



SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING
(Deemed to be University)

Syllabus for M.Sc. in Food and Nutritional Sciences
with specialization in (A) **Applied Nutrition** and (B) **Food Technology**

Prasanthi Nilayam – 515 134

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SCHEME OF INSTRUCTION AND EVALUATION

(From 2019-20 Batch onwards)

FIRST YEAR

S. No.	Paper Code	Title of the Paper	Theory/ Practical	Credit	Contact Hours	Mode of Evaluation	Max. Marks
I Semester							
1.	PFNS-101	Concepts in Food Science, Nutrition and Technology	T	4	4	IE2	100
2.	PFNS-102	Bio-macromolecules and Intermediary Metabolism	T	4	4	IE2	100
3.	PFNS-103	Research Methodology and Applied Statistics	T	4	4	IE2	100
4.	PFNS-104	Food Microbiology and Safety	T	4	4	IE2	100
5.	PFNS-105	Practical I: Food Microbiology and Safety	P	1	3	I	50
6.	PFNS-106	Practical II: Food Analysis	P	2	6	I	50
7.	PFNS-107	Practical III: Computer Applications in Research	P	1	3	I	50
8.	PAWR-100	Awareness Course-I: Education for Life	T	1	2	I	50
		Total		21	30		600
II Semester							
9.	PFNS-201	Analytical Techniques	T	4	4	IE2	100
10.	PFNS-202	Chemistry of Food Components	T	4	4	IE2	100
11.	PFNS-203	Nutrition Through Life Cycle	T	4	4	IE2	100
12.	PFNS-204	Food Product Development and Evaluation	T	4	4	IE2	100
13.	PFNS-205	Practical IV: Chemistry of Food Components	P	1	3	I	50
14.	PFNS-206	Practical V: Nutrition through Life Cycle & Food Product Development and Evaluation	P	2	6	I	50
15.	PAWR-200	Awareness Course-II: God, Society, and Man	T	1	2	I	50
		Total		20	27		550

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Second year

S. No.	Paper Code	Title of the Paper	Theory/ Practical	Credit	Contact Hours	Mode of Evaluation	Max. Marks
III Semester							
16.	PFNS-301	Food Quality Control & Assurance	T	4	4	IE2	100
17.	PFNS-302 (A)	Advanced Human Nutrition	T	4	4	IE2	100
	PFNS-302 (B)	Postharvest Technology of Fruits and Vegetables					
18.	PFNS-303 (A)	Therapeutic Nutrition and Dietetics	T	4	4	IE2	100
	PFNS-303 (B)	Advances in Food Processing and Packaging Technologies					
19.	PFNS-304	Elective I	T	3	3	IE2	100
20.	PFNS-305 (A)	Practical VI: Advanced Human Nutrition	P	1	3	I	50
	PFNS-305 (B)	Practical VI: Postharvest Technology of Fruits and Vegetables					
21.	PFNS-306 (A)	Practical VII: Dietetics and Clinical Nutrition	P	1	3	I	50
	PFNS-306 (B)	Practical VII: Advances in Food Processing and Packaging Technologies					
22.	PFNS-307	Practical VIII: Experimental Methods	P	2	6	I	50
23.	PFNS-406	Project Work (review)*	-	Non-credit	6	-	50*
24.	PAWR-300	Awareness Course-III: Guidelines for Morality	T	1	2	I	50

		Total		20	35		650
IV Semester							
S. No.	Paper Code	Title of the Paper	Theory/ Practical	Credit	Contact Hours	Mode of Evaluation	Max. Marks
25.	PFNS-401 (A)	Indian Traditional Foods and Ayurvedic Nutrition	T	3	3	IE2	100
	PFNS-401 (B)	Dairy Technology					
26.	PFNS-402 (A)	Public Nutrition and Epidemiology	T	3	3	IE2	100
	PFNS-402(B)	Food Grain and Oilseed Technology					
27.	PFNS-403	Elective II	T	3	3	IE2	100
28.	PFNS-404 (A)	Practical IX: Public Nutrition and Epidemiology	P	1	3	I	50
	PFNS-404 (B)	Practical IX: Dairy Technology and Food Grain and Oilseed Technology					
29.	PFNS-405	Practical X: Special Research Techniques	P	1	3	I	50
30.	PFNS-406	Project Work**	-	6	18	PW	200**
31.	PFNS-407	Comprehensive <i>Viva voce</i>	-	1	-	COV	50
32.	PAWR-400	Awareness Course–IV: Wisdom for Life	T	1	2	I	50
		Total		19	35		700
		GRAND TOTAL		80	127		2500

Indicator	Legend
IE1	CIE and ESE ; ESE single evaluation
IE2	CIE and ESE ; ESE double evaluation
I	Continuous Internal Evaluation (CIE) only Note: 'I' does not connote 'Internal Examiner'
E	End Semester Examination (ESE) only Note: 'E' does not connote 'External Examiner'
E1	ESE single evaluation
E2	ESE double evaluation

Indicator	Legend
T	Theory
P	Practical
V	Viva voce
PW	Project Work
D	Dissertation

Continuous Internal Evaluation (CIE) & End Semester Examination (ESE)

PS: Please refer to guidelines for 'Modes of Evaluation for various types of papers', and 'Viva voce nomenclature & scope and constitution of the Viva voce Boards'.

COV – Comprehensive viva voce

NOTES:

1. (*) The Project Work topic would be finalized at the end of second semester. The Project Work starts in the third semester and gets completed in the fourth semester. The Project Work done in the third semester is reviewed based on a preliminary report submitted by the student and is evaluated for 50 marks: which is later included as part of the total marks of 250 in the fourth semester.
2. (**) Total marks for the Project Work would be 250 marks, which would include 50 marks for the review of the preliminary report submitted by the student at the end of the 3rd semester + 50 marks for the Project Work viva-voce conducted at the end of the 4th semester + 150 marks for the double evaluation of the Project Report submitted at the end of the fourth semester.
3. Students will take four specialization courses and a minimum of two qualifying electives pertaining to any particular stream to be entitled for a specialization in that stream.
4. A number of electives have been identified as suitable for consideration in two specialization streams. These courses are identified with a special code, E-AN for Applied Nutrition and E-FT for Food Technology. An elective with a code of E-ANFT/E-FTAN as a prefix will be considered as a valid common elective for both the specializations.
5. The choice of electives being offered in each semester is at the discretion of the Head of the Department.

List of Electives offered in PFNS-304 & PFNS-403: (3 credits each)

ELECTIVE A: APPLIED NUTRITION

E- ANFT1: FUNCTIONAL FOODS AND MOLECULAR NUTRITION

E-ANFT2: FOOD FORTIFICATION AND FERMENTATION

E-AN3: NUTRITIONAL COUNSELLING AND SUPPORT SYSTEMS

E-AN4: PEDIATRIC AND GERIATRIC NUTRITION

E-AN5: HEALTH PROMOTION THROUGH NUTRITION COMMUNICATION

E-AN6: SPORTS NUTRITION

E-AN7: ADVANCES IN WOMEN NUTRITION

ELECTIVE B: FOOD TECHNOLOGY

E-FTAN1: FUNCTIONAL FOODS AND MOLECULAR NUTRITION

E-FTAN2: FOOD FORTIFICATION AND FERMENTATION

E-FT3: PHYSICAL PROPERTIES OF FOODS

E-FT4: UNIT OPERATIONS IN FOOD PROCESSING

E-FT5: BAKING TECHNOLOGY

E-FT6: TECHNOLOGY FOR PLANTATION CROPS AND SPICES

E-FT7: ENTREPRENEURSHIP AND MARKETING

Syllabus for M.Sc. in Food and Nutritional Sciences

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Programme Specific Outcomes (PSO)

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

1. PSO 1: Effectively collect, analyse, critically review and organize scientific information related to food science, nutrition, and the underpinning sciences.
2. PSO 2: Demonstrate proficiency to work with equipment's, conduct investigations of complex problems, use research-based knowledge to provide valid conclusions for solving the problems related to nutrition and food technology.
3. PSO 3: Devise low cost locally relevant intervention strategies for ensuring and promoting health and nutrition in the community.
4. PSO 4: Exhibit adequate analytical and development skills in terms of modern technologies and processes related to production of healthy and safe food.
5. PSO 5: Show competence to take up environmentally conscious research for social upliftment, for improving local economy, and to address globally relevant food and nutrition problems.
6. PSO 6: Display competency to make their careers in academics, health care, government, and national and international non-governmental organizations related to public nutrition.
7. PSO 7: Take up jobs in different domains such as food industries, quality control organizations, food research laboratories, government sectors like Food Corporation of India, FSSAI etc. and competent to establish their own startup.
8. PSO 8: Develop innovative food products and establish entrepreneurial activities in food sector and nutrition counselling.
9. PSO 9: Analyze health conditions of individuals and integrate modern science of functional foods, molecular nutrition with ancient science of Ayurveda to provide wholistic therapeutic solutions.

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PFNS-101: CONCEPTS IN FOOD SCIENCE, NUTRITION AND TECHNOLOGY

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand and learn basics of foods, food composition, nutritive value, functions and roles of foods in relation to human consumption.
2. Understand fundamental principles of nutrition.
3. Learn basic principles of food processing and preservation methods.

Course outcomes

The students will be able to:

1. Recognize it as a subject with integrating knowledge from various fields applied to the study of foods; describe the main areas of specialty.
 2. Comprehend the role of food components, with emphasis on nutritive value and composition of various food groups, including meats, dairy, eggs, grains, legumes, fruit, and vegetables.
 3. Explain different types of dietary reference intakes and factors affecting digestion and absorption of nutrients.
 4. Comprehend principles of different food processing and preservation techniques and unit operations in food processing industry.
 5. Apply the technology in developing different processed foods including cereals, legumes, fruit and vegetable, dairy, confectionery and animal-based foods.
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UNIT I Dimensions of food science

Food groups classification; Composition and nutritive value of cereals, 15 h millets and pulses; milk and animal products; vegetables and fruits; oils, fat, nuts and sugar, spices and beverages; Malting and germination of grains – process, characteristics, nutritional benefits and uses; Current trends in food science; Organic foods, genetically modified foods, functional foods.

UNIT II Fundamentals of nutrition

- Brief history of nutrition, nutrient needs - dietary reference intakes 20 h (DRI), RDA and daily values/DV, dietary guidelines and the food guide pyramid, balanced diet, popular diets across the world.
- An overview of digestion and absorption of food - Role of enzymes in digestion, regulators of gastrointestinal activity, hormonal mechanisms,

digestive process, absorptive mechanisms, digestion and absorption of nutrients, factors affecting digestion.

- Macronutrients and Micronutrients: Sources, functions and deficiency conditions.

UNIT III Food preservation and processing

15 h

- Historical developments in food preservation and processing, general principles of food preservation: moisture removal, controlling water activity, sterilization, low temperature treatment and acidity control.
- Introduction to processes for food preservation- Dehydration, freezing, canning, irradiation, fermentation, pasteurization, sugaring, pickling and curing.
- Basic concepts in unit operations - material handling, separating, cleaning, disintegrating, pumping, mixing, heat exchange, evaporation, drying, forming and packaging.

UNIT IV Technology of food products

Processing of breakfast cereal and baked foods (bread, biscuits), legume based products (TVP and instant legume powders), vegetable and fruit based products (instant mashed potato and tomato products), dairy product processing (ice cream), confectionary (crystalline and amorphous – fondant and brittles), processed egg products (instant egg white and egg yolk powders), processed fish and flesh products (fish protein concentrates). 10 h

Reference Textbooks:

1. Murano PS. Understanding Food Science and Technology, Thomson learning Inc., California. 2003.
2. Mahan KL and Escott-Stump S. Krause's Food, Nutrition and Diet Therapy, W.B. Saunders Co, Philadelphia. 2000.
3. Potter N and Hotchkiss JH. Food Science, 5thedn, CBS Publishers and Distributors, New Delhi. 1996.
4. Richardson T and Finley JW. Chemical changes in Food during Processing, CBS Publishers & Distributors, New Delhi. 1997.
5. Winton AL and Winton KB. Milk and Milk Products Agro Botanical Publishers, Bikaner, India. 1998.

Suggested Readings:

1. Parker R. Introduction to Food Science, Thomson learning Inc, California. 2003.
2. Davidson S, Passmore R. Brock JF and Truswell AS. Human Nutrition and Dietetics, English Language Book Society. 1985.
3. Sanders T and Emery P. Molecular Basis of Human Nutrition, Taylor and Francis, London. 2003.

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PFNS-102: BIO-MACROMOLECULES AND INTERMEDIARY METABOLISM

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand the structure and functions of biomolecules.
2. Understand the concept of intermediary metabolism of biomolecules.

Course outcomes

The students will be able to:

1. Explain the enzyme kinetics, including the effects of inhibitors, substrate concentration, and allosteric regulators on enzyme activity.
 2. Describe the structural and functional characteristics of carbohydrates, lipids and proteins.
 3. Understand about the biochemical mechanisms associated with the digestion, assimilation and transportation of macromolecules.
 4. Learn about the basics of molecular biology, genetics and recombinant DNA technology.
 5. Describe the structure of nucleic acids and explain how DNA is replicated, transcribed and translated into proteins.
 6. Gain a comprehensive understanding on bioenergetics.
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UNIT I Biomolecules

An overview of bio-macromolecules: carbohydrates, lipids, amino acids, proteins, and nucleic acids. 2 h

UNIT II Enzymes

General properties, classification, co-enzymes and co-factors, kinetics of enzymes. Enzyme activation, inhibition, regulation, enzyme specificity, mechanism of action, multienzyme systems, isoenzymes, allosteric enzymes, and purification of enzymes. 8 h

UNIT III Chemistry and metabolism of carbohydrates

Classification, structure, functions, biomedical importance of sugar derivatives, digestion, absorption and metabolism of carbohydrates (glycolysis, formation and fate of pyruvate, Krebs's cycle, hexose monophosphate shunt, glycogenesis, glycogenolysis, gluconeogenesis), hormonal regulation of carbohydrate metabolism. 12 h

UNIT IV Chemistry and metabolism of lipids

Classification, structure and functions of lipids, biomedical importance of lipoproteins, digestion, absorption, transportation and metabolism (oxidation and biosynthesis of fatty acids, triglycerides, phospholipids, cholesterol and bile acids). 10 h

UNIT V Chemistry and metabolism of proteins

Classification, structure and functions of amino acids, structure and functions of proteins, digestion, absorption and metabolism of proteins (biosynthesis of proteins, amino-acid metabolism–transamination, deamination, transmethylation, transamidation, decarboxylation and urea cycle), biosynthesis of biologically important compounds from amino acids. 10 h

Unit VI Nucleic acids

Chemistry and metabolism of nucleic acids: definition, components, nucleosides, nucleotides, structure of DNA and RNA, types of RNA, replication, transcription, role of DNA and RNA in protein synthesis. 10 h

Unit VII Bioenergetics

Electron transport chain - Structure of mitochondria, sequence of electron carriers, inhibitors of electron transport chain, redox reaction, sites of ATP production, oxidative phosphorylation (ATP synthesis), chemi-osmotic hypothesis of ATP generation, inhibitors and uncouplers of oxidative phosphorylation. 4 h

Unit VII Genetics

Basics of molecular biology and genetics, molecular basis of mutation, restriction enzymes, recombinant DNA technology, cloning of genes. 4 h

Reference Textbooks:

1. Albert L. Lehninger Biochemistry, 2ndedn, The John Hopkins University School of Medicine. 1990.
2. Satyanarayana U. Biochemistry, Books and Allied (P) Ltd. Kolkatta, India. 2008.
3. Singh R. Introduction to Biotechnology, Vol. 1& 2 Global Vision Publishing House, New Delhi. 2003.
4. West ES, Todd WR, Mason HS and Van Burggen JT. Text Book of Biochemistry, 4thedn, Mac Millan Co, New York. 1968.

Suggested Readings:

1. Harold A. Review of Physiological Chemistry, Mothari Book Department, Bombay. 1999.
2. Zubey G. Biochemistry, WMC Brown Communication Inc, USA. 1993.

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PFNS-103: RESEARCH METHODOLOGY AND APPLIED STATISTICS

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand the fundamental principles and techniques of methodology concerning research.
2. Applied statistical procedures to analyze numerical data and draw inference.

Course outcomes

The students will be able to:

1. Demonstrate a comprehensive understanding of research design considerations (question formulation, sample selection, randomization, study design, and research protocols).
 2. Collect, classifying and tabulate research data and presenting it in graphical and diagrammatic presentation.
 3. Carry out parametric and nonparametric assumptions and tests.
 4. Apply appropriate statistical test for varied research problems.
 5. Exhibit suitable aptitude to write research reports and publications.
 6. Display an insight into practical, socially relevant problems and to develop analytical thinking.
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UNIT I Research

Meaning of research, ethics in research, types of research and their applications. 2 h

UNIT II Methods of collecting data

Conducting enquiries to collect primary data, sources for secondary data, preparation of schedules and questionnaires, rating scales, checklists, interview, method of enquiry, training of interviewers, Observation, pre- testing of data, editing and coding the data. 5 h

UNIT III Classification and Tabulation of data

Meaning, Course Objectives, types of classification, formation of frequency 4 h

distribution. Tabulation of data- Tabulation schemes, general rules, types of tables and preparation of tabular forms, methods of securing accuracy in tabulation.

UNIT IV Representation of the data

Graphical and diagrammatic representations- Significance, types of diagrams and types of graphs. 4 h

UNIT V Sampling Methods

Census and sampling survey, methods of sampling- probability sampling (simple random samples, systematic samples, cluster sample, stratified sampling), and non- probability sampling methods (judgment, quota sample, convenience, snow ball sample), size of sample, sources of bias and methods of reducing bias. 4 h

Unit VI Design of experiments

Meaning, concepts relating to experimental design, Formal experimental design- Completely randomized design, Randomized block design, Latin square design, Factorial design, Informal experimental design. 4 h

Unit VII Research report

Basic components of research report-pre-factory material, introduction and review of related literature, methodology, results, discussion, conclusion, summary, abstract, bibliography and appendices. Formulation of research proposal and report writing. 3h

Unit VIII Measures of central tendency

Mean, median, mode, their relative advantages and disadvantages. 5 h

Unit IX Measure of dispersion

Mean deviation, standard deviation, standard error, quartile deviation, Co-efficient of variation, percentiles and percentile ranks. 6 h

Unit X Correlation

Association of attributes, contingency table, correlation, coefficient of correlation and its interpretation, Rank correlation, Regression equations and Predictions. 8 h

Unit XI Probability

Rules of probability and it application. 3 h

Unit XII Distributions

Normal, binomial, their properties, importance of these distributions in statistical studies. 6 h

Unit XIII Tests of significance

Large and small sample test– ‘t’-test and interpretation, Chi square test and its interpretation, and ‘F’ tests- simple problems, Analysis of variance and interpretation- One –factor analysis of variance, two- factor analysis of variance and applications. 6 h

Reference Textbooks:

1. Gupta SP. Statistical Methods, Sultan Chand & Co. 2017.
2. Mahajan, B.K. Methods in Biostatistics for Medical Students and Research Workers, 7th Edition. Jaypee Brothers Medical Publishers (P) LTD, New Delhi. 2010.
3. Kothari CR. Research Methodology-Methods and Techniques, Wiley Eastern Limited, New Delhi. 1990.
4. Ahuja R. Research Methods, Rawat Publications, New Delhi. 2002.
5. Kamath R and Udipi R. Thesis and Scientific Writing: Process and Content, Agrotech Publishing Academy, New Delhi. 2010.

Suggested Readings:

1. Devadas R. Handbook on Methodology of Research, Sri Ramakrishna Mission Vidyalaya. 1977.
2. McBurney DH. Research Methods, Thomson Asia Pvt. Ltd, Singapore. 2002.
3. Khanzode VV. Research Methodology- Techniques and Trends, APH Publishing Corporation, New Delhi. 2004.

PFNS-104: FOOD MICROBIOLOGY AND SAFETY

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand the interactions between microorganisms and food.
2. Learn the basics of microbiology causes and consequences of food contamination, methods of preservation.
3. Develop skills in identification, testing and control of microorganisms in relation to food safety.

Course outcomes

The student will be able to:

1. Know the importance and principles of food hygiene and sanitation.
 2. Evaluate the microbiological quality of foods by qualitative and quantitative microbiological analyses.
 3. Correlate food spoilage during preparation, processing, and storage to potential spoilage microorganisms.
 4. Know the various physical and chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
 5. Identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods.
 6. Understand the principles that make a food product safe for consumption.
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UNIT I Introduction

Historical development of food microbiology. Morphology, general characteristics and classification of bacteria, fungi, and algae. Viruses: structure and replication with reference to food borne viruses. Primary sources of microorganisms in food. 10 h

UNIT II Microbial growth

Growth of microorganisms- physiological and nutritional need, growth curve and methods of measuring microbial growth. Role of intrinsic and extrinsic parameters that affect microbial growth in foods. 10 h

UNIT III Microbial spoilage of foods

Causes of food spoilage; Microbial contamination of water; 10 h
Spoilage of different group of foods - Milk and milk products; Cereals and cereal products; Fruits, vegetables and their products; Meat and meat products; Fish and fish products; Poultry and eggs; Canned foods.

UNIT IV Food Preservation

Methods and principles of food preservation: 10 h

- Physical: Low temperature; High temperature (pasteurization, canning); Irradiation (UV, microwave, ionization); Drying; High pressure processing
- Chemical preservatives and natural antimicrobial compounds
- Biobased preservation systems: LAB and bacteriocins

UNIT V Food safety and quality control

20 h

- Foodborne hazards
- Microbial hazards: Bacterial food poisoning and infections (*Bacillus*, *E.coli*, *Staphylococcal*, *Campylobacter*, *Salmonella*, *Shigella*, *Listeria*, *Clostridium*, *Vibrio*, *Mycobacterium*); Viral foodborne disorders; Mycotoxins.
- Chemical hazards –Food adulterants, Pesticide residues;
- Physical hazards.
- Food Safety principles: Importance and principles of food hygiene and sanitation; Basic principles of food plant sanitation.
- Introduction to food quality control - Indicators of food safety and quality; Microbiological criteria of foods; Legislation for food safety - HACCP and ISO systems; Food standards (FSSAI, Codex Alimentarius, Other Indian standards).

Reference Textbooks:

1. Talaro K and Talaro A., Foundations in Microbiology 10th Ed, WCB publications, USA. 2018.
2. Jay, James, M. Modern Food Microbiology, 7th Ed, Aspen publishers, Inc., Maryland. 2005.
3. Roday, S. Food Hygiene and sanitation, 2nd Edition. Tata McGraw Hill, New Delhi. 2011.
4. Hogg S., Essential Microbiology 1st Ed, John Wiley & Sons, Ltd. England 2005.

Suggested Readings:

1. Doyle P. Michael, Beuchat R.L. and Montville J.T. Food Microbiology Fundamentals & Frontiers, 4th Ed, ASM Press, Washington D.C. 2013.
2. Banwart, G. Basic Food Microbiology, 2nd Ed, CBS Publisher. 1989.

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PFNS-105 Practical I: FOOD MICROBIOLOGY AND SAFETY

Credits: 1

1. Preparation of common laboratory media and special media for cultivation of bacteria, yeast & molds
 2. Identification of microorganisms – Gram staining of bacteria; Staining of yeast and molds.
 3. Isolation of microorganisms - Pure culture techniques (Streak plate, spread plate, pour plate).
 4. Enumeration techniques – Total plate count, total yeast and mold count.
 5. Bacteriological analysis of water and milk: MPN (Coliform Count) and MBRT.
 6. Assessment of surface sanitation of food preparation units - swab and rinse techniques.
 7. Biochemical tests used in identification of commonly found bacteria in foods: MRVP, IMVIC, H₂S, Catalase, carbohydrate fermentation (Acid/gas).
 8. Tests for food adulterants.
 9. Microbial evaluation of naturally fermented foods: Traditional Indian fermented foods/soy fermented products/lactic acid fermented vegetables.
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PFNS-106: PRACTICAL II: FOOD ANALYSIS

Credits: 2

- Unit I** Determination of **moisture** by hot air/vacuum oven method
- Unit II** **Carbohydrates**
Determination of:
a) Carbohydrate profile: Total sugars, reducing sugars and non-reducing sugars
b) Fibre profile
- Unit III** **Lipids**
Estimation of fat by Soxhlet extraction method
- Unit IV** **Proteins**
a) Identification of amino acids by paper and thin layer chromatography
b) Determination of proteins by Micro Kjeldahl and Biuret methods
c) Any **one** enzyme assay in food samples (PPO, SOD, CAT)

Unit V Minerals

Determination of:

- a) Total ash
- b) Magnesium, potassium and zinc

Unit VI Vitamins

Determination of thiamine/ riboflavin (fluorimetric) and vitamin C (colorimetric)

Unit VII Non-nutrients and phytochemicals

I. Isolation and identification of β carotene by column chromatography

II. Determination of:

- a) Oxalates, phytates and saponins
- b) Total phenolics and flavonoids

Unit VIII Advanced analytical techniques

- a) Trace minerals by atomic absorption spectrometry (demonstration)
- b) Demonstration/ determination of pesticides in foods by ELISA/HPLC
- c) Demonstration/ determination of fatty acids in foods by gas chromatography
- d) Demonstration/ determination of any one phytochemical in foods by HPLC

PFNS-107: PRACTICAL IV: COMPUTER APPLICATIONS IN RESEARCH**Credits: 1**

1. Use of word processing software for creating reports and presentation
 2. Use of internet data base and software tools for literature review and bibliography.
 3. Statistical analysis using MS-Excel and other statistical software for –
 - i) Applications in food quality data analysis
 - ii) Applications in nutritional epidemiology and clinical study data analysis
 - iii) Representation
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PFNS - 201: ANALYTICAL TECHNIQUES

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand the principles and applications of biochemical techniques used in the field of foods and nutrition.

Course outcomes

The student will be able to:

1. Choose appropriate strategies and instrumentation for analysis of different sample types.
 2. Display familiarity with the analytical instruments through an understanding of the working principles and applications.
 3. Demonstrate a comprehensive understanding of the theory and usage of radio isotope techniques and their application in biological sciences and food preservation.
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UNIT I Spectrometric methods

Principles and applications of UV and visible spectrophotometry, flame photometry-Atomic Absorption Spectrophotometry (AAS) and Atomic Emission Spectrophotometry (AES), Spectrofluorimetry and brief mention (principle and applications) of Nuclear Magnetic Resonance (NMR), Electron Spin Resonance (ESR) spectrometry, Mass spectrometry (MS), Fourier Transform Infrared Spectrometry (FTIR) and Electron microscopy. 15 h

UNIT II Chromatographic techniques

Principle and applications of paper, thin layer, adsorption, gel, gas, ion exchange, affinity chromatography, HPLC and HPTLC techniques. 15 h

UNIT III Electrophoretic techniques

Principle and applications of paper, starch gel, agar gel and polyacrylamide gel electrophoresis. Isoelectric focusing, Immuno-electrophoresis, Enzyme linked immunosorbant assay (ELISA), Radio-immuno assay (RIA). 15 h

UNIT IV Centrifugation techniques

Basic principles, preparative centrifugation techniques, analytical ultra-centrifugation techniques, application-determination of molecular weight and purity of macromolecules. 6 h

UNIT V Radioisotope techniques

Radioactive isotopes, units of radioactivity, Geiger and Scintillation counting techniques, Cerenkov counting, autoradiography, applications of radioisotopes in biological sciences and food preservation. Hazards of ionizing radiations. 9 h

Reference Textbooks:

1. Nielsen S. Suzanne. Food Analysis, Springer, U.S.A. 2010.
2. AOAC. Official methods of analysis, Association of Official Chemists, 14thedn, Washington DC. 1985.
3. Plummer TD. An Introduction to Practical Biochemistry, Tata McGraw Hill Publishing Company Ltd. 1999.
4. Winton LA and Winton BK. Techniques of Food Analysis, Allied Scientific Publishers, New Delhi. 1999.

Suggested Readings:

1. Raghuramulu N, Nair KM and Kalyanasundaram S. A Manual of Laboratory Techniques, NIN Press, National Institute of Nutrition, Hyderabad. 2010.
2. Sadasivam S. Biochemical Methods, Wiley Eastern Ltd, New Delhi. 1992.
3. Jayaraman J. Laboratory Manual in Biochemistry, Wiley Eastern Ltd. 1985.

PFNS-202: CHEMISTRY OF FOOD COMPONENTS

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Gain knowledge regarding the physico-chemical properties of the food constituents.
2. Understand the changes which occur during the product processing, storage, and handling of foods and their applications.
3. Be familiar with effects of reactions on the quality and safety of food.

Course outcomes

The students will be able to:

1. Identify chemical structures of major food components and relate them to nutritive and qualitative properties of food systems.
 2. Explain the properties of food components and identify the ways to modulate processing conditions to obtain food products with desired characteristics.
 3. Control the major chemical and enzymatic reactions that influence food quality.
 4. Interpret chemical and biochemical transformations which occur during storage and food processing with respect to food quality and nutrient composition.
 5. Be familiar with effects of reactions on the quality and safety of food.
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UNIT I Water in foods

Review of structure and properties of water. Concept of water activity. 4 h
Prediction of water activity. Water activity and shelf life of foods. Moisture sorption isotherms. Phase transition of foods containing water. WLF reaction

UNIT II Carbohydrates in foods

Overview of classification, structure and occurrence. Monosaccharides, 12 h
disaccharides and sweeteners: Sugars – Types and properties (Solubility, crystallization & factors affecting; Hydrolytic reactions, Hygroscopicity, colligative properties, caramelization, flavor & textural contributions, fermentation, non-enzymatic browning/Maillard reaction); Types and uses of natural and alternative sweeteners.

Polysaccharides: Starch functional properties (Gelatinization, gelation,

retrogradation, dextrinization) & factors affecting; Modified starches: Types -(pregelatinized, thin boiling starch, cross-linked starches, starch ethers and esters; oxidized starches), properties and uses in foods; Non starch polysaccharides: Pectins, plant and seed gums, seaweed extracts, microbial gums – types, properties and uses.

UNIT III Lipids in foods

Review of nomenclature, classification and properties; Sources: Oils from plants, dairy fats, animal fats. Effects of processing on chemical and physical properties: Fat crystallization and application in foods. Changes in lipids exposed to frying conditions, Prevention of rancidity; Quality determination in fats and fatty acids. Shortenings, spreads, reduced calorie fat substitutes and fat replacers. 10 h

UNIT IV Proteins in foods

Review of structure and classification of food proteins; Protein denaturation; Physico -chemical & functional properties; Processing induced physical, chemical and nutritional changes; Texturised proteins; Protein isolates and protein hydrolysates. 8 h

UNIT V Enzymes in foods

Review of nomenclature and classification; Factors influencing enzyme activity; Enzyme inhibitors in foods; Enzyme inactivation and control in foods; Immobilized enzymes and enzymes in food processing (fruit juices, dairy processing, baking, meat & egg processing, starch processing, flavour production); Enzyme in waste management. 8 h

Unit VI Food flavours

Flavour chemistry; Chemistry of taste and aroma compounds; Natural flavours, Process flavours; Artificial flavours&flavour enhancers; Flavour deterioration in foods. 6 h

Unit VII Food pigments and colourants

Natural pigments – Occurrence, chemistry, properties and changes during processing of chlorophyll, carotenoids, anthocyanins, meat pigments. Food colourants – Natural and synthetic. 6 h

Unit VIII Dispersion systems: Colloids in foods

Types, Surface properties of foods- Surface tension, Surface activity and Interfacial tension; Colloidal Systems in Food – Sols, gels, emulsions, and foams. Emulsifying agents- their uses in foods. 6 h

Reference Textbooks:

1. Belitz HD and Grosh W. Food Chemistry, 2ndedn, Springer, New York. 1999.
2. Brady WB. Introductory Food Chemistry, Comstock Publishing Associates, Hong Kong. 2013.
3. Fennema. Food Chemistry, 3rdedn, Marcel Dekker Inc, New York. 1996.
4. Meyer LH. Food Chemistry, Affiliated East West Press Pvt. Ltd. Bombay. 1987.
5. Pomeranz Y. Functional Properties of Food Components, 2ndedn., Academic Press Inc, California. 1991.
6. Richard Owusu-apenten. Introduction to Food Chemistry, CRC Press, Boca Raton, Florida. 2005.

Suggested Readings:

1. Cui SW. Food Carbohydrates, CRC Press, USA. 2005.
2. Margaret McWilliams. Foods- Experimental Perspectives, Prentice Hall, Inc. New Jersey. 2003.
3. Walstra P. Physical Chemistry of Foods, Marcel Dekker, Inc. New York. 2003.
4. Paul PC and Palmer HH. Food and Applications, John Wiley and Sons Inc., New York. 1972.

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PFNS-203: NUTRITION THROUGH LIFE CYCLE

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Gain knowledge on the importance of nutrition during life span
2. To do computation of nutrient allowances during life span.
3. Enlighten on the dietary modifications.

Course outcomes

The students will be able to:

1. Apply the knowledge of the science of nutrition to human health across the life span.
2. Describe the physiological basis for nutritional needs of normal healthy humans as they move through life cycle stages.
3. Explain the importance of maternal nutrition on foetal outcome and can identify the critical periods where the foetus at most risk for nutritional deficiency.
4. Assess and compare diet and nutritional requirements relative to age, developmental and disease status.
5. Evaluate nutrition products for composition, quality, and appropriateness of use (e.g. infant formulas, supplements and specialty foods) and formulate dietary interventions to address nutritional deficiencies.

UNIT-I	General concepts about growth and development through different stages of life.	2 h
UNIT II	Maternal nutrition	
	Nutrition in pregnancy:	22 h
	<ul style="list-style-type: none">• Maternal nutrition and outcome, Importance of pre and periconceptional nutrition during pregnancy; Pre pregnancy weight and fetal outcome. fetal weight gain. Nutritional assessment and guidance in prenatal care• Physiological changes during pregnancy, expansion in blood volume, hormonal profile in pregnancy, organ functions, placental transfer of nutrients and resulting complications in pregnancy. Other nutrition related conditions; pregnancy in obese women, gestational diabetes, preeclampsia, alcohol and caffeine abuse.	

- Maternal nutrient metabolism and recommended intakes in pregnancy. Maternal weight gain in pregnancy. Intrauterine growth retardation. High risk pregnancies and common concerns during pregnancy. Importance of antenatal care.

Nutrition in lactation:

- Nutritional needs for lactation. Breast feeding biology, Psycho - physiological aspects of lactation. Factors affecting lactation capacity. Management of lactation, exclusive breast feeding, Breast support and counseling. Effect of breast feeding on maternal health.

UNIT III Nutrition for infant 10 h

- Infant growth and physiological development. Norms/standards for growth. Growth monitoring and promotion. Failure to thrive. Infant nutritional needs and concerns. Nutrition and brain development. Infant feeding, volume and composition of breast milk, human milk Vs. artificial formula. Development and nutritional quality of infant food: Modern infant formula, complementary and supplementary feeding. Dietary management issues in infant feeding. Food allergies in infancy.
- Preterm and LBW infants: Consequences, implications for feeding and management. Neonatal infant mortality and child mortality, IMR.

UNIT IV Nutrition in childhood 10 h

- Growth and development, physiological development. Nutritional needs and feeding for preschool children. Micronutrient malnutrition among preschool children. Child health, morbidity, mortality and under five mortality rate (U5MR).
- Nutritional requirements and RDA. Feeding school children, behavioral characteristics and feeding problems. Dietary patterns, planning a school lunch, factors to be considered. Implications of childhood obesity and other nutritional concerns. Healthy food choices during childhood.

UNIT V Adolescence 6 h

Growth during adolescence, nutritional requirements, hormonal influences, age of menarche-factors affecting, physiological problems and nutritional issues in adolescence.

UNIT VI Nutrition for adulthood and old age 10 h

- Nutritional requirements for adult man and woman. Nutritional concerns and diet. Nutrition and work efficiency.

- Physiological changes in aging, effects of aging on nutritional health of elderly. RDA, nutritional guidelines. Modification in diet, feeding old people. Nutritional concerns in old age and their management.

Reference Textbooks:

1. Chernoff R. Geriatric Nutrition, The Health professionals Hand book.4th Edition, Jones and Bartlett Learning, Burlington. 2013.
2. Edelstein S and Sharlin J. Life Cycle Nutrition: An Evidence Based Approach, Jones and Barlett publishers, USA. 2009.
3. Ghai OP. Essential Pediatrics, 2ndedn, Interprint, New Delhi. 1990.
4. John EM and David RT. Geriatric Nutrition. CRC Press. Taylor & Francis group. Boca Raton. 2007.
5. Kathleen ML and Escott S. Krause's Food, Nutrition and Diet Therapy,9thedn, W.B. Saunders Company Pennsylvania. 2000.
6. Mahtab S. Bamji, Kamala Krishna Swamy and G N V Brahman. Text book of Human Nutrition. Oxford and IBH Publishing, New Delhi. 2009.

Suggested Readings:

1. Park K. Text Book of Preventive and Social Medicine. 21stedn, Banarsidas Bhanot Publishers, Jabalpur, India. 2011.
2. Shills ME, Olson JA, Moshe S and Ross CA. Modern Nutrition in Health and Disease, 9thedn, Lippincott Williams and Wilkins. 2006.
3. Seth V and Singh K. Diet planning through life cycle: Part 1. Elite publishing house pvt ltd, New Delhi. 2006.
4. Smolin and Grosvenor. Nutrition Science and Applications, 3rdedn, Saunders College Publishing, Philadelphia. 2000.

PFNS-204: FOOD PRODUCT DEVELOPMENT AND EVALUATION

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Identify the processes & stages for new product development from conception to commercialization.
2. Understand the technical and scientific data required for product development.
3. Provide adequate theoretical background and practical understanding about sensory evaluation of food.
4. Enable students to analyze and interpret sensory evaluation data.

Course outcomes

The students will be able to:

1. Identify, categorize, and analyze major trends in product development.
 2. Understand new products from consumer viewpoint, identify and assess “gaps” in the current and future food market.
 3. Develop a new food product from concept to prototype or pilot-scale production with inclusion of a critical analysis of the quality, safety, shelf-life, packaging, labeling and cost of the product.
 4. Understand the role of sensory and objective evaluation in product development, quality control, research in the food and other consumer industries.
 5. Apply the knowledge and skills acquired in sensory and objective evaluation of developed products.
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UNIT I Introduction to food product development

New food products & food product development- Concepts, definitions & characteristics. Factors to consider for food product development (external and internal factors); Reasons for food product development- market concerns, consumer demands, societal changes, technological concerns, corporate influences, governmental influences; Types of new food products- Line extensions, “me toos”, new to world products, innovative/creative products, 10 h

existing products- repositioned, reformulated, new form, new size and new package.

UNIT II Stages in food product development

Idea generation - internal & external sources; Screening - Course Objectives and criterion; Development of product prototype- market research, concept testing approaches, product formulation and specification, product optimization, process development & optimization, product attributes, scale up requirements; Product prototype testing - consumer testing, packaging testing, shelf life testing, product integrity and conformance to standards; Marketing plans - price structure, place & distribution system, promotional program, market positioning, test marketing, results evaluation. 15 h

UNIT III Concepts in sensory evaluation of foods

- Sensory attributes of foods: Chemical senses (olfactory and gustatory); physical, kinesthetic and tactile senses (appearance, color, texture, & overall taste). 10h
- Planning and conducting sensory evaluation: Physical setup for conducting sensory analysis; Panel development for sensory evaluation- selection and training; performance appraisal of panel. Preparation and presentation of samples; Score card development. Role of sensory analysis in product development & quality control.

UNIT IV Sensory evaluation methods

Subjective and objective methods- Definition, advantages and disadvantages. Correlation between sensory and instrumental data. Subjective tests: Analytical tests (sensitivity tests, difference tests, ranking tests), descriptive tests, consumer/ preference tests. 10 h

UNIT V Objective and instrumental evaluation methods

- Objective methods for appearance, size, shape, volume, specific gravity, refractive index, moisture, fat and others. 15h
- Instrumental methods for evaluation of colour, viscosity, texture & aroma.

Reference Textbooks:

1. Awasthi D, Jaggi R and Padmanand V. A Manual for Entrepreneurs: Food Processing Industry. Tata McGraw-Hill Publishing Limited. 2006.
2. Bedekar SJ. Marketing Concepts and Strategies, Oxford University Press. 1991.

3. Fuller GW. New Food Product Development- From concept to marketplace. CRC Press, Taylor & Francis Inc., USA. 2005.
4. Moskowitz HR. New Directions for Product Testing and Sensory Analysis of Foods. Food and Nutrition Press, Connecticut. 1985.
5. Paine FA and Paine HY (eds). A Handbook of Food Packaging, 2nd Edn. Blackie Academic and Professional. 1992.

Suggested Readings:

1. Connie M. Weaver and James R. Daniel. The Food Chemistry Laboratory – A manual for Experimental Foods, Dietetics and Food Scientists, CRC Press, New York. (Practical). 2003.
2. Lyon DH, Francombe MA, Hasdell TA and Lawson K (eds). Guidelines for Sensory Analysis in Food Product Development and Quality Control. Chapman and Hall, London. 1992.
3. Moskowitz, HR, Saguy I, Sam and Straus T. An Integrated Approach to New Food Product Development. CRC Press, Taylor & Francis Inc., USA. 2009.

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PFNS-205 PRACTICAL IV: CHEMISTRY OF FOOD COMPONENTS

Credits: 1

1. Effect of water activity on shelf life of foods.
 2. To determine the saturation points of sugars at different temperatures.
 4. Effect of added ingredients on crystallization of sugars through the preparation of fondant.
 5. Study of microscopic structure of starch from different sources.
 6. Comparison of sources of starch for formation of gel and sol.
 7. Studying the effect of factors that influence the viscosity of products thickened by starch.
 8. Gelling capacity of non- starch polysaccharides (pectin), effect of sugars and acid.
 9. Effect of pH /heat on plant pigments.
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**PFNS 206 PRACTICAL V: NUTRITION THROUGH LIFE CYCLE &
FOOD PRODUCT DEVELOPMENT AND EVALUATION**

Credits: 2

UNIT I Nutrition through life cycle

Menu planning and preparation for the following groups with variation:

- a) Age specific
- b) Activity
- c) Income and
- d) Physiological condition (Pregnancy and lactation)

Development of complimentary and supplementary foods.

UNIT II Food product development and evaluation

1. Sensitivity tests

- a) Recognition tests for four basic tastes
- b) Threshold test

2. Analytical tests

- a) Difference test (paired – comparison; duo–trio and triangle test)
- b) Ranking test (colour, taste)
- c) Descriptive tests (Flavour & texture profile, QDA)

3. Market and Consumer Survey :

- a) Market research for new products
- b) Consumer survey & consumer tests for new product samples

4. Instrumental / objective methods of analysis

- a) Colour (Lovibond Tintometer)
 - b) Viscosity (Bookefield Viscometer, Bostwick's consistometer)
 - c) Texture (Penetrometers)
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PFNS 301: FOOD QUALITY CONTROL AND ASSURANCE

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Know the importance of quality assurance in food industry.
2. Know the various tests and standards for quality assessment and food safety.
3. Know the various tests used to detect food adulterants.
4. Be familiar with the fundamentals that should be considered for successful quality control program.

Course outcomes

The students will be able to:

1. Understand the principles of quality management systems in a food industry.
 2. Use and apply quality management systems to food processing and evaluation.
 3. Identify and understand issues pertaining to food safety and quality control.
 4. Apply HACCP to a food production process.
 5. Perform experiments assessing the effect of processing conditions on quality parameters.
 6. Describe the meaning and importance of national and international food standards.
 7. Apply hygiene and sanitation methods to processing plants and various food processing equipment.
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Unit I Introduction

Definition & organization of quality control function in the food industry. 5h
Concepts of quality and approaches to quality management.

Unit II Laboratory requirement

Layout and requirements of quality control laboratory. Good Laboratory 2h
practices (GLP).

Unit III Food standards

Introduction, horizontal and vertical standards. International: FPO, Codex 8h
Alimentarius, APHA, and FDA. National: FSSAI- Introduction, regulations,
standard review groups (SRGs), harmonization of local standards with global

standards and initiation of food safety knowledge assimilation network.

Unit IV Food quality assurance and evaluation

Food safety: The concept of food safety and its definition. Elements of food safety management. Challenges in management of food safety and outlook. Hazards associated with foods – Milk and dairy products; meat ,egg and poultry; fruits and vegetables; nuts and oil seeds. Control of hazards and management of safety of foods at raw and processed stage. 20h

Quality assurance and total quality management (TQM), Quality policy and quality analysis. Quality management system. ISO 9000 Quality Management System. Hazard Analysis and Critical Control Point System (HACCP): Introduction, the need for HACCP, Principles of the HACCP System and application of HACCP.

Unit V Product quality evaluation

Sampling for product evaluation and line control, Statistical quality and process control, Sample preparation, measurement systems capability, reporting results and reliability of analysis 10h

Unit VI Food plant sanitation & Environmental management

Sanitation: General aspects and importance of sanitation. Sanitizers and cleaning equipment. General programs for plant sanitation including measures to prevent rodent and insect infestation. Concerns about biosecurity and food sanitation. Indian specifications regarding general and specific hygiene conditions required in a food plant. Cleaning in place (CIP). Environmental Management: ISO 14001 Environmental Management Systems. Waste treatment methods. Sewage treatment plants. Solid and liquid wastes. Aerobic and anaerobic reactors. Activated sludge process, BOD, COD of waste-water. National and international standards for treated water. 15h

Reference Textbooks:

1. Bryan FL. Hazard Analysis Critical Control Point Evaluations: A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. 1992.
2. Dev Raj, Rakesh Sharma and Joshi VK. Quality Control for Value Addition in Food Processing, New India Publishing Agency, New Delhi. 2011.
3. Food Safety and Standards Authority of India. Manual of methods of analysis of foods, New Delhi. 2018.
4. Hubbard RM. Statistical Quality Control for the Food Industry, Pelnum Publishers, New York. 2003.
5. Jaiswal P.K. Food Quality and Safety. CBS Publishers and Distributor. New Delhi. 2011.
6. Manoranjan K. Food analysis and quality control. Kalyan Publishers. New Delhi. 2002.

7. Marriott NG. Principles of Food Sanitation Connecticut, Vol I AVI Publishing Company, .Inc. 1985.
8. Mehta R and George J. Food Safety Regulations, Concerns and Trade, MacMillan India Ltd. 2005.

Suggested Readings:

1. Askar A and Treptow H. Quality Assurance in Tropical Fruit Processing, Springer – Verlag, Berlin. 1993.
2. Shirley J and Woodburn M. Food Preservation and Safety, Surabhi Publications, Jaipur. 1999.
3. Vasconcellos J A. Quality Assurance for The Food Industry: A practical approach. CRC Press. 2004.

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PFNS- 302 (A): ADVANCED HUMAN NUTRITION

Credits: 4

Hours: 60

Course objective

To enable the students to:

1. Obtain depth in the study of nutrients and develop competence for undertaking nutritional investigations.

Course outcomes

The students will be able to:

1. Assess the nutritional status and determine nutrition related conditions and diseases.
2. Critique and effectively communicate nutrition information.
3. Describe methods used in assessing the nutritional status.
4. Understand adult human body composition and demonstrate the techniques for the measurement of body compositions.
5. Apply knowledge in the assessment of energy expenditure for various activities.
6. Understand inborn errors of various metabolism.

Unit I Concepts in nutrition and metabolism

2 h

Nutrient balance, turnover, flux, metabolic pools and adaptation to altered nutrient supply.

Unit II Body composition and energy expenditure

6 h

Composition of human adult body, techniques for the measurement of body composition, primary influences on body composition (nutrition, physical activity, hormones, trauma and disease).

Energy balance- Components of energy intake and expenditure; Control of food intake and regulation of energy balance- internal and external factors; Assessment of energy expenditure at rest and work- calorimetry and computation of energy requirements.

Unit III Carbohydrates

8 h

Carbohydrate metabolism and regulation, disorders related to carbohydrate metabolism, Inborn errors of carbohydrate metabolism; Glycemic and non-glycemic carbohydrates, glycemic response of foods - factors affecting glycemic index and measurement.

Dietary fiber and non-starch polysaccharides- classification, digestion, absorption and mechanisms of health effects.

Unit IV Proteins

8 h

Protein and amino acid composition of foods, amino acid metabolism and its regulation; Protein turnover, factors influencing protein turnover- body size, age, metabolic rate, deficiency and imbalance of amino acid, pathological states; Inborn errors of amino acid metabolism; Protein quality evaluation of foods; Computation of protein requirements of individuals.

Unit V Lipids

8 h

Classification of dietary lipids, structural and physiological aspects; dietary lipid uptake, digestion – gastric and intestinal step; Absorption of lipids – role of small intestine; transport and secretion of lipids; Postprandial lipid metabolism, disorders related to lipid metabolism; Essential fatty acids: functions and role in eicosanoid metabolism, deficiency conditions.

Unit VI Body fluid and electrolyte balance

4 h

Water distribution in the body, preformed and metabolic water; maintenance and regulation of fluid and electrolyte balance.

Unit VII Minerals

12 h

Dietary sources, digestion, absorption, bioavailability, transport and storage; functions and mechanisms of action; interaction with other nutrients, requirements, deficiency, toxicity and clinical assessment of minerals such as calcium, phosphorus, magnesium, iron, zinc, copper, cobalt, manganese, molybdenum, selenium, iodine and fluorine. Mineral antagonists in foods.

Unit VIII Vitamins

12 h

Nomenclature, chemistry, dietary sources, digestion, absorption, bioavailability, transport and storage; loss in preparation and handling; functions and mechanisms of action; interaction with other nutrients, requirements, deficiency, toxicity and clinical assessment of vitamins: Fat soluble vitamins - A, D, E, K; water soluble- B and C vitamins. Vitamin antagonists in foods.

Reference Textbooks:

1. Groff JL and Gropper SS. Advanced Nutrition and Human Metabolism, Wadsworth Thompson Learning, USA. 2000.

2. Mc Clements DJ and Decker EA. Designing Functional Foods. Woodhead Publishing, USA. 2009.
3. Shills ME, Olson JA, Shike M and Ross CA (Eds). Modern Nutrition in Health and Disease, Lippincott Williams and Wilkins, London. 1999.
4. Gibney MJ, Macdonald IA and Roche HM. Nutrition and Metabolism, Blackwell Publishing, UK. 2003.

Suggested Readings:

1. Forbes GB. Human Body Composition. Springer-Verlag, New York, U.S.A. 1987.
2. Vergroesen AJ and Crawford M (eds.). The Role of Fat in Human Nutrition, 2ndedn. Academic Press, London. 1989.

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PFNS-302 (B): POSTHARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

Credits: 4

Hours: 60

Course objectives

This course should enable students to:

1. Acquire knowledge in concept and importance of postharvest technology.
2. Facilitate deeper understanding on principles and practices of postharvest management of fruits and vegetables.
3. Understand the importance of technologies used in extending the post-harvest life of fruits and vegetables.

Course outcomes

The students will be able to:

1. Identify the losses occurring in fruits and vegetables and the ways to prevent these losses.
 2. Comprehend the physiology and biochemistry of ripening processes and manage the associated changes encountered during storage.
 3. Gain an overview of cold chain management supply of fruits and vegetables.
 4. Identify the different postharvest technologies and their role in improving the shelf life of fruits and vegetables.
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Unit I Introduction

Production status of fruits and vegetables, classification, structure, cellular components, composition and textural characteristics of fruits and vegetables. 3 h

Unit II Postharvest management of fruits and vegetables

Importance and role. Contribution to economy. Postharvest losses; type and extent of losses, causes, loss assessment, methods of loss reduction, improvements needed for postharvest handling of fruits and vegetables. Indian technological and research scenario in postharvest management of fruits and vegetables 6 h

Unit III Postharvest physiology

Product growth and maturation. Physiology and biochemistry of fruit ripening, vegetable hardening, senescence and abscission. Gas exchange, respiratory patterns, climacteric and non-climacteric fruits. Ethylene biosynthesis and 15 h

mechanism of action of ethylene and its role in fruit ripening. Recommended ripening conditions and associated changes for fruits and vegetables.

Nature and type of stress in relation to harvested products. Forces driving the movement and exchange of gases, movement of solutes and solvents, exchange of water product and environment.

Unit IV Postharvest handling of fruits and vegetables

8 h

Maturity and quality grades: Importance and determination of harvest maturity and quality for fruits and vegetables. Handling of fruits and vegetables.

Effect of postharvest practices and harvesting conditions on postharvest quality and possible loss. Postharvest treatments to hasten and delay ripening, low temperature, high temperature, chemical treatments, irradiation.

Unit operations: packinghouse unit operations-sorting and grading, fruit sizing, cleaning and washing, waxing, film wrapping, trimming, curing, vapour heat treatment and chemical treatment

Unit V Transportation and Storage

8h

Transportation: Factors affecting the produce quality during transport. Product transit temperature management. Transport conditions and control systems for preserving quality during transportation.

Storage: Storage considerations, methods of storage. Cold storage, controlled /modified atmosphere and hypobaric storage. Volatile monitoring in storage. Strategies to improve the quality of stored products

UNIT VI Technology of processing of fruits & vegetables

20 h

Production technology of dehydrated products: Raw material preparation, treatments and processing of fruit and vegetable juice powders, fruit cereal flakes, soup powders and dried vegetables.

Canning of fruits and vegetables: syrups and brines for caning, thermal process requirements and steps in commercial canning.

Fruit juices, Beverages and Concentrates: Classification, methods of preparation, specifications, packaging and preservation of fruit juices, cordials, squashes, syrups, sherbets and RTS and fermented beverages and concentrates.

Jams, Jellies and Marmalades: Technology of production; of gel formation, strength of pectin jellies.

Preserves and crystallized fruits: Processing and specifications.

Tomato Products: Juice, puree, cocktail, paste, ketchup, sauce and soup.

Characteristics and technology of preparation.

Fruit Chutneys, Sauces and Pickles: Raw material preparation, treatments and specifications for thin and thick sauces, fruit chutneys and pickles.

Byproducts of fruits and vegetables processing waste: Citrus peel oil, pectin from pectin rich material and vinegar.

Reference Textbooks:

1. Cruess, W.V. Commercial fruit and vegetable products, Agrobios, Jodhpur. 2004.
2. K P Sudheer and V Indira. Postharvest technology of fruits and vegetables. New India Publishing Agency, New Delhi. 2007.
3. Nanjunda Swamy. A.M. Fruits & Vegetables Technology Process & Product Development. Priyadarshini Prakashana, Bangalore. 2008.
4. Rajarathnam.S and Ramteke.R.S. Advances in Preservation and Processing Technologies of fruits and vegetables. New India Publishing Agency, New Delhi. 2011.
5. Salunkhe DK and Kadam SS. Hand Book of Fruit Science and Technology – Production, storage and processing. Marcel Dekker Inc. New York. 1995.
6. Thompson AK. Postharvest Technology of Fruits and Vegetables. Blackwell Sons. 1995.
7. Verma.LR. and Joshi.V.K. Post-Harvest Technology of Fruits and Vegetables-Vol.1 & II Indus Publishing Company, New Delhi. 2012.

Suggested Readings:

1. Giridharilal, Siddappa. G.S and Tandon G.L. Preservation of fruits and vegetables. ICMR, New Delhi. 1998.
2. Kays, S.J. Postharvest physiology of perishable plant products, AVI Publications, Canada. 1991.
3. Kader A.A. “Postharvest Technology of Horticultural Crops”, 2nded, University California, Oakland, CA, 1992.
4. Nelson PE &Tresslor D.K. Fruit and Vegetable Juice Processing, Technology AVI Publishing company Co., west port, Ct. 1988.
5. Satish Kumar Sharma. Postharvest Management and Processing of Fruits and Vegetables. New India Publishing Agency, New Delhi. 2010.
6. Jagtiani. J. Tropical Fruit Processing, Academic Press – San Diego – CA. 1988.
7. VictorianoValpuesta. Fruit and Vegetable biotechnology CRC Woodhead Publishing Ltd. 2002.

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PFNS-303(A): THERAPEUTIC NUTRITION AND DIETETICS

Credits: 4

Hours: 60

Course objectives

To enable the students to:

1. Understand the role of nutrition for good health.
2. Obtain knowledge on different therapeutic diets and their preparation.
3. Develop capacity and aptitude for taking up dietetics as a profession.

Course outcomes

The students will be able to:

1. Analyse and understand the relationship between healthy eating and prevention and treatment of illness and disease.
 2. Demonstrate knowledge and skills to enable individuals to work in public health and health promotion.
 3. Manage nutrition related disease and/or disease related malnutrition.
 4. Apply the knowledge in primary care in managing dietary needs in long term health conditions.
 5. Exhibit the techniques of writing menus and different types of food services.
 6. Demonstrate knowledge and understanding regarding hospital food service system & food delivery.
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Unit I Introduction to therapeutic nutrition and dietetics

Nutritional assessment in clinical care – goals and methods (SGA). 8 h
Modification of normal diets (normal, soft and fluid diets), types and factors to be considered in planning therapeutic diets, general principles of dietary calculation.

Principle involved in planning menu. Techniques of writing menus, Food service management in hospitals- Types (centralized and decentralized systems of service), management of delivery and service of food in different systems.

Unit II Dietary management of metabolic syndrome and associated disorders

Metabolic syndrome: Concept; Pathophysiology of insulin resistance. 10 h

Obesity- introduction, etiology, clinical assessment, treatment approaches, consequences of obesity and its prevention.

Diabetes mellitus – types, etiology, symptoms and diagnosis, aims of dietary treatments, special dietary consideration for type I and II diabetics, complications of diabetes

Diseases of the heart and blood vessels- etiology, symptoms and diagnosis; atherosclerosis, lipids and other dietary factors and coronary heart diseases (CHD). Diet in CHD, hypertension, congestive heart failure and hyperlipidemia.

Unit III Dietary management of gastrointestinal tract disorders

Structure and function of gastrointestinal tract, dietary treatment for constipation, diarrhea, peptic ulcer, celiac disease, tropical enteropathy, tropical sprue, inflammatory bowel disease, irritable bowel syndrome and diverticular disease. 10 h

Unit IV Nutritional management in liver and kidney diseases

Diseases of the liver - functions of liver, clinical assessment of liver function. Pathogenesis, signs and symptoms of hepatitis, acute liver failure, cirrhosis and encephalopathy. Nutritional management in liver diseases. 10h

Dietary management in gallbladder diseases.

Diseases of the kidney - functions of kidney, clinical assessment of kidney function. Pathogenesis, signs and symptoms of acute and chronic renal failure, nephrotic syndrome and renal calculi. Nutritional management in kidney diseases and during renal replacement therapy.

Unit V Nutritional aspects of disease affecting the skeleton

Bone architecture and physiology- composition of bone, bone metabolism, bone mass development and markers, nutrients related to bone health. Rickets, osteomalacia and osteoporosis - etiology, pathophysiology, risk factors and nutritional care. 8h

Unit VI Nutritional therapy in neoplastic diseases

Cancer- Types, stages and markers. Nutrition in the etiology of cancer. Nutritional effects of cancer and cancer therapy, nutritional care of cancer patient. Complementary and alternative nutrition therapies. 6 h

Unit VII Diet principles in other diseases

Infectious diseases (typhoid, malaria, tuberculosis, HIV), arthritis, gout, hypothyroidism, food allergy, surgery and trauma. 8 h

Reference Textbooks:

1. Davidson S, Passmore R, Breck JFT. Human Nutrition and Dietetics, The English Language Book Society and Churchill Livingstone, 1975.
2. Kathleen ML and Escott S. Krause's Food, Nutrition and Diet Therapy, 9thedn, W.B. Saunders Company Pennsylvania, 2000.

3. Thomas B. Manual of Dietetic Practice. Blackwell Scientific Publications, Oxford, London, 1988.
4. Robinson CH. Normal and Therapeutic Nutrition. Oxford Publishing Co, Bombay, 1972.

Suggested Readings:

1. Erdman JW, Macdonald IA and Zeisel SH. Present Knowledge in Nutrition, 10thedn, International Life Sciences Institute Press, Washington DC, 2012.
2. Shills ME, Olson JA, Moshe S and Ross CA. Modern Nutrition in Health and Disease, 9thedn, Lippincott Williams and Wilkins, 2006.
3. Gibney MJ, Macdonald IA and Roche HM. Nutrition and Metabolism, Blackwell Publishing, UK, 2003.
4. Gibney MJ, Elia M, Ljungqvist O and Dowsett J. Clinical Nutrition, Blackwell Publishing, UK, 2005.
5. Park K. Text Book of Preventive and Social Medicine. 21stedn, Banarsidas Bhanot Publishers, Jabalpur, India, 2011.

PFNS-303(B): ADVANCES IN FOOD PROCESSING AND PACKAGING TECHNOLOGIES

Credits: 4

Hours: 60

Course objectives

To enable students to:

1. Gain knowledge of basic and applied aspects of food processing principles.
2. Gain knowledge about various packaging materials and importance of packaging.
3. Be able to select appropriate packaging material for a variety of food stuffs.

Course outcomes

The students will have/able to:

1. A holistic and comprehensive view of the advances in food processing and packaging which will be instrumental in future for food industries.
2. An in-depth understanding of the principles underlying the food processing techniques and applying them in solving food processing problems and product quality.
3. Apply novel /innovative food technologies to design and improve products and processes.
4. Design/develop/adapt and critically analyze scope and limitations of thermal and non-thermal processing methods in food processing.
5. Choose the appropriate packaging materials and types in relation to the food that is to be packaged as well as to understand any problems that may occur due to inappropriate packaging.

Food Processing Technologies

Unit I Introduction

An overview and purpose of food processing; Principles of food processing - physical and chemical principles. Emerging issues and sustainability in food processing. 2 h

Unit II Food processing by heat

Classification of thermal processes; Principles and methods of thermal processing: 10 h

- a) Sterilization and pasteurization; Heat transfer considerations, thermal inactivation, blanching and thermal pasteurization, In container sterilization, UHT sterilization.

- b) Drying- Drying rate curve, drying systems, drying and food quality.
- c) Evaporation and food concentration systems.
- d) Microwave and dielectric heating.

Unit III Processing by low temperature

Refrigeration – Principles, types and refrigerated storage systems (Ventilated, CA, MA storage and cascade system). 8h

Freezing – Principles- freezing time and rate; methods, changes in foods. Freeze drying and freeze concentration- principles, rate of heat and mass transfer, methods and quality characteristics.

Unit IV Non-thermal and emerging processing technologies

Process principles, applications and effects on food quality in Osmotic dehydration; High pressure processing; Pulsed electric field; Oscillating magnetic field; Pulsed light technology; Ultrasound processing; Ozonation; Hybrid drying technologies; Minimal processing of ready meals; Radio frequency electric fields and Membrane Technologies. 10 h

Packaging Technology

Unit V Introduction

- Packaging- Concepts, terminology, definition, significance & functions, types (Retail packs, Industrial and transport packaging).
- Packaging designs considerations: Product, packaging material, transport, market, consumer and environmental considerations.

5h

Unit VI Packaging materials, forms and testing

- Packaging materials: Composition, properties, advantages & limitations of Glass; Metal (aluminum, tinplate, and composite); Paper and paperboard; Polymer/plastic materials (Polyethylenes, PC, PS, PP & BoPP, PET); Laminates, multilayer composition and metalized poly films; edible and bio-based packaging materials.
- Package forms: Glass and metal containers; Wooden crates & boxes; Corrugated fiber board cartons, (Set up boxes and folding cartons), Bag-in-box system.
- Mechanical and permeability (COBB test, WVTR, gas permeability) tests of packaging materials; Product and package interactions (migration and scalping); Shelf life evaluation of packed foods.

15h

Unit VII Packaging methods and techniques

- Vacuum packaging and MAP
- Aseptic and retort packaging
- Protective packaging (cushioning materials), shrink and stretch packaging
- Novel packaging techniques- antimicrobial, active and intelligent packaging
- Form, fill and sealing machines; Fillers for solids and liquids.

10h

Reference Textbooks:

1. Ahvenainen R (ed.). Novel Food Packaging Techniques, Wood head Publishing Ltd, England. 2003.
2. Da -Wen Sun. Emerging technologies for food processing. Elsevier academic press, California, USA. 2005.
3. Fellows PJ. Food Processing Technology: Principles and Practice. Ellis Horwood Ltd, USA. 1998.
4. Gordon RL. Food Packaging: Principles and Practice, 2ndedn, Taylor & Francis Group, New York. 2006.
5. Paine FA. Handbook of Packaging, Blackie Academic Publishing. 1992.
6. Smith PG. Introduction to food process engineering, Springer India Private Limited, New Delhi. 2005.
7. Stephanie C, Stephanie J, Lamsal B. Food Processing and Principles, 2ndedn, Wiley Blackwell publishers, USA. 2014.

Suggested Readings:

1. Edmund LA. Packaging: Specifications, Purchasing, and Quality Control, 4thedn, Marcell Dekker Inc, New York. 1996.
2. Berwal JS, Grewal RB, Kapoor CM and Gary MK. Practical Methods in Food Analysis, Agrotech Publication Academy, Udaipur, India. 2004.
3. Ramaswamy H and Marcotte M. Food Processing- Principles and Applications, Taylor and Francis group, Florida. 2006.
4. Sarvacos GD and Kostaropoulos AE. Handbook of food processing equipment, Springer India Private Limited, New Delhi. 2006.

PFNS-305(A): PRACTICAL VI: ADVANCED HUMAN NUTRITION

Credits: 1

1. Demonstration of blood glucose monitoring using glucometer.
 2. Body composition analysis: Anthropometric and bioelectrical impedance methods.
 3. Physical activity measurement using standard questionnaire.
 4. Computation of total energy expenditure using factorial method.
 5. Development of low cost protein food supplements and protein quality evaluation by computational method (PDCAAS).
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PFNS-305(B): PRACTICAL VI: POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES

Credits: 1

1. Analyzing maturity indices of commercially important fruits and vegetables.
 2. Effect of pretreatments (pre cooling, wax coating and chemicals) on quality characteristics in stored fruits and vegetables.
 3. Instrumental methods for measurement of colour, respiration and texture in fruits and vegetables.
 4. Quality evaluation of fruit and vegetable products: Determination of TSS, pH, pectin, acidity, fruit content, sugars and salt content. Estimation of sulphur dioxide/benzoic acid, Enzyme activity assays: Catalase and peroxidase
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PFNS-306 (A): PRACTICAL VII: DIETETICS AND CLINICAL NUTRITION

Credits: 1

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- UNIT I**
1. Survey to elicit information regarding locally available ready to eat therapeutic foods in the market
 2. Planning and preparation of routine hospital diets
 3. Planning and calculation of therapeutic diets for various diseases:
 - a) Obesity and underweight
 - b) Heart diseases (CAD, hypertension)
 - c) GI tract diseases (Diarrhea, constipation, peptic ulcer, celiac disease, irritable bowel syndrome).
 - d) Kidney disorders (Acute and chronic renal failure and renal calculi)
 - e) Liver disorders (Hepatitis, cirrhosis and acute liver failure)

(Preparation of diets for any three conditions)

UNIT II 1. Clinical chemistry basics

- a) Collection of blood and separation of serum
- b) Separation of plasma, serum and erythrocytes
- c) Safety guidelines for clinical chemistry analysis

2. Analysis of blood for

- a) Glucose
- b) Glycosylated haemoglobin
- c) Cholesterol
- d) Serum proteins
- e) Serum A/G ratio
- f) Serum Bilirubin
- g) SGOT and SGPT

3. Analysis of urine for

- a) Creatinine
- b) Urea

PFNS-306 (B): PRACTICAL VII: ADVANCES IN FOOD PROCESSING AND PACKAGING TECHNOLOGIES

Credits: 1

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- UNIT I**
1. Dehydration methods: Tray drying, osmotic drying, solar drying, vacuum drying and freeze drying of seasonal fruits or vegetables.
 2. Pasteurization and bottling of beverages
 3. Demonstration of minimal processing operations for fruits and vegetables

- UNIT II**
1. Testing of packing materials
 - a) Mechanical strength: Substance and ream weight, thickness, and tear resistance,
 - b) Permeability properties: Water penetration (COBB test); Grease resistance, Water Vapour Transmission Rate / WVTR test (Cup method).
 2. Selection of packaging material for different foods: Dried products, Lipid-based products, RTE foods, Dairy Products, Snack foods
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PFNS-307: PRACTICAL VIII: EXPERIMENTAL METHODS

Credits: 1

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1. Planning and presentation of project proposal.
 2. Standardization of basic experimental methods to carry on analysis in the respective research projects.
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PFNS-401(A): INDIAN TRADITIONAL FOODS AND AYURVEDIC NUTRITION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Have knowledge of traditional Indian foods and diet, their evolution and significance.
2. Understand the basic tenets of Ayurveda and its dietary principles.
3. Integrate the Ayurvedic diet principles into contemporary dietary practices.

Course outcomes

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

1. Demonstrate an understanding of the diversity and importance of Indian food culture.
 2. Comprehend the basic tenets and significance of ayurveda and its dietary principles.
 3. Apply the knowledge of ayurveda for a healthy diet and for dietetic practice.
 4. Synthesize the knowledge of Ayurvedic and modern nutrition in dietetic practice.
 5. Position themselves uniquely to address various diseases and nutritional disorders with a synergistic food and dietary approach.
-

Unit I Indian traditional foods

History of Indian foods and food ethos; Traditional Indian food dietary patterns; Traditional ethnic cuisines of India; Traditional and modern methods of processing foods - significance to health. 5h

Unit II Fundamental principles of Ayurveda

The five elements; *Tridhatus* & *Tridoshas* – types & functions; Relation between *tridosha* and five elements; *Saptadhatu*; *Prakruti*/ Body constitution - Concept, factors affecting constitution, types; Assessment of constitution; Assessment of *Vikruti* (imbalance of *doshas*). 10 h

Unit III *Aharatathwa* – Ayurvedic principles of food

Qualities of food: *Shariragunas* – anabolic & catabolic (20 attributes); *Rasa*, *Virya*, *Vipaka* & *Prabhava*; *Anupanas of different foods*; Food and the cycles of nature; *Sathvic*, *rajasic* and *tamasic* foods; Ayurvedic classification of dietary substances, Concept of *Agra Dravyas*. 10 h

Unit IV Ayurvedic diet principles

Concept of '*Agni*' (digestive fire) and '*Amma*' (undigested food); Ayurvedic perspective of balanced diet; Foods-good and bad for various constitution; Diets for the various constitutions (*Vata*, *Pitta*, *Kapha* & their combinations); Food for various age groups and women; Ayurvedic diet for weight gain and reduction; Foods for brain and intellect; Ayurvedic kitchen pharmacy– Therapeutic use of spices, herbs and condiments. 15h

Unit V Ayurvedic principles of food consumption

Ashtavidha samskara (eight factors related to food consumption); *Viruddhaahara*; Regulation of food and water intake; Order of food consumption and other ayurvedic dietary rules and etiquettes. 5h

Reference Textbooks:

1. Smith V A. Ayurvedic Nutrition, Motilal Banarsidass, New Delhi. 2011.
2. Ranade S. Ayurvedic Nutrition and Cooking, Chaukhamba Sanskrit Pratishthan, New Delhi. 2007.
3. Achaya K T. Indian Food-A Historical Companion, Oxford University Press, New Delhi. 1998.
4. Raghunatha Suri's Bhojanakutahalam. Edited and Translated by Institute of Ayurveda and Integrative Medicine (I-AIM), FRLHT, Bangalore.

Suggested Readings:

1. Lochan K. Dietary Rules and Prohibitions in Different Diseases (based on Bhaisajya Ratnavali), Chaukhamba Publications, New Delhi, 2016.
2. Gupta L P. Biogenic Secrets of Foods in Ayurveda, Chaukhamba Sanskrit Pratishthan, New Delhi. 2011.
3. Gautam R S. Dietetic Regime in Children, Chaukhamba Sanskrit Bhavan, Varanasi. 2010.
4. Charaka Samhita.
5. Dravyaguna Vigyana.

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PFNS-401 (B): DAIRY TECHNOLOGY

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Understand and learn recent development in milk processing technology.
2. Acquire skills in developing and preparation of milk products and product evaluation.
3. Acquire skills to work in milk Industry and to run milk product industries.

Course outcomes

The students will be able to:

1. Acquire the basic knowledge in milk Technology.
2. Perceive the different properties of milk and milk products.
3. Apprehend the thermal processing of milk.
4. Acquire the knowledge in manufacturing of different dairy products.
5. Gain knowledge regarding hygiene and sanitation practices in the milk and milk products industry.

Unit I Dairy industry

Review of dairy development in India (Amul model, National Dairy Development. Board and Operation Flood program). Dairy industry in India and abroad. Market survey and analysis: milk production & consumption pattern, national and global markets. 4 h

Unit II Milk

Definition of milk. Composition, constituents & processing characteristics. 6h
Factors affecting composition of milk. Physico-chemical properties of milk. Clean milk production & hygienic handling of raw milk. Milk collection/procurement & pricing (2-Axis basis). Judging and grading. Flavor defects in milk; their causes and prevention. Platform test and quality.

Unit III Fluid milk

Milk processing: Pasteurization, sterilization, homogenization. Sterilized, 6h
homogenized, aseptic packaged milk. Full cream, standardized, toned & double toned milk. Reconstituted, rehydrated & recombined milk. Flavoured milk.

Unit IV Indian milk products

Introduction to Indian milk products and profile. Technology for manufacture. 12h
Desiccated milk products (eg. khoa/mawa, gulabjamun, burfi, kalakand, milk

cake, etc). Heat-acid coagulated products (paneer/channa, rassogulla, rasmalai, chamcham, etc). Cultured milk products (dahi, yoghurt, srikhand, chakka, lassi, etc). Fat rich products (ghee, makkhan, malai, chocolate burfi, etc). Milk-based puddings/desserts (kheer, payasam, phirni, gajar-ka-halwa, etc).

Unit V Butter, cheese and ice cream

- Introduction to butter & cheese. Yield of cream. *Butter*: Definition, composition, flow diagram for manufacture of butter, overrun. Yield & fat losses in butter- manufacture. Continuous butter-making; Judging & grading of table butter. 9 h
- Defects in butter, causes & prevention. *Cheese*: Definition, types & composition; Flow diagram of cheese production (cheddar/other cheeses). Curing & storage. Defects, their causes & prevention. Judging and grading. *Ice-cream*: Definition & composition. Flow diagram of production. Defects in ice-cream, causes & prevention. Judging and grading.

Unit VI Dried milks

Introduction. Definition & composition. Types of dried milk. Flow diagram of production. Spray and roller drying. Judging and grading. 4h

Unit VII Application of biotechnology in dairy Industry 4 h

Reference Textbooks:

1. Aneja RP, Mathur, BN, Chandan RC, Banerjee AK. Technology of Indian Dairy Products. Dairy India Yearbook Publications, New Delhi. 2002.
2. Gupta PR. Dairy India, 5th edn, New Delhi. 1997.
3. Fox PF. Advanced Dairy Chemistry. Chapman and Hall, New York. 1992.
4. Robinson RK. Modern dairy Technology, 2nd edn, Chapman and Hall, New York. 1994.

Suggested Readings:

1. Fox PF and Mc Sweeney PH. Advanced Dairy Chemistry, Vol. 2, Lipids Springer, USA. 2006.
2. Robert J, Hurst W and Barry AL. Enzymes in Food Technology, Sheffield Academic Press, CRC Press. 2002.

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PFNS-402 (A): PUBLIC NUTRITION AND EPIDEMIOLOGY

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Gain insight into the national nutritional problems and their implications.
2. Develop skills in organizing and evaluating nutrition projects.

Course outcomes

The students will be able to:

1. Demonstrate knowledge and understanding of the wider determinants of health and ill-health.
2. Demonstrate knowledge and understanding of the roles of people and agencies who undertake work in the promotion of public health.
3. Identify and distinguish public health and prevention strategies from curative strategies for prevalent health problems.
4. Identify and explain how various organizations contribute to carrying out public health's core functions, essential services, and assess the components of the public health infrastructure.
5. Apply principles derived from the basic public health sciences to planning, implementing and evaluating public health interventions.

Unit I **Public Nutrition and Health care system**

Aim, scope, content and ethics in public health nutrition. 4h
Role of public nutrition professionals' in the health care delivery.
Health- definition, dimensions, determinants, and indicators.
Health care system and health care of community.

Unit II **Nutritional Epidemiology**

Definition, aim, Types of study- epidemiological studies, ecological studies, 4h
cross-sectional studies, cohort studies, case- control studies, experimental
studies.
Study design- sampling, study size and power
Measurement of exposure and outcome

Measuring diet- disease (exposure-outcome) association and interpretation.

Unit III Screening for disease

Iceberg phenomenon of disease, Concept of screening, uses, Types- mass screening, High risk/ selective screening, multiphase screening; criteria for screening- based on disease and test to be applied. 3h

Unit IV Assessing food and nutrition security

Definition and assessment schedule, national and household food security. Factors affecting food security system: their implication for nutrition and health. 3h

Unit V Assessment of Nutritional Status

Assessment of nutritional status of individual and populations: Anthropometry, Biomarkers (biochemical & biophysical), clinical measures and Dietary assessment. 5h

Unit VI Public health aspects of under nutrition

Etiology, prevalence, clinical manifestations, preventive measures/ curative strategies for PCM and micronutrient deficiencies of public health importance (Vitamin A, iron, iodine and zinc) 4h

Unit VII Nutrition policy and programs

National nutrition policy: need for nutrition policy, policy strategies and their implementations. 6h
Nutrition programs- National anemia prophylaxis programs, vitamin A prophylaxis programs, national iodine prophylaxis programs, goiter control program, ICDS, SNP, ANP, and other programs.

Unit VIII Approaches and Strategies for improving nutritional status and health

Health-based interventions, Food-based interventions including fortification and genetic improvement of foods, supplementary feeding, Nutrition education for behavior change, environmental sanitation. 5 h

Unit IX Role of National and International organizations to combat malnutrition

National organizations concerned with food and nutrition- ICMR, ICAR, NIN, CSIR and others. 4 h
International organizations concerned with food and nutrition - FAO, WHO, UNICEF, AFPRO, World Bank and others.

Unit X Nutrition Education

Meaning, nature and importance of nutrition education to the community and the lessons to be taught. Training workers in nutrition education programs, integration of nutrition education with education and extension work. Principles of planning, executing and evaluating nutrition education programs, problems of nutrition education, Nutrition education approaches. 4 h

Unit XI Health Economics and Economics of Malnutrition

Productivity and national development. Cost–Benefit, Cost effectiveness and Cost Efficiency. 3 h

Reference Textbooks:

1. Willett W. Nutritional Epidemiology, Oxford University Press. 2013.
2. Park K. Textbook of Preventive and Social Medicine, Banarsidas Bhanut Publishers, Jabalpur. 2011.
3. Gibney MJ, Magarets BM, Kearney JM and Lenore A. Public Health Nutrition, Blackwell Publishing Co, UK. 2004.
4. Frankle RT and Owen AL. Nutrition in the community: The art of delivering services, Mosby. 1993.
5. Owen AL, Splett PL and Owen GM. Nutrition in the Community, WCB McGraw Hill. 1999.
6. Sari Edelstein. Nutrition in Public Health. A Hand book for Developing programs and Services. Jones and Barlett Publishers, Canada. 2006.

Suggested Readings:

1. Bandila R. Food Problems in India, Ashish Publishing House, New Delhi. 1992.
2. Sabarwal B. Public Health and Nutritional Care, Common Wealth Publishers, New Delhi. 1999.
3. Shukla PK. Nutritional Problems of India, Vol. II, Plentice Hall of India Private Ltd, New Delhi. 1982.
4. Journal of Nutrition Education, SNBC Deker Inc.
5. Bulletin of the WHO, WHO, Geneva.
6. Proceedings of the Nutrition Society of India, NIN, Hyderabad.

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PFNS- 402 (B): FOOD GRAIN AND OILSEED TECHNOLOGY

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Acquaint with structure, composition and to learn the skills of processing and technology of cereal grains, legumes and oilseeds.
2. Get firsthand experience by working with cereals, legumes and oilseeds in industries and development of new products.
3. Apply acquired skills in cereal, pulse and oilseed industries.

Course outcomes

The students will be able to:

1. Understand the importance of supply chain of grains and different grading systems.
 2. Define the properties of food grains and influence of properties on bulk storage.
 3. Describe the factors involved in designing of bulk storage structures and identify the problems associated with the bulk storage of grains.
 4. Understand the milling technologies of food grains and the utilization of byproducts.
 5. Understand the significance of oilseed processing for oil extraction and conversion into protein sources.
 6. Understand the purification of oil for consumption and modification of oils and fats.
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Unit I Introduction

Production and supply chain of food grains: wheat, paddy, coarse grains, pulses, oilseeds. Grading systems for various food grains. 2 h

Unit II Wheat

Types, structure of wheat grain: chemical composition, kernel structure and its relation to processing quality (botanical, physical and chemical); Wheat milling: general principles, cleaning, conditioning and milling systems. Flour streams, extraction rates and their composition. Criteria for flour quality, protein quantity and quality, colour, enzymatic activity; Composition and functionality of wheat flour components. 10 h

Unit III Rice

Chemical composition; Grain structure; Distribution of nutrients and effect of 6 h

processing; Physical properties of paddy and rice; Physico-chemical properties of rice and effect on quality characteristics. Rice milling technology, byproducts of rice milling and their utilization; parboiling of paddy; ageing and curing of rice; processed rice products.

Unit IV Coarse grains

Chemistry and technology of maize, sorghum, oats and millets. Dry and wet milling of corn. Starches and their conversion products, production of glucose syrups – dextroses and HFCS modified. Pearling, malting and brewing of millets. 6 h

Unit V Pulses

Chemical and quality aspects; composition and technology of pulses; Milling of pulses: traditional and modern milling methods. Emerging technologies for pulse processing. Pulse based food products: Traditional (Dehydrated, Canned, Sprouted, fermented) Quick cooking, extruded, snacks and value added products. Novel food and industrial uses of pulse flours and byproduct utilization. 6 h

Unit VI Storage

Physicochemical and thermal properties of grains. Grain drying. On farm and commercial storage-Traditional and Modern storage Structures. Design of Storage Structure: Moisture Migration, Characteristic of bulk material, flow through orifices, pressure distribution in bin, grain storage loads. 5 h

Unit VII Oilseeds

Importance, trends in production and consumption of oilseeds; Composition of oilseeds; technology of oilseeds: Extraction of oil from groundnut, sesame, sunflower, soybean, coconut and palm seeds; Processing of oilseeds for direct consumption; Oil expulsion and extraction; Processing of extracted oils: Degumming, refining, hydrogenation, interesterification and winterization; Processing of deoiled cakes into protein concentrates and isolates. 10 h

Reference Textbooks:

1. Berwal JS. Practical Methods in Food Analysis, Agrotech Publishing Academy, Udaipur. 2004.
2. Morris JB. The Chemical Analysis of Food and Food Products, 3rdedn, CBS Publishers & Distributors, New Delhi. 1999.
3. Morris PC and Bryce JH. Cereal Biotechnology, Wood Head Publishing Ltd., England. 2000.
4. Samuel A. The Chemistry and Technology of Cereals as Food and Feed, Chapman and Hall Inc, New York. 1996.
5. Vijayakhader. Text book of Food Science and Technology, ICAR, New Delhi. 2001.

6. Winton LA and Kate WB. Techniques of Food analysis, Allied Scientific Publishers. 1999.

Suggested Readings:

1. Aglneard F. Food Technology Processing and Laboratory Control, Allied Scientific Publishers, Bikaner.1999.
2. Woodroff JG. Peanuts – Production, Processing and Products, Chapman and Hall, London. 1983.
3. Chriestenson CM. Storage of Cereal Grains and Their Products, 3rdedn, American Association of Cereal Chemists, St Paul MN. 1982.

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PFNS-404 (A): PRACTICAL IX: PUBLIC NUTRITION AND EPIDEMIOLOGY

Credits: 1

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- 1 Conducting dietary surveys with special emphasis on environmental factors, socio-economic and cultural factors.
 - 2 Designing and implementation of nutrition and health education program for the community
 - 3 Development of low-cost nutritious recipes suitable for various vulnerable sections of the population
 - 4 Assessment of nutritional status of the community using anthropometry and clinical techniques.
 - 5 Testing of iodized salts using field kits.
 - 6 Visit to local feeding centers
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**PFNS-404 (B): PRACTICAL IX: DAIRY TECHNOLOGY and
FOOD GRAIN AND OILSEED TECHNOLOGY**

Credits: 1

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- UNIT I**
1. Rapid tests for evaluation of milk quality-
Clot on boiling test, alcohol test, alizarin alcohol test, phosphatase, acidity, turbidity
 2. Chemical analysis of milk and determination of its components like fat, SNF, protein and TSS.
 3. Preparation and quality evaluation of milk products: Heat desiccated/ Heat – acid coagulated milk products, Cultured milk products, Fat rich products, Puddings / desserts.
 4. Visit to dairy plant
- UNIT II**
1. Evaluation of physical properties of food grains: Hydration capacity and Hydration index, swelling capacity, water binding capacity, viability of grains, sedimentation value.
 2. Evaluation of chemical properties of cereals, coarse grains and their milled products: Acidity, gluten content, diastatic activity and Polenske value.
 3. Grading of oilseeds-seed index; Comparison of physicochemical properties of oils extracted from different oil seeds - Refractive index, specific gravity, viscosity, colour and rancidity.
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PFNS -405: PRACTICAL X: SPECIAL RESEARCH TECHNIQUES

Credits: 1

Exposure to and acquisition of skills in advanced techniques in the chosen field of research.

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ELECTIVE A: APPLIED NUTRITION

E-ANFT1: FUNCTIONAL FOODS AND MOLECULAR NUTRITION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Develop an understanding of functional foods and nutraceuticals and their potential health benefits.
2. Highlight the importance of safety and efficacy of functional food ingredients and be familiar with the applications of functional foods.
3. Understand the core concepts in molecular nutrition.

Course outcomes

The student after taking the course will be able to:

1. Use scientifically verifiable procedures in applications of nutraceuticals in prevention of chronic lifestyle related diseases.
 2. Demonstrate an understanding of various aspects involved in designing functional foods.
 3. Comprehend the assessment and legal requirements for functional foods and nutraceuticals.
 4. Demonstrate the ability to use the knowledge of how common food ingredients affect health by altering the expression of genes and the structure of an individual's genome.
 5. Draw up and present a work with an evidence-based approach to answer a question in functional and molecular nutrition.
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Unit I Introduction

Definition and classification of functional foods and nutraceuticals; Assessment of safety and efficacy of functional foods and ingredients; Legal requirements and stability testing. 15h

Principles of designing functional foods – bioaccessability and bioavailability of nutrients and nutraceuticals, role of physiology, food matrix and meal factors.

Oxidative stress and free radicals – concept, causes and mechanisms of free radical formation, general biological effects of free radicals, biological defense

systems; classification of food antioxidants.

Pathophysiology of cancer, cardiovascular diseases, diabetes, and inflammatory conditions.

Unit II Nutraceuticals and functional foods for health and disease prevention

Nutraceuticals: Sources, types and bioavailability of probiotics, prebiotics, bioactive peptides, bioactive lipids, phytochemicals, bioactive vitamins and minerals. 20 h

Functional foods for immune, intestinal, bone and brain health.

Functional foods for cancer, diabetes, cardiovascular disorders, osteo-arthritis, rheumatoid arthritis, osteoporosis, other inflammatory conditions, and obesity.

Unit III Concepts in molecular nutrition

- Nutrigenomics – Definition; Basic principles of nutrigenomics. 10 h
- Nutrient-gene interactions - Regulation of gene transcription, transcription factors, post-transcription, translation & post-translational protein modification by macronutrients, micronutrients and bioactive compounds.
- Effects of genetics on physiological response to nutrients; Common polymorphisms & disease susceptibility.

Reference Textbooks:

1. Smith J and Charter E (eds) Functional Food Product Development. Wiley- Blackwell Publication, UK. 2010.
2. Mc Clements DJ and Decker EA, Designing Functional Foods, Woodhead Publishing, USA. 2009.
3. Wildman REC Handbook of Nutraceuticals and Functional Foods, 2ndedn, CRC Press, USA. 2007.
4. Gibney MJ, Macdonald IA and Roche HM Nutrition and Metabolism. Blackwell Publishing, UK. 2003.

Suggested Readings:

1. Pathak Y (eds). Handbook of Nutraceuticals: Ingredients, Formulations and Applications, Vol. 1. CRC Press, USA. 2010.
2. Schmidl MK and Labuza TP. Essentials of Functional Foods. An Aspen Publication, Maryland, USA. 2000.
3. Gibson R G and Williams M C (eds). Functional Foods Concept to Product. Woodhead Publishing Ltd., England and CRC Press, USA., 2000.

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E-ANFT2: FOOD FORTIFICATION AND FERMENTATION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Understand the principles, importance, and methods of food fortification.
2. Learn various aspects of food fermentation and fermented products.

Course outcomes

The students will be able to:

1. Acquire knowledge on different techniques used for fortifying foods.
2. Generate cost-effective and safe fortified foods for target populations.
3. Understand the working of a fermentation system.
4. Describe key industrial bioprocesses, from the traditional to the recently evolved.
5. Integrate biological and engineering principles involved in the production and recovery of commercial products.
6. Develop critical thinking skills and learn to employ a quantitative, scientific approach towards conversion of biological materials to value added products.

UNIT I Introduction to food fortification

Food fortification: Definition, Course Objectives, types, Legal considerations: Mandatory vs. Voluntary fortification, importance and health benefits; Food vehicles and Fortificants: Selection of food vehicles, criteria for selection of food fortificants: Bioavailability, Stability and interaction of fortificants in the foods, Level of fortification: Safety limits, technological limits and cost limits; Determining cost effectiveness and cost benefit of fortification; Biofortification of foods. 4 h

UNIT II Food fortificants

Vitamins (A, B, C and D) and minerals (iron, iodine, zinc and calcium) – Sources, Physical characteristics and choice of fortificant methods to increase absorption of fortificants/prevention of loss, Fortification premixes - design and composition of premixes. 10 h

UNIT III Technology of fortifying food products

8 h

Foods as vehicles for fortification:

i) Rice, Cereal flours, cereal products (bread, pasta, noodles, biscuits and breakfast cereals); ii) Salt and sugar, iii) edible oils, iv) Beverages; v) Candies, Nutri- bars, and Granola bars, vi) Snack food, water and other foods.

Technology of fortification, challenges (safety, technological and cost limits), packaging and shelf life quality of fortified foods.

UNIT IV Food Fermentation

1. Concept, types, importance and advantages 15 h
2. Technology of production of fermented foods: Fermentation principle, microorganisms involved, processing conditions and methods for:
 - i) Fermented cereal and legume based products -Idli, dosa, dhokla, cereal gruels/Ganji, soya sauce, natto, tempe, kinema and yeast leavened cereal products;
 - ii) Alcoholic beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc.), sugar cane (rum) and vinegar;
 - iii) Fermented vegetable products – Sauerkraut, kimchi and others;
 - iv) Fermented milk products – yoghurt, cheese, shikhand, curd and lassi.

UNIT V Fermentation process for production of food ingredients

Organic acids (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Polysaccharides (Dextran, Xanthan), microbial sources of single cell proteins. 8 h

Reference Textbooks:

1. Allen L, Benoist BD, Dary O and Hurrell R. Guidelines on Food Fortification with Micronutrients. WHO and Food and Agricultural Organization, USA. 2006.
2. Crueger W and Crueger A. Biotechnology: A Textbook of Industrial Microbiology, 2nd edn, Panima Publishing Corporation, New Delhi. 2003.
3. Israel G and Williams R. Biotechnology and Food Ingredients, Van Nostrand Reinhold, New York. 1991.
4. Preedy VR, Srirajavenkathan R and Patel VB. Handbook of Food Fortification and Health, Vol. 1 & 2, Springer Publications. 2013.
5. Schmidl MK and Labuza TP. Essentials of Functional Foods, ASPEN Publication, New

Delhi. 2000.

Suggested Readings:

1. Aneja KR. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 3rdedn, New Age International Publishers, New Delhi. 2001.
2. Lotfi M, Mannar MG, Merk RJHM and Heuvel PND. Micronutrient Fortification of Foods -Current Practices, Research and Opportunities, The Micronutrient Initiative and International Agricultural Centre, USA. 1996.
3. Steinkraus KH. Hand Book of Indigenous Fermented Foods, 2ndedn, Marcel Dekker Inc, New York.1996.

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E-AN3: NUTRITION COUNSELLING AND SUPPORT SYSTEMS

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Understand the basic counseling and communication skills for medical nutrition therapy.
2. Learn about various medical nutritional support systems.
3. Be aware of the use and interactions of nutrient and diet supplements with pharmacological interventions.

Course outcomes

The students will be able to:

1. Identify the components of nutrition assessment as described in the Nutrition Care Process.
2. Critically evaluate patient information to complete a nutrition assessment.
3. Apply the knowledge to practice state-of-the-art nutrition care in collaboration with other health-care providers in interdisciplinary settings.
4. Provide nutrition counseling and education to individuals, groups, and communities using a variety of communication channels as per professional practice standards.
5. Demonstrate nutrition counselling and education to individuals, groups, and communities using a variety of communication channels as per professional practice standards.
6. Analyse the impact of drugs on nutritional status.

NUTRITION COUNSELLING

Unit I Basics of communication and counselling skills for dietetics professionals

Nutritional Counselling (NC): Scope, concept and purpose of NC; Importance in medical nutrition therapy; Stages of NC – Nutritional assessment, goal setting, intervention and treatment, evaluation and follow-up. 4h

Communication skills - Verbal and nonverbal communication; Counselor responses during client negotiation - Types (listening, action, sharing and teaching responses); Choosing the appropriate response. Interviewing clients (diet histories) – Conditions facilitating interviews, parts of interview, types of questions – advantages and disadvantages.

Unit II Nutritional counselling techniques

Behavior modification – Classical conditioning, operant conditioning and modeling approaches; Assessment of the client's readiness for change; Techniques for behavior modification – incentives, record keeping and self monitoring, controlling stimuli and environments, changing actual eating habits, changing activity pattern, rewards and re-enforcements; Enhancing social support. 6h

Modifying cognitions – recognizing cognitive distortions; phases of cognitive behavior modification; Self efficacy; Relapse prevention - Motivational strategies.

NUTRITIONAL SUPPORT SYSTEMS

Unit III Enteral Nutrition (EN)

Selection and assessment of patient; Routes of EN - Gastric (Nasogastric and gastrostomy) and Intestinal (Jejunostomy and rectal feeding) routes, requirements and benefits; Enteral vs parenteral nutrition. 15h

Types of enteral access for EN – Types of short-term and long term feeding tubes; Placement techniques and post-insertion care of feeding tubes (Preventing aspiration and microbial contamination).

Enteral formulas – Standard tube feeding formulas, disease specific formulas and modular supplements; Characteristics of enteral formulas – Osmolality, caloric density, renal solute load.

Delivery systems – Gravity feeding methods (Bolus feeding and gravity drip method), Pump controlled methods (Open vs closed enteral pumps), continuous infusion, cyclic and intermittent feeding; Initiating and progressions of tube feeding; Preventing dumping syndrome.

Management of patients receiving EN – Monitoring of signs of feeding intolerance (subjective complaints, physical assessments, measuring gastric residual volume); Managing gastrointestinal disturbances; Achieving nutritional goals; Promoting comfort and well-being during tube-feeding (Oral hygiene and activity).

Unit IV Parenteral Nutrition (PN)

Indications for PN, avoiding inappropriate use of PN, selecting patients for home PN, timing of nutritional intervention. 15h

PN formulas – Guidelines for macronutrient composition, electrolytes, vitamins and trace minerals in PN formulas; storage and handling of formulas.

Administration of PN – Admixture methods, central vs peripheral administration, considerations (infusion rate, essential fatty acid deficiency, fat overload syndrome), Equipment – Infusion pumps and filters; Types of venous access devices/catheters for PN.

Management of PN –beginning PN, observing adverse effects, continuous vs intermittent PN. Monitoring and management of complications (Glycemic control, fluid and electrolyte disturbance, hepatobiliary complications, metabolic bone disease) Terminating therapy; Managing home PN.

Unit V Drug-nutrient interactions

Risk factors; Impact of nutritional status, food and nutrients on drug effect; 5h
Impact of drugs on nutritional status; Identifying and reducing the incidence of drug-nutrient interactions.

Reference Textbooks:

1. Gibney JM, Elia M, Ljungqvist O and Dowsett J. Clinical Nutrition, Blackwell Publishing, IOWA, USA. 2005.
2. Worthington PH. Practical Aspects of Nutritional Support – An Advance Practical Guide, Saunders, Pennsylvania, USA. 2004.
3. Holli BB and Calabrese RJ. Communication and Education Skills for Dietetics Professionals. Lippincott Williams and Wilkins, USA. 1998.

Suggested Readings:

1. Snetselaar LG. Nutrition Counselling Skills for Medical Nutrition Therapy, An Aspen Publication, Maryland, USA. 1997.
2. Aronson V. The Dietetic Technician-Effective Nutrition Counselling, The AVI Publishing Company, USA. 1986.

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E-AN4: PEDIATRIC AND GERIATRIC NUTRITION

Credits: 3

Hours: 45

Course objectives

The course is designed to:

1. Get acquainted with growth and developmental changes from conception till childhood.
2. Understand the inter-relationship between nutrition and growth and development during infancy and childhood.
3. Familiarize the students with the multifaceted aspects of ageing.
4. Make the students competent for nutritional and health care of the elderly.

Course outcomes

The students will be able to:

1. Understand the role of nutrition in growth and development of infants and childhood.
 2. Assess and evaluate the nutritional status of infants and children using different techniques.
 3. Gain a deeper understanding of the etiology, pathophysiology and clinical features of pediatric diseases and conditions that require dietary modification.
 4. Understand the theories of ageing and the nutritional impact of physiological changes occurring in older adults.
 5. Gain a comprehensive knowledge on the special problems of elderly and nutritional guidelines to overcome the problems.
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Unit I Nutrition and development during infancy and childhood

Growth and development during infancy and childhood, Nutrient needs for infants and children. Assessment of nutritional status of infants and children. Feeding the infant, preschool child, school-aged child and preventing chronic diseases. 4 h

Unit II Nutritional support of preterm infants, LBW infants

Physiology and care of the preterm infants- introduction, growth, nutritional requirements and feeding of preterm infants. Nutritional support of LBW children and children with developmental disabilities. 6 h

Unit III Nutritional concerns

Childhood obesity, underweight and under nutrition- short-term and long term 4 h

consequences in brief, failure to thrive, growth faltering and detection, mineral and vitamin deficiencies, dental caries, allergies, attention-deficit hyperactivity disorder.

Unit IV Inborn errors of metabolism

Disorders of amino acid metabolism (PKU, maple syrup urine disease, homocystinemia), disorders of CHO metabolism (galactosemia, glycogen storage disorders), other disorders e.g. Wilson's disease, nutritional care management of these conditions. 6 h

Unit V Nutritional management of diseases during childhood

Gastrointestinal diseases: diarrhoea, inflammatory bowel disease, constipation and fat absorption test diet (calculation of fluids and electrolytes- both deficit and maintenance and management of caloric intake). 10 h

Neurological diseases in children: epilepsy (ketogenic diets)

Pulmonary diseases: pulmonary disease in children, cystic fibrosis

Renal diseases: nephritic syndrome, chronic renal failure and different types of dialysis (calculation of fluids and electrolytes- deficit, maintenance and management of caloric intake).

UNIT VI Geriatric nutrition -Ageing

Theories of ageing, physiological, biochemical and body composition changes, socio-psychological aspects of ageing, special problems of elderly. 3 h

UNITVII Nutritional and health status of elderly

Requirements and metabolism, digestion and absorption, Food selection pattern and requirements, dietary management to meet nutritional needs. 4 h

UNITVIII Nutritional and health related problems of elderly

Health status including life style, nutrition related problems of old age- osteoporosis, obesity, neurological dysfunction, anaemia, malnutrition, constipation - symptoms, management, prevention and control. Degenerative diseases: Etiopathogenesis, prevention and control; Drugs and old age; Nutritional assessment of older adults. 8 h

Reference Textbooks:

1. Baker S.S. Baker R.D and Davis A.M. Pediatric nutrition support, Jones and Barlett Publishers, Sudbury, Massachusetts. 2007.
2. Chernoff R. Geriatric Nutrition, The Health professionals Hand book.4th Edition, Jones and Bartlett Learning, Burlington. 2013.
3. Ghai, O P. Essential Pediatrics, Interprint, New Delhi. 1990.

4. Thaman O P. Text book of Pediatrics. Tata McGraw Hill Publishing Ltd, New Delhi.1984.
5. John E M and David R T. Geriatric Nutriiton. CRC Press. Taylor & Francis group. Boca Raton. 2007.

Suggested Readings:

1. Edelstein S and Sharlin J. Life Cycle Nutrition: An Evidence Based Approach, Jones and Barlett publishers, USA. 2009.
2. Sachdev and Choudhury. Nutrition in Children – Developing Countries Concerns. 1995.
3. Seth V and Singh K. Diet planning through life cycle: Part 1. Elite Publishing House Pvt Ltd, New Delhi. 2006.
4. Park K. Text Book of Preventive and Social Medicine. 21stedn, Banarsidas Bhanot Publishers, Jabalpur, India. 2011.

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E-AN5: HEALTH PROMOTION THROUGH NUTRITION COMMUNICATION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. With the national and international health and nutrition guidelines.
2. Develop understanding regarding the vital aspects of nutrition communication.
3. Familiarize students with the methods and tools of nutrition education and communication.
4. Develop skills to plan and use nutrition communication in health programmes.

Course outcomes

The students will be able to:

1. Develop the knowledge and the skills to effectively educate communities to initiate and maintain behavioral changes that support health and wellness and be able to articulate integrative health modalities & wellness practices from a scientific perspective.
 2. Assess population needs relevant to community health education program.
 3. Design and plan community health education programs.
 4. Implement community health education programs.
 5. Evaluate community health educational programs and participate in research related to community health education.
 6. Apply the knowledge and the skills to administer and manage community health education programs.
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Unit I Nutrition and health related concerns

National/ international nutrition and health guide lines and their role in health promotion; Critical appraisal of the current guidelines. 2h

Unit II Concept of communication

Concept of communication and mass communication, scope of communication, elements of communication, models of communication, communication process, the essentials for effective communication, barriers to communication, role of nutrition communication in disease prevention and health promotion. 8h

Unit III Communication for behavioral change in nutrition and health

Understanding behavior and behavior change, ecological perspective to behavior change, theories and models for influencing eating behavior, social marketing, effectiveness of behavior change in nutrition intervention. 4h

Unit IV Methods and tools of communication

- a) Methods- Individual communication, group communication, mass communication, Planning and preparation of communication methods. 16h
- b) Projected tools of communication- Transparencies for OHP, soft copy presentation (CD and pen drive) for computer aided projectors, other e-learning material, script for radio and TV, preparation and presentation of projected tools.
- c) Non- projected tools of communication: Model- working, non-working; printed material- leaf lets, folders, posters, charts, flash cards, newsletters, circular letters, bulletin- Preparation of non-projected tools.

Unit V Planning effective nutrition communication programs for health promotion

Broad-based strategy for specific Course Objectives, identification of key messages for re-enforcement, preparation of material, refining of messages, social mobilization, social marketing. 6h

Unit VI Implémentation

Use of communication material, training, support, supervision and monitoring of nutrition communication, ethics in nutrition communication 5h

Unit VII Impact évaluation of nutrition communication

Evaluation- types of évaluation, designing and executing process and out come évaluation 4h

Reference Textbooks:

1. ASPEN Reference group. Community Health Education and Promotion: A Guide to Program design and Evaluation, Gaithersburg, MA. 1997.
2. Owen AL, Splett PL and Owen GM. Nutrition in the community, WCB McGraw-Hill. 1999.
3. Singh R. Extension education. Sathya Kala Prakashan, Ludhiana. 1994.
4. Gibney MJ, Magarets BM, Kearney JM and Lenore A. Public Health Nutrition, Blackwell Publishing Co, U.K. 2004.

Suggested Readings:

1. Tones K and Tilford S. Health Education Effectiveness, Efficiency and Equity, Singular Publishing Group Inc, San Diego. 1994.
2. Contento IR. Nutrition Education: Linking Research and Practice, Jones and Bartlett Publishers, Sudbury, Massachusetts. 2007.
3. Reddy A. Extension Education, Sree Lakshmi Press, Bapatla. 1987.
4. Ray R. Communication Today. Himalaya Publishing House, Mumbai. 1997.

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E-AN6: SPORTS NUTRITION

Credits: 3

Hours : 45

Course objectives

The course will prepare the students to:

1. Understand the components of health and fitness and the role of nutrition
2. Make nutritional, dietary and physical activity recommendations to achieve fitness and well-being.
3. Develop ability to evaluate fitness and well-being.

Course outcomes

The students will be able to:

1. Apply the art and science of sports nutrition.
2. Understand the philosophy of wellness as a lifestyle strategy.
3. Utilize exercise for weight & body composition management.
4. Describe the role of nutrition for health and sports performance.
5. Identify key dietary sources of macro and micro-nutrients for a sports person and compare to dietary standards of a reference man and woman.
6. Understand the role and evaluate the role of sports supplements use amongst individual athletes.
7. Provide individual advice and guidance in the area of sports nutrition.

Unit I Introduction: Performance and endurance nutrition

Evolution of sports nutrition; Special nutrition for performance and physical fitness. 2 h

Unit II Energy system for endurance and activity

Fuels and nutrients to support physical activity; Shift in carbohydrate and fat metabolism during exercise. 4 h

Unit III Nutritional requirements of athletes 20 h

- Sports specific requirements – short term, intermediate term and long term
- Pre-event, during the event and post-event meal requirements.
- Carbohydrate requirements; Carbohydrate loading and performance.

- Fat requirements; Role of saturated and unsaturated fat on the athletic performance.
- Protein requirements, specific amino acid needs and role of protein quality.
- Vitamin and minerals requirements, sources and functions of water soluble vitamins, vitamin C and β - carotene and role of major (including electrolytes) and trace minerals in athletic performance.
- Water requirements; Regime of hydration and dehydration, symptoms and effects of dehydration.

Unit IV Nutrition for special needs

- Weight loss and weight gain challenges for athletes; effective weight management and muscle gain in athletes. 8 h
- Special nutritional considerations based on gender and age.
- Special nutritional needs for injured and vegetarian athletes.

Unit VI Supplements and performance enhancers

Use of protein and antioxidant supplements, Branched Chain Amino Acids (BCAA), caffeine, L- Carnitine, Coenzyme Q10, creatine, creatinine, choline and glutamine. 6 h

Unit VII Functional foods in sports nutrition

Ergogenic aids: Beverages, sports drinks, energy bars, energy gels and other power boosters; Meal replacement products. 5 h

Reference Textbooks:

1. Geetanjali B and Subhadra M. Nutritional Guidelines for Sportspersons Jaypee brothers Medical Publishers, 1st Edn, New Delhi. 2018.
2. Bean A. The Complete Guide to Sports Nutrition, A&C Black, London. 2001.
3. Dawn Weatherwax RD and Weiss S. Sports Nutrition, Alpha books, United States of America. 2012.
4. Ira Wolinsky (Ed.). Nutrition in exercise and sports, 3rd Edn, CRC press. 1998.

Suggested Readings:

1. Dawn WRD and Weiss S. Sports Nutrition, Alpha books, United States of America. 2012.
2. Wolinsky I (Ed.). Nutrition in Exercise and Sports, 3rd edn, CRC Press. 1998.
3. McArdle W, Katch F and Katch V. Exercise Physiology: Energy, Nutrition and Human Performance, 4th edn, Williams and Wilkins, Philadelphia. 1996.
- 4.Sizer F and Whitney E. Nutrition- Concepts and Controversies, 8th Edn. Wadsworth Thomson Learning. 2000.

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E-AN7: Advances in Women Nutrition

Credits: 3

Hours : 45

Course objectives

To enable the students to:

1. Address the health issues affecting women of all ages.
2. Understand the nutritional needs of women during the lifecycle.
3. Understand the relation between maternal nutrition, fetal programming and adult onset of diseases.
4. Explore the relationship between nutrition and health and onset of nutrition related diseases in women of all age groups.

Course outcomes

The students will be able to:

1. Identify and map the causes of malnutrition in women and their consequences on health.
2. Gain knowledge on the nutritional concerns of women at different age periods.
3. Describe the nutritional needs of women at different stages of life span.
4. Focus on role of nutrition in disease risk reduction and management of the diseases in women.
5. Identify areas for future research in prevention and treatment of diseases in women.

Unit I Nutrition and health in women

5 h

- An overview of the health of the women.
- Problems associated with poor nutrition.
- The mutability of women's health with age- Age, health and weathering.
- Recent approaches in women's health care.
- Healthy women's diet- future considerations and challenges.

Unit II	Nutritional concerns in adolescence	10 h
	<ul style="list-style-type: none"> • Hormonal regulation of growth in adolescence. • Factors influencing changes in linear growth and body composition • Short term and long term consequences of early and late maturation - Influence of nutrition • Menstruation and menstrual disorders: Introduction, normal variation in menstrual cycle across the life span. • Menstrual disorders and risk factors associated with menstrual disorders. Nutritional treatments and remedial measures. 	
Unit III	Nutritional concerns of women in the preconceptional, prenatal and postpartum periods	20 h
	<ul style="list-style-type: none"> • Foetal programming– Introduction, theories of foetal programming, effects of maternal nutrition on foetal programming. Influence of maternal diet and micronutrient status on foetal origin of adult diseases. Role of placenta in foetal programming. • Nutritional programming of the brain- Maternal nutrition and cognition in off spring. • Nutritional recommendations and dietary guidelines for pregnant women. Optimal weight gain, special diets, supplements and specific nutrients during pregnancy-Iron and adverse outcomes. Folate requirements and pregnancy outcomes. • Postpartum period: Nutritional issues during lactation. Postpartum depression and the role of nutritional factors. 	
Unit IV	Nutrition for women in middle and old age	10 h
	<ul style="list-style-type: none"> • Factors influencing the nutritional status of women – lifestyle and health, changes occurring, nutritional concerns and requirements. • Leading threats to women’s health-Heart diseases, stroke, cancer, thyroid disorders, chronic lower respiratory diseases and degenerative disorders. • The peri-menopausal transition and weight management, hormones and health, dietary strategies for a healthy weight. • Nutrition and diet in menopause – Menopause related physiological changes and their possible control through diet. • Risk factors associated with menopause- Osteoporosis and Sarcopenia. Nutrition and bone mineral density in women. Dietary supplements and their role in preventing osteoporosis and sarcopenia in post-menopausal women. • Changes occurring in elderly women and nutritional concerns. 	

Reference Textbooks:

1. Carol West and Merrily Forbes Browley, Nutrition: Principles and Application in Health, Edn. 2nd J.B. Lippincott Company, Philadelphia. 1984.
2. Lilian U Thompson, Wendy E Ward. Optimizing women's health through nutrition. Taylor and Francis group. CRC Press, 2007.
3. Marlene Goldman, Rebecca Troisi and Kathryn Rexrode. Women and Health. 2nd Ed, Academic Press, 2013.
4. Rajendram Rajkumar, Preedy Victor and Vinod R Patel. Diet, Nutrition and foetal programming. 1st E, Humana press, Springer link. 2017.
5. Simon and Langley Evans. Nutrition: A Life span approach. Wiley Blackwell publishing. 2009.

Suggested Readings:

1. Edelstein S, Sharlin J. Life cycle nutrition. An evidence based approach, Jones and Barlett publishers, U.S.A. 2009.
2. Energy Nutrition for Women, World Review of Nutrition and Dietetics.

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ELECTIVE B: FOOD TECHNOLOGY

E-FTAN1: FUNCTIONAL FOODS AND MOLECULAR NUTRITION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Develop an understanding of functional foods and nutraceuticals and their potential health benefits.
2. Highlight the importance of safety and efficacy of functional food ingredients and be familiar with the applications of functional foods.
3. Understand the core concepts in molecular nutrition.

Course outcomes

The student after taking the course will be able to:

1. Use scientifically verifiable procedures in applications of nutraceuticals in prevention of chronic lifestyle related diseases.
2. Demonstrate an understanding of various aspects involved in designing functional foods.
3. Comprehend the assessment and legal requirements for functional foods and nutraceuticals.
4. Demonstrate the ability to use the knowledge of how common food ingredients affect health by altering the expression of genes and the structure of an individual's genome.
5. Draw up and present a work with an evidence-based approach to answer a question in functional and molecular nutrition.

Unit I Introduction

Definition and classification of functional foods and nutraceuticals; Assessment of safety and efficacy of functional foods and ingredients; Legal requirements and stability testing. 15h

Principles of designing functional foods – bioaccessability and bioavailability of nutrients and nutraceuticals, role of physiology, food matrix and meal factors.

Oxidative stress and free radicals – concept, causes and mechanisms of free radical formation, general biological effects of free radicals, biological defense

systems; classification of food antioxidants.

Pathophysiology of cancer, cardiovascular diseases, diabetes, and inflammatory conditions.

Unit II Nutraceuticals and functional foods for health and disease prevention

Nutraceuticals: Sources, types and bioavailability of probiotics, prebiotics, 20 h
bioactive peptides, bioactive lipids, phytochemicals, bioactive vitamins and
minerals.

Functional foods for immune, intestinal, bone and brain health.

Functional foods for cancer, diabetes, cardiovascular disorders, osteo-arthritis,
rheumatoid arthritis, osteoporosis, other inflammatory conditions, and obesity.

Unit III Concepts in molecular nutrition

- Nutrigenomics – Definition; Basic principles of nutrigenomics. 10 h
- Nutrient-gene interactions - Regulation of gene transcription, transcription factors, post-transcription, translation & post-translational protein modification by macronutrients, micronutrients and bioactive compounds.
- Effects of genetics on physiological response to nutrients; Common polymorphisms & disease susceptibility.

Reference Textbooks:

1. Smith J and Charter E (Eds) Functional Food Product Development. Wiley- Blackwell Publication, UK. 2010.
2. Mc Clements DJ and Decker EA, Designing Functional Foods, Woodhead Publishing, USA. 2009.
3. Wildman REC Handbook of Nutraceuticals and Functional Foods, 2ndedn, CRC Press, USA. 2007.
4. Gibney MJ, Macdonald IA and Roche HM Nutrition and Metabolism. Blackwell Publishing, UK. 2003.

Suggested Readings:

1. Pathak Y (Eds). Handbook of Nutraceuticals: Ingredients, Formulations and Applications, Vol. 1. CRC Press, USA. 2010.
2. Schmidl MK and Labuza TP. Essentials of Functional Foods. An Aspen Publication, Maryland, USA. 2000.
3. Gibson R G and Williams M C (Eds). Functional Foods Concept to Product. Woodhead Publishing Ltd., England and CRC Press, USA. 2000.

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E-FTAN2: FOOD FORTIFICATION AND FERMENTATION

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Understand the principles, importance and methods of food fortification.
2. Learn various aspects of food fermentation and fermented products.

Course outcomes

The students will be able to:

1. Acquire knowledge on different techniques used for fortifying foods.
 2. Generate cost-effective and safe fortified foods for target populations.
 3. Understand the working of a fermentation system.
 4. Describe key industrial bioprocesses, from the traditional to the recently evolved.
 5. Integrate biological and engineering principles involved in the production and recovery of commercial products.
 6. Develop critical thinking skills and learn to employ a quantitative, scientific approach towards conversion of biological materials to value added products.
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UNIT I Introduction to food fortification

Food fortification: Definition, Course Objectives, types, Legal considerations: Mandatory vs. Voluntary fortification, importance and health benefits; Food vehicles and Fortificants: Selection of food vehicles, criteria for selection of food fortificants: Bioavailability, Stability and interaction of fortificants in the foods, Level of fortification: Safety limits, technological limits and cost limits; Determining cost effectiveness and cost benefit of fortification; Biofortification of foods. 4 h

UNIT II Food fortificants

Vitamins (A, B, C and D) and minerals (iron, iodine, zinc and calcium) – Sources, Physical characteristics and choice of fortificant methods to increase absorption of fortificants/prevention of loss, Fortification premixes - design and composition of premixes. 10 h

UNIT III Technology of fortifying food products

Foods as vehicles for fortification:

i) Rice, Cereal flours, cereal products (bread, pasta, noodles, biscuits and breakfast cereals); ii) Salt and sugar, iii) edible oils, iv) Beverages; v) Candies, Nutri- bars, and Granola bars, vi) Snack food, water and other foods.

Technology of fortification, challenges (safety, technological and cost limits), packaging and shelf life quality of fortified foods.

UNIT IV Food fermentation

1. Concept, types, importance and advantages 15 h
2. Technology of production of fermented foods: Fermentation principle, microorganisms involved, processing conditions and methods for:
 - i. Fermented cereal and legume based products -Idli, dosa, dhokla, cereal gruels/Ganji, soya sauce, natto, tempe, kinema and yeast leavened cereal products;
 - ii. Alcoholic beverages based on fruit juices (wines), cereals (whisky, beer, vodka etc.), sugar cane (rum) and vinegar;
 - iii. Fermented vegetable products – Sauerkraut, kimchi and others;
 - iv. Fermented milk products – yoghurt, cheese, shikhand, curd and lassi.

UNIT V Fermentation process for production of food ingredients

Organic acids (Citric Acid, Lactic Acid), Amino Acids (Glutamic acid, Lysine), Polysaccharides (Dextran, Xanthan), microbial sources of single cell proteins 8 h

Reference Textbooks:

1. Allen L, Benoist BD, Dary O and Hurrell R. Guidelines on Food Fortification with Micronutrients. World Health Organization and Food and Agricultural Organization, USA. 2006.
2. Crueger W and Crueger A. Biotechnology: A Textbook of Industrial Microbiology, 2ndedn, Panima Publishing Corporation, New Delhi. 2003.
3. Israel G and Williams R. Biotechnology and Food Ingredients, Van Nostrand Reinhold, New York. 1991.
4. Preedy VR, Srirajavenkathan R and Patel VB. Handbook of Food Fortification and Health, Vol. 1 & 2, Springer Publications. 2013.
5. Schmidl MK and Labuza TP. Essentials of Functional Foods, ASPEN Publication, New Delhi. 2000.

Suggested Readings:

1. Aneja KR. Experiments in Microbiology, Plant Pathology, Tissue Culture and Mushroom Production Technology, 3rd edn, New Age International Publishers, New Delhi. 2001.
2. Lotfi M, Mannar MG, Merk RJHM and Heuvel PND. Micronutrient Fortification of Foods -Current Practices, Research and Opportunities, The Micronutrient Initiative and International Agricultural Centre, USA. 1996.
3. Steinkraus KH. Hand Book of Indigenous Fermented Foods, 2nd edn, Marcel Dekker Inc, New York. 1996.

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EFT3: PHYSICAL PROPERTIES OF FOODS

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Provide a fundamental understanding of physical properties of foods.
2. Be acquainted with basic definitions and principles of physical properties of foods.
3. Understand the relationship between physical and functional properties of raw, semi-finished and processed food to obtain products with desired shelf-life and quality.
4. Get acquainted with different method of measuring physical properties in foods.

Course outcomes

The students will be able to:

1. Gain an understanding of physical properties of foods.
2. Learn about the rheological and textural properties of foods.
3. Describe the thermal and electromagnetic properties of foods.
4. Gain comprehensive understanding of sorption and surface properties of foods.
5. Analyze, interpret, and explain the phenomena related to the properties of food materials.
6. Conceptualize the knowledge on predicting the behaviour of new food materials.

Unit I **Physical Attributes of foods**

Size, Shape, Particle Size Distribution, Volume - Methods of measurement (Liquid Displacement, Gas Displacement, Solid Displacement Methods. Expressions of Volume, density, porosity and shrinkage. 5h

Unit II **Rheological Properties of Foods**

- Introduction to Rheology 12h
- Flow of Material - Newtonian & Non-Newtonian Fluids, Bingham & Non-Bingham Plastic Fluids; Viscosity Measurement (Capillary Flow Viscometers, Orifice Type Viscometers, Falling Ball Viscometers, Rotational Viscometers, Concentric Cylinder (Coaxial Rotational) Viscometers, Cone and Plate Viscometer, Parallel Plate Viscometers, Single-Spindle Viscometers/Brookfield Viscometer, Vibrational/Oscillation Viscometer, Bostwick Consistometer.

- Deformation of Material – Visco-elastic Behavior, Stress Relaxation Test, Creep Test, Dynamic Test (Oscillatory Test), Extensional Flow.
- Texture of Foods - Compression, Snapping-Bending, Cutting Shear, Puncture, Penetration, Texture Profile Analysis.
- Dough Testing Instruments - Farinograph and Mixograph, Extensograph and Alveograph, Amylograph.

Unit III Thermal Properties of Foods

- Fourier's Law of Heat Conduction; Thermal Conductivity - Measurement of Thermal Conductivity (Steady State & Unsteady-State Methods); 8h
- Specific Heat - Measurement of Specific Heat (Differential Scanning Calorimeter/DSC), Method of Calculated Specific Heat; Enthalpy and Latent Heat;
- Thermal Diffusivity (Indirect Prediction Method & Direct Measurement Methods).

Unit IV Electromagnetic Properties

- Color – Measurements (Spectrophotometers & Colorimeters); Color Systems - Munsell Color System; CIE & CIE $L^*a^*b^*$ (CIELAB) Color Systems, Hunter Color Lab, Lovibond System. 10 h
- Dielectric Properties of Foods – Definition, factors affecting (moisture, temperature, food composition); Assessment of Quality of Foods Using Dielectric Properties; Measurement of Dielectric Properties.

Unit V Water Activity and Sorption Properties of Foods

- Colligative Properties - Boiling Point Elevation, Freezing Point Depression, Osmotic Pressure. 5h
- Water Activity - Prediction of Water Activity, Measurement Methods - Based on Colligative Properties (Vapor Pressure Measurement, Freezing Point Depression) and Hygroscopicity of salts (hygrometers).
- Preparation of moisture-sorption isotherms.

Unit VI Surface Properties of Foods

- Surface Tension, Surface Activity and Interfacial Tension. 5 h
- Colloidal Systems in Food – Sols, gels, emulsions, and foams.
- Measurement Methods of contact angle and surface tension.

Reference Textbooks:

1. Sahil S and Sumnu S. Physical Properties of Foods, Springer Science, Business Media, New York. 2006.
2. Figura L and Teixeira AA. Food Physics: Physical properties- Measurement and application, Springer-Verlag, Berlin, Heidelberg. 2007.
3. Vliet TV. Rheology and Fracture Mechanics of Foods, CRC Press, Boca Raton: US. 2014.

Suggested Readings:

1. Fellows PJ. Food Processing Technology: Principles and Practice. Ellis Horwood Ltd, USA, 1998.
2. Ramaswamy H and Marcotte M. Food Processing- Principles and Applications, Taylor and Francis group, Florida. 2006.

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E-FT4: UNIT OPERATIONS IN FOOD PROCESSING

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Gain knowledge of basic and applied aspects of food processing operations.
2. Gain knowledge of basic principles and procedures of food processing methods.

Course outcomes

The students will be able to:

1. Gain knowledge regarding various unit operations employed in food processing with respect to their function and effects on food materials and the equipment employed.
2. Describe how various unit operations work individually and together.
3. Understand about the physical principles of operation for various types of equipment and impact of the processing on the physical, chemical and sensory properties of the food products.
4. Understand the mechanisms of preservation applied to the foods through the unit operations.
5. Identify and discuss the equipment required in unit operations to product transformation specifications and general plant operations in a food industry.

Unit I	Introduction to food processing unit operations.	2 h
Unit II	Separation methods <ul style="list-style-type: none">• Size reduction, size measurement, screen types: Grizzly, revolving, shaking, rotary, vibratory & horizontal screens, perforated metal screen, wire mesh screen, ideal and actual screen. Effectiveness of screen, air-screen cleaners, separators, screen analysis, fineness modules; crushing efficiency.• Filtration: Centrifugal filters, Filter media, Filter aids, Principle of cake filtration, Clarifying filters, Cross flow filtration, Gravity sedimentation process, Centrifugal sedimentation process.• Centrifugation: Stokes law; clarifiers and separators, centrifugal separators. Efficiency of separation, Flow rate, Power requirement, Strength of bowl, Construction of separator, Standardization of milk, Bactofugation.• Distillation: Flash distillation; Continuous distillation with reflux; Distillation in packed column; Batch distillation; Multi component distillation.• Leaching and Extraction: Principle of leaching and its equipment; Principle	24 h

of extraction and its equipment; Extraction techniques.

- **Crystallization:** Crystal geometry, equilibrium and yields, nucleation, crystal growth, crystallization equipment, crystallization from melts.

Unit III Mixing & Homogenization

Dry & wet grinders. Slicers, dicers, pulpers and granulators: types & applications. Homogenization: technical execution, efficiency of homogenization. Operation & maintenance. Homogenizers & colloid mills: principles & types. Mixing & kneading: equipment & applications. 8 h

UNIT IV Heat Transfer

5 h

Drying & Dehydration- Drying theory, types of dryers, drier efficiencies. Refrigeration & Freezing- Refrigeration components and controls, Refrigerator construction and working, cascade system for refrigeration- introduction and working.

UNIT V Material Handling

6 h

Belt conveyors, belt tension, bucket elevator, buckets, drive mechanism, pneumatic & hydraulic conveying systems.

Reference Textbooks:

1. Fellows, P.J. Food Processing Technology: Principles and Practice, Second Edition, CRC Woodhead Publishing Ltd., Cambridge, 2000.
2. Gould, G.W. New Methods of Food Preservation, Blackie Academic & Professional, London. 1995.
3. Ramaswamy H and Marcotte M. Food Processing- Principles and Applications, Taylor and Francis group, Florida. 2006.
4. Sarvacos GD and Kostaropoulos AE. Handbook of food processing equipment, Springer India Private Limited, New Delhi. 2006.
5. Von Loesecke, H.W. Food Technology Series: Drying and Dehydration of Foods, Allied Scientific Publishers. 1986.

Suggested Readings:

1. Hosene, R.C. Principles of Cereal Science and Technology, Second Edition, American Association of Cereal Chemists, St. Paul, Minnesota. 1996.
2. Salunkhe, D.K. and S.S. Kadam. Handbook of Fruit Science and Technology: Production, Composition, Storage and Processing, Marcel Dekker INC. New York. 1995.
3. Oliveira, A.R., Oliveira, J.C. Processing Foods, Quality Optimization and Process Assessment, CRC Press, Boca Raton. 1999.

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E-FT 5: BAKING TECHNOLOGY

Credits: 3

Hours: 45

Course objectives

To enable the students to:

1. Equip with knowledge related to baking technology.
2. Impart knowledge related to processing techniques of baked products.

Course outcomes

The students will be able to:

1. Apply their knowledge of food and equipment handling to create a safe environment for themselves and others around them.
2. Gain an understanding of scientific and aesthetic principles of commercial baking.
3. Describe properties and functions of the basic ingredients used in baked goods and observe and practice a wide variety bakery methods.
4. Discuss nutritional concerns as they apply to baking and bring in the modification to create more nutritionally beneficial baked goods ensuring their the quality.
5. Demonstrate proper storage techniques for all baked products and the ability to work in a team environment.

Unit I Introduction

Baking, Baking industry and its scope in the Indian economy. History of Baked foods - present trends, prospects. Bakery ingredients/raw materials. Food additives used in baking. Nutrition facts of bakery products. 5h

Unit II Technology for the manufacture of baked products

- a) Preparation of bread - ingredients used; methods of dough preparation; steps in bread making; evaluation of the baked bread; staling of bread; 30h
- b) Preparation of cakes - types of cakes; ingredients used; balancing of cake formula; methods of batter preparation; steps in cake making; evaluation of the baked cake; operational faults in cake and the remedial measures. Cake decoration- different methods of cake decoration.
- c) Preparation of pastry - types of pastries (short crust, puff/flaky and choux pastry); ingredients; evaluation. Faults and remedies.
- d) Biscuit and Cookies - Preparation of biscuits and cookies – types; ingredients and evaluation.

Unit III Baked food quality

The effect of variations in formulation and process parameters on the quality of finished product. Quality considerations and parameters, dough development, method of dough mixing, dough chemistry, rheological testing of dough Farinograph, Extensograph, Amylograph/Rapid visco Analyzer, Falling no. Hoosney dough stickiness tester and interpretation of data. 10 h

Reference Textbooks:

1. Faridi H. The Science of Cookie and Crackers Production, CBS Publishers, New Delhi. 2004.
2. Ketrappaul N, Grewal RB and Jood S. Bakery Science and Cereal Technology. Daya Publishing House, New Delhi. 2005.
3. Matz A .Bakery Technology and Engineering, CBS Publishers, New Delhi.1998.
4. Ashok kumar Yogambal. Text book of Bakery and Confectionary. PHI Publisher. 2ndEdn. . 2009.
5. Isabel Moore. Baking Course – Pastry, Cakes and Bread. Royoon Publishing Company, London. 1984.

Suggested Readings:

1. Kingslee john. Bakery and confectionary. New age international (P) limited. 2006.
2. Stanley Cauvain and Lind Young. Baked Products, Blackwell Publishing, Oxford. 2006.

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E-FT 6: TECHNOLOGY FOR PLANTATION CROPS AND SPICES

CREDIT: 3

Hours: 45

Course objectives

To enable the students to:

1. Provide an understanding of the science and technology for processing coffee, tea, cocoa products and spices.
2. Apply acquired skills in spice processing and beverage industries.

Course outcomes

The students will be able to:

1. Understand the unit operations and processing steps involved for different plantation and spice products.
2. Acquire the knowledge of instant tea, coffee and cocoa processing methods.
3. Understand the processing of commercially important crops and sources of flavours.
4. Illustrate the knowledge of quality grading in plantation and spice products.
5. Acquire knowledge of Processing and Extraction Techniques of major spices.

Unit I Spices and condiments

Introduction and History of Herbs, Spices and condiments, Classification, 12h
composition, nutritive value. Standards of purity and sensory assessment of
herbs and spices Packaging of spices, spice products and plantation products.

Spice processing- Milling, gas sterilization of spices, Heat treatment,
Extraction and distillation of volatile oils, Spice essential oils, Application of
spice essential oils.

Oleoresins- Extraction, Quality and application of oleoresins.

Major spices: Pepper, cardamom, ginger, chili and turmeric– Method of
manufacture of Oleoresins and essential oils; chemistry of the volatiles;
enzymatic synthesis of flavor identicals; quality control; fumigation and
irradiation of spices.

Unit II Plantation crops

Citrus fruits: Citrus essential oils, Composition of Citrus oils, processed citrus 8h
oils, methods of deterpenization, citrus leaf and flower oils.

Mints: Peppermint-Cultivation and distillation, Rectification. Corn mint-
Cultivation and distillation, Dementholization. Spearmint-Blended Peppermint,

Composition of mint oils.

Unit III Other commercially important sources

12h

Fruit, Fruit juices and concentrates.

Vanilla: Introduction, curing process, classification, flavour, chemistry of vanilla flavour, precursors and the development of flavour.

Cashew: Chemistry and technology of cashewnut processing,

Coconut: Production, composition, Grading, post-harvest technology and treatments; processing of coconut, coconut milk and its applications.

Aromatic vegetables

Unit IV Beverage flavours

Cocoa: Production, composition, grading, processing-cocoa mass, cocoa powder, cocoa butter, cocoa based beverages and cocoa liquor. 8h

Tea: Tea processing-leaves gathering, Grading, leaf processing; Types of tea & processing-dust tea, black tea, green tea, Oolong tea, Instant tea; Plant layout and machinery for tea processing.

Coffee: Grading, blending, roasting of seeds, grinding, brewing. Coffee varieties & processing -Decaffeinated Coffee, Instant Coffee, extraction, and chicory. Plant and machinery for coffee processing. chicory chemistry; quality grading of coffee.

Unit V Flavoring materials made by processing

Natural products made by roasting(cocoa/chocolate) Reaction flavors- 5h
Enzymatically derived flavorings (Butter and cheese)-Flavors made by fermentation-Flavors made by pyrolysis.

Reference Textbooks:

1. Banerjee B. Tea Production and Processing, Oxford University Press. 2002.
2. Flavor Chemistry and Technology 2nd Edition by Gary Reineccius.1994.
3. Minifie BW. Chocolate, Cocoa and Confectionery Science and Technology, 3rdedn, Chapman and Hall, London, NY. 1986.
4. National Institute of Industrial Research Board. Handbook on Spices, Asia Pacific Business Press Inc, 2004.

Suggested Readings:

1. Pursegrove JW, Brown EG and Green CL. Spices, Vol.1 and II, SRJ Academic Press, New Delhi.
2. Vijayakher. Textbook of Food Science and Technology, ICAR, New Delhi. 2001.

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E-FT 7: ENTREPRENEURSHIP AND MARKETING

Credits: 3

Hours : 45

Course objectives

To enable the students to:

1. Gain knowledge base in key areas of food industry management.
2. Impart necessary expertise to function as food plant manager.
3. Plan suitable strategies for the marketing of a specific food product.
4. Develop critical abilities necessary to start their own food service unit leading to entrepreneurship.

Course outcomes

The students will be able to:

1. Articulate the key economic and business challenges facing decision makers in the food industry and how to address them.
 2. Articulate the size, structure and organisation of the food industry and food supply chain in India and globally whilst showing understanding of the drivers for change in food policy.
 3. Recognise and apply subject specific facts, theories, paradigms, concepts or principles; allowing for competing or alternative explanations within the subject area of food business entrepreneurship.
 4. Analyze lines of enquiry, investigate knowledge gaps, and apply appropriate research methodology.
 5. Integrate practical knowledge to tackle problems and develop innovations in the food sector.
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Unit I Entrepreneurship

Nature, scope and importance of entrepreneurship: Concept of an Entrepreneur and business acumen. Business ideas, source of business ideas, feasibility studies, problem solving and decision making, creating efforts, SWOT Analysis. Case studies of successful entrepreneurs. 15h

Unit II Entrepreneurship in food sector

Profile of the food-processing sector in India: problems and opportunities. 15h
Business opportunity identification in the food industry. Planning a small-scale unit and whom to approach for what. Market survey tools, schedule and techniques of data collection, business plan format for tiny and small enterprises, assessing techno-economic viability of project, break-even analysis.

entrepreneurship development policies of government in food business.

Unit III Marketing

Introduction to marketing, fundamentals of marketing, fundamentals of operations and supply chain management; marketing challenges and approaches for new products and services; Role of e-commerce in food entrepreneurship and industry; Pretest and test marketing of products, launching, product lifecycle, branding and positioning decisions, marketing techniques, marketing and distribution of processed products; Costing and pricing of products; Cost control – food cost, labour cost and other costs (Labeling and packaging cost). 15h

References Textbooks:

1. Anil Kumar S, Poornima SC, Abraham MK and Jayashree K. Entrepreneurship Development, New Age International Publishers. 2008.
2. SISI .Entrepreneur's Guidebook on Food Processing Industries – Arunachal Pradesh. 1983.
3. Sudheer K.P. Entrepreneurship Development in food Processing. New India Publishing Agency, New Delhi. 2017.
4. Vasant D. The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House Pvt. Ltd., Mumbai, India. 2011.

Suggested Readings:

1. Acharya SS and Agarwal NL. Agricultural Marketing in India, Oxford & ISH Publishing Co, New Delhi, India. 1987.
2. Chandra P. Projects, Planning, Analysis, Selection, Implementation and Review, Tata McGraw-Hill Publishing Company Limited, New Delhi, India. 1996.
3. David H. Entrepreneurship – Anew Venture Creation, Prentice Hall of India Pvt. Ltd, New Delhi, India. 2002.
4. Phillip K. Marketing Management, Prentice Hall of India Pvt. Ltd, New Delhi, India. 1994.
5. Naidu NVR and Rao KT. Management and Entrepreneurship, I.K. International Pvt. Ltd. 2009.
6. Jane E, Liz S and Stephen B. Food Supply Chain Management, Elsevier Science. 2001.

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