects of fatty acids in polymorphisms & its application. (iii) Chemical aspects of lipolysis, autooxidation, antioxidants (iv) Technology of fat and oil processing-a) Refining b) Hydrogenation c) Interesterification d) Safety use of oils and fats in food formulation

Unit 7: Enzymes in food industry

Carbohydrases (amylases, cellulases, pectinases, invertases) Proteases, lipases & oxidases in food processing.

Practicals:

1. Determination of moisture content of foods using different methods

2. Studies of sorption isotherm of different foods

3. Study of swelling and solubility characteristics of starches

4. Study of rheological properties of diphase system

5. Determination of crude protein by microkjeldhal method

Reference books:

1. Food chemistry: Vol I Fennama O.R.

2. Food chemistry : Mayer L.H.

FUNDAMENTALS OF MICROBIOLOGY

CCFS -VI-A. **Credit-2**

1. Microbiology -

a) Evolution & scope of microbiology

b) Need & Importance

c) General morphological, cultural characteristics

d) Reproduction of bacteria, yeasts, moulds, actionomycetes, algae, protooa.

2. Nutrient transport phenomenon & physiology of micro-organisms

3. Genctic recombination, transduction, transformation & bacterial conjugation, mutation & mutagenesis

4. Growth curve: Physical & chemical factors influencing growth & destruction of microorganisms including thermal death time, Z,F, & D values.

5. Viruses : Structure & replication with perticular reference to food borne viruses

6. Control of microorganisms by physical & chemicals, antibiotics & other chemotherapeutic agents

Practicals:

1) Microscopy
2) Micrometry.
3) Cleaning and sterilization of Glassware
4) Preparation of nutrient agar media and techniques of inoculation
5) Staining methods : Monochrome staining, Negative staining, Gram staining, endospore staining.
6) Pure culture techniques (Streak plate / pour plate)
7) Introduction to identification procedures (morphology and cultural characteristics)
8) Study of growth characteristics of bacteria
9) Study of anaerobic culture methods.

Reference books:

1) Biology of Microrganisms T.D. Brock
2) Microbiology Fundamentals and Applications Purohit SS
3) Microbiology

HUMAN NUTRITION

CCFS – VIIA. Credit-2.

1. Concepts & content of nutrition -
a) Nutrition agencies
b) Nutrition of community
c) Nutritional policies & their implementation
d) Metabolic function of nutrients
2. Water & energy balance
a) Water intake & losses
b) Basal metabolism-BMR Body surface area & factors affecting BMR
3. Formulation of diets
a) Classification of balanced diet
b) Preparation of balanced diet for various groups Diets & disorders
4. Recommended dietary allowances For various age groups
a) According physiological status, Athletic & sports man
b) Geriatric persons
5. Malnutrition
a) Type of Malnutrition
b) Multi-factorial causes
c) Epidemiology of under nutrition & over nutrition
d) Nutrition infection & immunity
e) Nutrition education
6. Assessment of nutritional status based on Diet surveys
a) Anthropometry
b) Clinical examination
c) Biochemical assessment
d) Additional medical information
7. In-born errors of metabolism related to Blood constituents
a) Nutrients
b) Hormones & enzymes
c) Miscellaneous disorders
8. Food fad & faddism
9. Potentially toxic substance in human food

Practicals:

1) Role of various national and International Agencies in the field of human nutrition

2) Study of calculation of BMR & body surface area
3) Anthropometric measurements
4) Techniques in animal feeding experiments
5) Biochemical analysis of urine and blood
6) Nutritional survey

Reference books:

1. Community Nutrition Mc. Laren
2. ICMR Publications ICMR
3. Food & Nutrition M. Swaminathan
4. Assessment of Nutritional status of community D.B. Jelliffee

Swami Ramanand Teerth Marathwada University, Nanded

Choice Base Credit System (CBCS) Course Structure

B.Sc First Year

Second Semester Food Science Syllabus

Effective from June 2016

CCFS-IB. COMMUNICATION SKILLS-II. Credit- 2

CCFS – IIB **Food Chemistry II** Credit- 2

Theory

Unit 1: Chemistry of food flavor: Functional characteristics of different flavors, Philosophy and definitions of flavor, Flavourmatics/flavouring compounds, Sensory assessment of flavor, Technology for flavor retention

Unit 2: Food additives and technology

General attributes, Buffer systems/salts/acids, Chelating agent and sequestrates, Antioxidants, Antimicrobial agents, Non nutritive and low calorie sweeteners, Stabilizer & thickeners, Fat replacers, Texturizers & improvers

Unit 3: Pigments in animal and plant kingdoms

Heme pigments, Chlorophyll, Carotenoids, Phenolic & flavonoids, Betalins, Effect of processing on pigment behavior, Technology and retention of natural colours of food stuffs

Unit 4: Food colorants

Regulatory aspects: Natural and synthetic permitted food colors, Properties of certified dyes, Use of regulatory dyes, Color losses during thermal processing

Unit 5: Vitamins and Minerals

Dietary sources and requirements, allowances, enrichment, Restoration, Fortification, Losses of vitamins and minerals

Unit 6: Food toxicology

Inherent toxicants: Antinutritional factors, their occurrences, effects and methods of elimination of inactivation-protease inhibition, lectins, lathyrogens, phytates & flatulence factors.

Terms in toxicology, Safety evaluation using traditional and modern approach, Food contaminants, Pesticide residues-permitted limits, Toxicology & public health

Unit 7: Enzymes in foods

Role of endogenous enzymes in maturation and ripening, Enzymatic browning- mechanism, methods of regulation control.

Practicals:

1. Preparation of mineral solutions by using ash and tri acid methods (Dry and wet oxidations)

2. Estimation of calcium
3. Determination of phosphorus
4. Determination of iron
5. Estimation of magnesium
6. Study of estimation of trypsin inhibitor activity
7. Study of tannins and phytic acid from foods
8. Determination of vitamin A (Total Carotenoids)
9. Determination of ascorbic acid by dye method
10. Determination of niacin end pyridoxine
11. Determination of food colors
12. Assessments of various pectinases from fruits

Reference books:

1. Food chemistry: Vol I Fennama O.R.
2. Food chemistry : Mayer L

CCFS – IIIB **Post harvest management of fruits and vegetables** Credit- 2

Theory

Unit 1: Post harvest technology of fruits and vegetables: an overview concept and science, importance of loss reduction, role in export, economy and employment generation

Unit 2: Morphology, structures and composition of fruit and vegetable – Physical, textural characteristics, structure and composition

Unit 3: Maturity standards: Importance, methods of maturity determinations, maturity indices for selected fruits and vegetables

Unit 4: Harvesting of important fruits and vegetable

Unit 5: Fruits ripening – Chemical changes, regulations, methods

Unit 6: Storage practices: controlled atmospheric, Bead atmosphere, hypobaric storage, cool store, zero energy, cool chamber

Unit 7: Commodity pretreatments – chemicals, wax coating, prepacking

Unit 8: Physiological post harvest diseases, chilling injury and diseases

Unit 9: Handling and packaging of fruits and vegetables: Post harvest handling system of citrus, mango, banana, pomegranate, tomato, papaya and carrot packaging house operations

Unit 10: Principles of transport and commercial transport operations

Practicals:

1. Studies on morphological features of some selected fruits and vegetables
2. Studies on maturity indices
3. Studies of harvesting of fruits and vegetables
4. Determination of RQ
5. Studies on pre-cooling and storage of fruits and vegetables
6. Studies on wax coating on apples, Papaya, citrus, mango, aonla
7. Studies on use of chemical for ripening and enhancing shelf life of fruits and vegetables
8. Studies on regulation of ripening of banana, mango, papaya
9. Studies on various storage systems and structures
10. Studies on prepacking of fruits
11. Studies on physiological disorders- Chilling injury of banana and custard apple
12. Visit to commercial packing house- grape/mango/pomegranate/banana
13. Visit to commercial storage structures onion, garlic, potato

Reference books:

1. B. Pantastico. Post harvest physiology, handling and utilization of tropical and subtropical fruits and vegetables.
2. R.B. Wills. T.L. Lee and E.G. Hall, L.R. Verma and V.K. Joshi.
Post harvests: An introduction to be physiology and handling of fruits and vegetables
Post harvest technology of fruits and vegetables Vol I.
3. D.K. Singh Hi-tech horticulture
4. Eskin. Biochemistry of foods
5. Townsend Duckworth. Fruit and vegetable technology

CCFS – IVB **Cereal Processing** Credit- 2

Theory

Unit 1: Present status and future prospects of cereals (Rice, wheat, /corn, sorghum, Rye)
Morphology of Rice: Physical properties: Density bulk density, Angle of response-hardness, asperity, porosity, stack of milling and moisture of physical properties. Chemical composition-Distribution of nutrients and Aroma of rice. Drying of paddy- General principles and methods of drying, batch type, continuous type driers.

Unit 2: Parboiling of rice: Milling of rice: Conventional milling, modern milling, advantages and disadvantages of milling machineries, By products of rice milling, Aging of rice, Enrichment-need of enrichment methods of enrichment, Enrichment levels of fortification of amino acids, processed foods from rice- breakfast cereals, flakes, puffing, canning and instance rice.

Unit 3: Corn morphology, Physicochemical properties, corn milling fractions and preparations of modified starches. Barley-morphology-physicochemical properties and processing (malting)

Unit 4: Sorghum-morphology Physicochemical properties Milling, Malting, Pearling and industrial utilization

Unit 5: Millets-Oat/Rye- Importance of Millet Composition, Processing of millets for food uses.

Practicals:

1. Study of morphological characteristics of cereals
2. Study of physical properties of cereals
3. Study of chemical properties of cereals
4. Study of determination of colour of cereals
5. Study of parboiling of paddy
6. Study of cooking quality of rice
7. Study of milling of rice
8. Study of conditioning of wheat
9. Study of production of sorghum flakes
10. Production of popcorns
11. Study of preparation of sorghum malt
12. Determination of gelatinization temperature by amylograph
13. Study of extraction of oil from rice bran
14. Visit to cereal processing unit

Reference books:

1. Technology of cereals: Kent
2. Post harvest technology of cereals, pulses and oil seeds: A. Chakrawarthy
3. Modern cereal science and technology: Y. Pomeranz
4. Utilization of rice: Luh
5. Post harvest biotechnology of cereals: D.K. Salunkhe
6. Handbook of cereal science and technology: O.R. Fennema, Markus, Karel

CCFS – VB **Food Microbiology** Credit- 2

Theory

Unit 1: Microbial spoilage of foods

Unit 2: Chemical changes caused by microorganisms

Unit 3: Principles of food preservation

Unit 4: Control of microorganism by use of low and half temperatures

Unit 5: Asepsis, water activity, drying, preservatives, radiations and pressure for control of microorganisms

Unit 6: Microbiology of milk and milk products

Unit 7: Microbiology of fruits and vegetables, Sources of contamination, spoilage and prevention

Unit 8: Microbiology of cereals and cereal products. Sources of contamination, spoilage and prevention

Unit 9: Microbiology of meat and meat products. Sources of contamination, spoilage and prevention

Unit 10: Microbiology of fish and other sea foods. Sources of contamination, spoilage and prevention

Unit 11: Microbiology of poultry and eggs

Unit 12: Microbiology of sugar and sugar products. Sources of contamination, spoilage and prevention

Unit 13: Microbiology of salts and spices products. Sources of contamination, spoilage and prevention

Unit 14: Microbiology of canned foods. Sources of contamination, spoilage and prevention

Practicals:

1. Study of isolation of molds from foods

2. Microbial examination of cereal and cereal products. Identification, isolation and confirmation of *R. nigricans*

3. Study of microbial examination of Vegetables and fruits. Identification, isolation and confirmation of *R. nigricans/ Erwinia carotovora.*

4. Microbial examination of meat and meat products. Identification, isolation and confirmation of coliform bacteria/*P. fluorescens*

5. Microbial examination of fish and other sea foods. Identification, isolation and confirmation of *Proteus*

6. Study of microbial examination of eggs and poultry identification, isolation and confirmation of *Pseudomonas fluorescens*

7. Study of microbial examination of milk and milk products. Identification, isolation and confirmation of *S. thermophilus*

8. Study of microbial examination of sugar, salt and spices. Identification, isolation and confirmation of *L. measenteroides/ L. dextranicum*

9. Study of thermal death time determination

Reference books:

1. Modern food microbiology. James M. Jay
2. Basic food microbiology G.J. Banwart
3. Applied Microbiology-Singh B.D., Nallariu P., Kavikishore P.B. and Singh R.P.
4. Food microbiology and Lab practice-Bell

CCFS – VIB **Energy generation and conservation** Credit- 2

Theory

Unit 1: Units and dimension, Basic concept: System, processes, cycles, energy, The zeroth law of thermodynamics

Unit 2: Ideal gases: Equation of state, Compression and expansion of gases

Unit 3: The first law of thermodynamics, internal energy, enthalpy

Unit 4: Renewable energy sources like solar, wind and biogas and their utilization in food processing

Unit 5: Related equipments and their machinaries for Renewable energy sources

Unit 6: Fuels; Chemical properties, air for combustion, calorific value and its determination, Burners, firing of fuels

Unit 7: Properties of steam: Wet, dry, saturated, superheated steam, use of steam tables

Unit 8: Steam generators: Fire tube boilers, Water tube boilers

Unit 9: Boiler mounting and boiler accessories.

Unit 10: Measurement of height of boiler chimney

Unit 11: Condensers- Principle and types

Unit 12: Layout of pipeline and expansion joints

Unit 13: Boiler trial: Codes, Indian boiler regulation acts, Air stage, Air compressors.

Practicals:

1. Application of thermodynamics in engineering problems
2. Determination of dryness fraction of steam
3. To study the boiler installed in modern plant water softening, plant backcock and steam line layouts and steam traps
4. Visit to sugar Mill or Rice Mill plant with steam utilization
5. Study of solar water heater and biogas plants and appliances

Reference books:

1. Engineering thermodynamics – C.P. Gupta Rajendra Prakash (1991) Nemi Chand and Sons Roorkee
2. Elements of Heat engines- N.C. Pandya. C.S. Shah (1990) Charotar Publishing house Anand
3. Indian boiler regulation codes (1991)
4. Dairy Plant Engg. And management: Tufail Ahmed (196). Kitab mahal New Delhi.
5. Thermal engineering: Mathur and Mehta

CCFS – VIIB **Heat and Mass Transfer** Credit- 2

Theory

Unit 1: Basic heat transfer process, Thermal conductivity, Overall heat transfer co-efficient, Physical properties related to heat transfer

Unit 2: One dimensional steady state conduction: Theory of heat conduction, Fourier's law, Derivation of Fourier's equation in Cartesian coordinates, heat flow through slab, cylinder and sphere with non uniform thermal conductivity

Unit 3: Heat transfer through composite walls and insulated pipelines

Unit 4: Steady state heat conduction with heat dissipation to environment: introduction to extended surfaces of uniform area of cross section. Education of temperature distribution with different boundry conditions. Introduction to unsteady state heat conduction

Unit 5: Convection: Forced and free convection, Use of dimensional analysis for correlating variables affecting convection heat transfer, Concept of Nossolt number, Prandtl number, Reynolds number

Unit 6: Radiation: Emissivity, absorptivity, transmissivity, Radiation through black and grey surfaces, Determination of shape factors

Unit 7: Heat exchangers: General discussion, fouling factors, Jacketed kettles, LMTD, Parallel and plate heat exchangers

Unit 8: Applications of different types of heat exchangers in dairy and food industries

Unit 9: Mass transfer: Fick's Law of Diffusion, steady state diffusion of gases and liquids through solids, isothermal evaporation of water into air, mass transfer coefficient, Applications in dairy and food industry.

Practicals:

1. To study different types of heat exchangers used in dairy and food industries
2. Preparation and calibration of thermocouples
3. Determination of thermal conductivity: Milk, solid dairy food products
4. Determination of overall heat transfer coefficient of : Shell and tube, Plate heat exchangers, Jacketed kettles used in dairy and food industries
5. Studies on heat transfer through extended surfaces
6. Studies on temperature distribution and heat transfer in HTST pasteurizer
7. Design problems on heat exchangers

Reference books:

1. A course in Heat Mass Transfer- S. Domkondwar (1993) Danpat Rai and Sons New Delhi
2. Heat transfer- C.P. Gupta (1964) Prentice Hall of India New Delhi
3. Principles of Heat transfer- F. Kretiths and M.S. Bohn (1986) Harper and Row Publishers, New York.