

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Understand minimum development of language grammar
- Understand and use phonetics
- Improve comprehension and expression skills required for classroom, academic, professional and cultural situations
- Develop the ability to communicate effectively using suitable styles and techniques

### **UNIT – I**

Introduction to communication and grammar: Consonants & Vowel Sounds, Indianism, Syllable & Syllable Stress, Determiners, Articles, Tense & Time, Preposition, Prepositional Phrases, subject-Verb Agreement, Active – Passive Voice, Intonation & Modulation, Conjunctions

### **UNIT – II**

Semantics: Synonyms, Antonyms, Homophones, Homonyms, Form and function of words  
Syntax: Sentence structures, Verb patterns and their usage.

### **UNIT – III**

Phonetics: Basic Concepts – Vowels, Consonants, Phonemes, Syllables; Articulation of Speech Sounds – Place and Manner of Articulation; Transcription of words and simple sentences, using International Phonetic Alphabet.

### **UNIT – IV**

Comprehension: Listening and Reading comprehension – Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing. Text: English for Students of Science by A.Roy and P.L. Sharma (Orient Longman)

Chapters for Study:

- "The year 2050" by Theodore J. Gordon.
- "The Mushroom of Death" by A.Bandhopadhyay.
- "The Discovery" by Herman Ould.

The prescribed text will be used as a case study for various components of the syllabus.

**Recommended Readings:**

- Roy, A. and Sharma, P.L. (2012). English for Students of Science. Orient Blackswan Private Limited.
- Bansal, R.K. and Harrison, J.B. (1988). Spoken English for India: A Manual of Speech and Phonetics. Orient Longman Limited.
- Balasubramaniam, T. (2012). A Textbook of English Phonetics for Indian Students. Macmillan Publishers, Chennai.
- Pink, M.A. and Thomas, S.E. (1998). English Grammar, Composition and Correspondence by S. Chand and Sons Pvt. Ltd., Delhi.
- Connor, J.D.O. (1980). Better English Pronunciation by, Cambridge Univ. Press, London.

***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and describe different chemical and functional properties of major nutritional constituent viz. carbohydrate, fat and protein
- Explain and compare the chemistry, properties and effects of processing on various food components
- Apply the knowledge to improve the shelf life and quality of foods during processing and storage
- Develop new innovative products, and to solve industrial problems pertaining to processing

#### UNIT – I

Scope, introduction, definition and importance of food chemistry; Chemistry of carbohydrates - classification, functions, chemical and physical properties, pentosans, mannans and galactans, pectic substances, gums; Types of fibers and its constituents - Celluloses, hemicelluloses, soluble fibers, insoluble fibers and their important functions; Enzymes and starches – Alpha amylase, beta amylase, modified starches, resistant starches, gelatinization of starches and starch blockers.

#### UNIT – II

Proteins and amino acids: types, chemical, physical and functional properties, denaturation of protein, gel formation. Proteins from milk, egg and meat. Allergens, toxic constituents and anti-nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing oligosaccharides, phytolectins).

#### UNIT – III

Fats and oils: classification, functions, physico-chemical properties, oxidation of oils and fats, rancidity. Chemistry of emulsifiers, antioxidants, stabilizers and additives used in food industry. Chemical properties and functions of minerals and vitamins. Chemistry of pigments and flavour compounds.

## UNIT – IV

Enzymatic and non-enzymatic browning in Foods: reactions of aldehydes and ketones with amino compounds, caramelization, oxidative changes of polyphenols) and their applications in food products. Important chemical changes during storage and cooking of foods, with some suitable examples from cereals, pulses and fruits and vegetables.

### **Recommended Readings:**

- Wang, D. (2012). Food Chemistry: Nova Science Publishers.
- Chopra, H. K. and Panesar, P. S. (2010). Food chemistry: Alpha Science International Ltd, Oxford, U.K.
- Coultate, T. P. (2009). Food: The Chemistry of Its Components (5ed.): American Chemical Society.
- Newton, D.E. (2009). Food Chemistry: Facts on File, Incorporated.
- Damodaran, S., Parkin, K. L. And Fennema, O. R. (2007). Fennema's Food Chemistry: CRC Press, Taylor and Francis group.

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**1BVFPE03**

**Computer Fundamentals and its Applications Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the basic functioning of computer system
- Explain the basics related to internet and computer programming languages
- Apply the applications of different programming languages
- Design different programs for computer related specific tasks

#### **UNIT – I**

An Overview of Computer System: Anatomy of a digital Computer, Memory Units, Main and Auxiliary Storage Devices, Input Devices, Output Devices, Classification of Computers. Radix number system: Decimal, Binary, Octal, Hexadecimal numbers and their inter-conversions; Representation of information inside the computers.

#### **UNIT – II**

Operating System Basics: The user Interface, Running Programmes, Managing files, Introduction to PC operating Systems: Unix/Linux, DOS, Windows 2000.

Internet basics: Introduction to the basic concepts of Networks and Data Communications, How Internet works, Major features of internet, Emails, FTP, Using the internet.

#### **UNIT – III**

Programming Languages: Machine, Assembly, High Level- Language, Assembler, Compiler, Interpreter, debuggers, Programming fundamentals: problem definition, algorithms, flow charts and their symbols, introduction to compiler, interpreter, assembler, linker and loader and their inter relationship. Microsoft office, functioning and application.

#### **UNIT – IV**

Strings: strings literals, string variables, I/O of strings, arrays of strings; applications. Use of various tool for data collection, compilation and interpretation using statistical tools.

#### **Recommended Readings:**

- Brian K Williams & Stacey C. Sawyer (2003). Using Information Technology, 5<sup>th</sup> Edition, Tata McGraw-Hill.

- Dennis M Ritchie, Brian W. Kernigham (1988). The C Programming Language, PHI.
- K.N. King (1996). C Programming – A modern approach, WW Norton & Co.
- Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin (1998). Information Technology, Tata McGraw-Hill.
- Byron Gottfried (2011). Programming with C, 2<sup>nd</sup> Edition, Schaum's Outlines Series, Tata McGraw-Hill.
- Barry Press and Marcia Press (2000). Teach yourself all about computers, IDG Books, India.
- Jack B. Rochester (1996). Using Computers and Information, Que Education & Training.

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**1BVFPE04**

**Grain Handling and Storage**

**Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Identify the pests damage in grain storage
- Understand different technologies for grain safe storage
- Recommend strategies for effective pest management for grain storage

#### **UNIT – I**

History of grain storage, Grain Storage overview, Ecosystem approach, Overview of grain storage issues, Handling and storage losses in India for grains, Monitoring the grain during storage, Safe storage practices.

#### **UNIT – II**

Insect and pests in cereals, pulses, oilseeds, milled products, Understanding the behavioural dynamics of life stages of insects and pests, Grain and seed borne pathogens and their management, Biochemical and nutritional changes in stored commodities due to storage pest infestation, Aflatoxin content in grains due to microbial infection.

#### **UNIT – III**

Grain Storage Facilities: The conventional storage facility, Metal bins, Silo, Temporary storage, Sheds, Alternative storage constructions, Horizontal warehouses. Unloading and Loading Equipment and techniques. Fumigation of grain storages: Basics of Fumigation, Fumigants- alternative fumigants for grain protection. Cleaning and maintenance practices in Storage houses. Familiarization with FIFO and FEFO guidelines.

#### **UNIT – IV**

Physical and chemical methods of pest control: Importance of temperature and moisture, Insect control by physical methods, Gadgets used in storage pest management. Modified atmospheric storage for stored grain insect pest management, Physical control measures for management of stored product pest management with special reference on techniques, Regulations for safe grain storage.

#### **Recommended Readings:**

- Cotton, Richard T. (2007). Insect Pests of Stored Grain and Grain Products.

- Ghosh, S.K. (2003). Integrated Management of Stored Grain Pest.
- Bhargava, M.C. & K.C. Kumawat. (2010). Pests of Stored Grains and Their Management.
- Bhadriraju, S. and David W. H. (2000). Alternatives to Pesticides in Stored Product IPM.
- David W. H. and Bhadriraju, S. (2008). Fundamentals of Stored-Product Entomology.
- David A.V. Dendy and Bogdan J. Dobraszczyk. (2001). Cereal and Cereal Products: Technology and Chemistry. Springer-Verlag, US.

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Evaluate the industrial aspects of grain storage
- Identify the pests damage in grain storage
- Understand different technologies for grain safe storage
- Recommend strategies for effective pest management for grain storage

**List of Practicals:**

- Effect of storage on physicochemical characteristics of grains
- Effect of storage conditions on grain quality
- Detection of rodent infestation by physical and chemical methods
- Grain sampling for insect infestation pests
- Evaluating different methods of control pests
- Observe the quality changes during different period of storage in infested/infected grain
- Nutritional changes due to stored grain pests
- Estimation of aflatoxin content in infected grain
- Effects of Temperature and Moisture on grain quality during storage
- Evaluating different methods of insect control
- Food Safety Regulations related to rodent infestation

**Recommended Readings:**

- Cotton, Richard T. (2007). Insect Pests of Stored Grain and Grain Products.
- Ghosh, S.K. (2003). Integrated Management of Stored Grain Pest.
- Bhargava, M.C. & K.C. Kumawat. (2010). Pests of Stored Grains and Their Management.
- Bhadriraju, S. and David W. H. (2000). Alternatives to Pesticides in Stored Product IPM.

- David W. H. and Bhadriraju, S. (2008). Fundamentals of Stored-Product Entomology. David A.V. Dendy and Bogdan J. Dobraszczyk. (2001). Cereal and Cereal Products: Technology and Chemistry. Springer-Verlag, US.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the structure of wheat, factors affecting grain size and its hardness/softness
- Explain the physical and chemical characteristics of wheat quality
- Discuss the wheat milling process and its related milled products
- Evaluate the different factors affecting the milling yield of wheat

#### UNIT – I

Classification and Structure of Wheat Grain: Introduction – origin, classification of wheat, production; Grain size and morphology – sources of grain size variations, relationship of grain size with endosperm and protein content, techniques used to study the structure of wheat grain;

Protein quality;  $\alpha$ -Amylase activity; Physico-chemical basis of wheat grain hardness or softness; Structural components of wheat grain; Chemical composition of wheat kernel

#### UNIT – II

Criteria of Wheat Quality: Introduction; Botanical and physical characteristics – wheat species, wheat varieties, test weight, kernel weight, kernel size and shape, kernel hardness; Chemical characteristics – moisture content, protein content, protein quality,  $\alpha$ -Amylase activity, ash content, legal standards for wheat flour and related products

#### UNIT – III

Milling Process and Milled Products: Preparation of wheat for milling; Aims of flour milling; Milling process – general principle, cleaning, tempering/conditioning, breaking or break system, sieving, purification, sizing, reduction; Flour streams and extraction rates; Milling machinery; Milling by-products; Soft wheat milling; Durum wheat milling

#### UNIT – IV

Experiment Milling and Milling Research: Air classification; Tempering; Automation; Experimental milling – procedures and equipments; Interpretation of results; Model predicting milling yield of wheats.

**Recommended Readings:**

- Kent, N.L. and Evers, A.D. (1994). Technology of cereals, 4<sup>th</sup> Edition, Pergamon Press Ltd., Oxford.
- Samuel, A.M. (1996). The Chemistry and Technology of Cereal as Food and Feed, CBS Publishers & Distribution, New Delhi.
- Pomeranz, Y. (1998). Wheat: Chemistry and Technology, Vol. I, 3rd Edition, American Assoc. Cereal Chemists, St. Paul, MN, USA.
- Hosney, R.C. (1986). Principles of Cereal Science and Technology, American Assoc. Cereal Chemists, St. Paul, MN, USA.
- Pomeranz, Y. (1976). Advances in Cereal Science and Technology, American Assoc. Cereal Chemists, St. Paul, MN, USA.
- Bushuk (2000). Wheat Production, Properties & Quality, AACCC Inc. St. Paul MN. USA.
- AACCC (1983), Approved methods of Analysis, 8<sup>th</sup> edition, American Association of Cereal Chemists. St. Paul, MN.
- Heyne EG (1987). Wheat and wheat improvement, American Society of Agronomy. Haworth Press Inc., Canada.
- Reddy, Y.S. (2000). Extraction Techniques for Food Processing, Daya Publishing House, New Delhi.
- Dobraszczyk BJ, Dendy DAV (2001). Cereal and Cereal Products: Chemistry and Technology, Aspen Publisher, Inc., Maryland.
- Pomeranz, Y. (1989). Wheat is Unique, AACCC Inc., St. Paul MN., USA.

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**1BVFPE07                      Wheat Grain Structure, Quality and Milling Lab    Credits: 0+0+2**

***Evaluation: Internal (30), External (70)***

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe different techniques for studying wheat grain structure
- Understand the experimental/laboratory and industrial wheat milling
- Operate and maintain various equipments of wheat grain milling and analysis
- Evaluate the physical and chemical characteristics of wheat grain and flour

**List of Practicals:**

- Different techniques used to study the structure of wheat grains
- Morphological parameters of wheat kernel – endosperm height & thickness, crease width & depth, aleurone layer thickness
- Determination of adulterants in wheat and wheat flour
- Measuring wheat physical characteristics – test weight, grain size/kernel weight (single kernel characterization system)
- Laboratory scale milling and flour yield
- Chemical characteristics – moisture content, protein content, protein quality, falling number, ash content
- Thousand kernel weight
- Sedimentation test
- Alcoholic acidity
- Particle size analysis
- Flour and Dough Tests – Flour colour analysis, Farinograph, Extensigraph, Alveograph, Mixograph, Glutomatic, Amylograph, Rapid Visco Analyzer, Solvent Retention Capacity (SRC)
- Visit to a wheat flour mill

**Recommended Readings:**

- Manual of Methods of Analysis of Foods (2015). Cereal and Cereal Products, FSSAI.
- Khatkar B.S. (2013). Wheat Quality and Product Testing Manual, CBS Publication.
- Wheat and Flour Testing Methods: A Guide to Understanding Wheat and Flour Quality (2004). Wheat Marketing Center, Inc. Portland, Oregon USA.

**Course Outcomes:** After the completion of this course, the students will be able to:

- Define and describe various terms related to types of packaging of grains and their products
- Select packaging materials and their types according to the requirements
- Acquire knowledge about evaluation of quality and safety of packaging materials.
- Evaluate grain and products according to Food Safety Standards and Regulations

#### **UNIT – I**

Introduction to food packaging, definitions, packaging terminology, Functions of packaging, Selection characteristics of packaging type (capacity, storage time etc.). Types of grain/flour and products packaging: Bulk packaging: Jute bags, woven sacks, multi wall paper sacks and laminates (PET/ink/LLDPE). Retail packaging, bag in box, BOPP film, CR paper board, CRB (coated recycled paperboard), bags in box packaging

#### **UNIT – II**

Types and categories of food packaging material specific to grain packaging. Paper, paperboard and printed fibreboard. Plastic films: LDPE/LLDPE films, High Molecular HDPE films, laminates made from BOPP/LDPE, cast propylene (CPP)/ LDPE, Polyeste, PET and others. Quality parameters: impact strength, tensile strength and puncture resistance, oxygen barrier, moisture barrier, heat sealeable, glossiness and flavour barrier. Nature and deteriorative characteristics and requirements of packaging of grains and flours. Recent advances in cereal packaging: CA, MAP, active packaging and vacuum packaging.

#### **UNIT – III**

Automated packaging machines, filling systems and integrated packaging solutions for grain and seed packaging needs. intelligent electronic weigh filler/cup filler, intelligent electronic weigh filler. Automatic flexible packaging machines: form-fill-seal (FFS) machines vertically (vertical-form-fill-seal or VFFS) or horizontally (horizontal-form-fill-seal or HFFS). Pouch formats in flexible packaging: three side seal bags, centre seal pillow packs, quad seal bags, flat bottom bags, gusseted bags, sachet etc.

## UNIT – IV

Package labels and labelling – functions, regulations, safety concerns in food pack. Weight/ measures, Labelling and nutritional Ingredients requirements for packed food and food products. Legislative and safety aspects of food packaging materials. National and International Food Safety Standards and Regulations. Package laws and regulation – general guidelines (FCI and PDS guidelines)/ declarations PFA rules, FPO rules.

### **Recommended Readings:**

- Robertson, G. L. (2012). Food Packaging: Principles and Practice, Third Edition, CRC Press.
- Coles, R., McDowell, D. and Kirwan, M.J. (2003). Food Packaging Technology, CRC Press.
- Mattsson B., and Sonesson U., (2000). Environmentally-Friendly Food Processing. Woodhead Publishing Ltd.
- Coles, R. and Kirwan, M. (2011). Food and Beverage Packaging Technology (2nd ed.): Wiley-Blackwell, UK.
- Eiri Board of Consultants. (2007). Food Packaging Technology: Engineers India Research Institute, New Delhi.
- Crosby, N.T. (1981). Food Packaging Materials. Applied Science Publication.
- Mahadeviah, M. and Gowramma, R.V. (1996). Food Packaging Materials. Tata McGraw Hill.
- Sacharow, S. and Grittin, R.C. (1980). Principles of Food Packaging. AVI Publication.

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**1BVFPE09 Grain and Grain Products Packaging and Labelling Lab Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of this course, the students will be able to:

- Analyse packed foods and packaging materials for labelling and quality parameters
- Evaluate grain packaging materials quantitatively and qualitatively
- Recognize packaging material based on evaluation tests
- Assemble and design new types of packaging styles

**List of Practicals:**

- Familiarization and study physical characteristics of different types of packages used for packaging of grains and products.
- Study packaging labels specific to grain and grain products.
- Determination of thickness and GSM of packaging materials.
- To find out the water absorptive percentage of test samples of packaging materials.
- To determine the adhesive percentage of tapes used in packaging.
- To perform physical identification test for plastics films.
- Examination of different types of packages and containers.
- To perform bursting strength, tearing resistance, tensile and permeability tests of packaging material.
- To perform vacuum packaging and determination of storage life of packaged foods.
- To perform leak test on a given packaging sample using vacuum leak tester.
- To determination of wax from waxed papers.
- Packaging of powder foods and estimation of shelf-life studies of packaged foods.
- Packaging of food material in seal and shrink-packaging machine and study its shelf life,
- Testing of strength of filled pouches by drop tester.
- Testing the compression strength of the boxes.

- Preparation of sorption isotherm curve and estimation of shelf life of various packed foods.
- Visits to food packaging plant/units, package manufacturing plant / industries.

**Recommended Readings:**

- Southwick, C.A. (1974). Packaging of cereal products. In Storage of Grains and Their Products, C.M. Christensen (Ed.), American Association of Cereal Chemists Inc., St. Paul, Minnesota.
- Bailey, J.E. (1974). Whole grain storage. In Storage of Cereal Grains and their Products, C.M. Christensen (Ed.), American Association of Cereal Chemists, St Paul, Minnesota.
- Matz, S.A. (1970). Cereal Technology, Avi Publishing Co. Inc., Westport, Connecticut.
- Paine, F.A. and Paine, H.Y. (1992). A Hand Book of Food Packaging. Blackie Academic& Professional.

**2BVFPE01**

**Communication and Writing Skills**

**Credits:4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Develop awareness of appropriate communication strategies
- Improve verbal communication skills required for classroom, academic, professional and cultural situations
- Write an impressive resume and face the interview confidently
- Develop the ability to write various types of reports using suitable styles and techniques

### **UNIT – I**

Communication skills: Introduction, Relevance of communication, Effective communication, Models of communication, Effective use of language, Tools of communications, Role and purpose of communication: 7 C's of communication, Barriers to effective communication

Forms of Communication: one-to-one, informal and formal

Group Discussion: Dynamics of Group Discussion, Introduction, Methodology, Role, Functions, Mannerism, Guidelines

### **UNIT – II**

Verbal Communication, Communication Networks, Inter-office communication, the business letters, E mail – Netiquette (etiquette on the mail). Intra- office communication, Memos, Notices, Circulars, Agenda and Minutes, Business Report writing

Proficiency in English – Building vocabulary, (Denotative & connotative), Extensive vocabulary drills, (Synonyms / Antonyms / Homonyms), One Word substitution, active and passive, Mechanics and Semantics of sentences, sentence writing, phrasing and rephrasing of sentences.

### **UNIT – III**

Writing skills: Introduction to Writing Skills, Effective Writing Skills, Avoiding Common Errors, Paragraph Writing, Note Taking, Writing Assignments, resume writing, CV writing, report writing Purpose and Scope of a Report, Fundamental Principles of Report Writing, Making formal presentations

## UNIT – IV

Technical writing: Thesis/ dissertation writing, Popular article writing, Research/ review article writing, Project Report Writing, Summer Internship Reports, Writing ethics, Plagiarism, similarity index.

### **Recommended Readings:**

- Jones, L. (2001), Working in English, Cambridge University Press
- Raman, M. and Singh, P. (2012), Business Communication, Oxford; Second edition
- Jha, M. (2007), Echoes: A Course in English Literature and Language, Orient Longman Publishers
- Swan, M. (2017), Practical English Usage, Oxford University Press; 4<sup>th</sup> International edition
- Sethi, A. and Adhikari, B. (2009), Business Communication - Tata McGraw Hill

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and understand the terms and concepts related to nutrition and health
- Explain and classify the requirements and sources of nutrients essential for health and their role in infection and diseases
- Distinguish the role of nutrition education and different organizations for improving human health
- Formulate balanced diet plans for different vulnerable groups according to RDAs

#### UNIT – I

Scope, concepts and importance of nutrition; definition of various terms related to nutrition, human digestive system. Malnutrition and its types, epidemiology of under nutrition and over nutrition, nutrition infection and immunity

#### UNIT – II

Nutrients: classification, functions, sources, requirement and deficiency of proteins, carbohydrates, lipids, vitamins and minerals. Importance of dietary fibre and water in human health.

#### UNIT – III

Energy: definition, units of measurement of energy, basal metabolic rate (BMR), specific dynamic action (SDA) of foods, factors affecting BMR and respiratory quotient (RQ). Recommended dietary allowance (RDA) for reference man and woman, concept of balanced diets, diets for different age groups, role of nutrition in pregnancy and lactation, infant nutrition, childhood nutrition, geriatric nutrition; Nutrition for special groups (space & sports). Introductory therapeutic nutrition

#### UNIT – IV

Importance of nutrition education, role of different national and international organizations in maintaining health and nutritional status, nutritional policies like food for work, mid-day meals, integrated child development services (ICDS) vitamin A and Iron, prophylaxis, measures. Existing food fads, fallacies and faulty food habits.

**Recommended Readings:**

- Joshi, S. A. (1995). Nutrition and Dietetics. Tata Mc Grow- Hill Publishing Company Ltd., New Delhi
- Swaminathan. M. (2015). Foods and Nutrition Vol I & II, NIN Publications.
- Manay, S. and Shadksharawamis, N. (2005). Food: Facts and Principles, New Age International Pvt.Ltd., New Delhi.
- Mann, J. and Truswell, S. (2007). Essentials of Human Nutrition 3rd Ed. Oxford University Press.
- Khanna, K. (1997). Textbook of Nutrition and Dietetics, Phoenix Publisher House Pvt. Ltd., New Delhi.
- Eastwood, M. S. (2003). Principles of Human Nutrition 2 ed, Blackwell Publishers.

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the microbiology of various food products
- Identify the important pathogens and spoilage microorganisms in foods
- Demonstrate understanding of how microorganisms enter and grow in food or can be used to make food and processes to identify and control food borne disease and food spoilage
- Compare the role and significance of microbial inactivation, adaptation and environmental factors (i.e., aw, pH, temperature) on growth
- Formulate different microorganisms for different industrial applications

#### UNIT – I

Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classification, Prokaryotes and Eukaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods- vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing.

#### UNIT – II

Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food product. Microbiology of food preservation, heating process, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.

#### UNIT – III

Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein, Genetically modified foods

## UNIT – IV

Food microbiology and public health: food poisoning and microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, Food Allergens, hurdle technology and its applications.

### **Recommended readings:**

- Frazier, W. C. and Westhoff, D. C. (2015). Food Microbiology: Tata McGraw Hill Publication, New Delhi.
- Adam, M. R. and Moss, M. O. (2008). Food Microbiology: Royal Society of Chemistry, Cambridge.
- James, M. J. (2005). Modern Food Microbiology (5th ed.): CBS Publishers, New Delhi.
- Stanier, R.Y. (1996). General Microbiology (5th ed.): MacMillan, Hampshire.
- Creager, J. G., Black, J. G. and Davison, V. E. (1990). Microbiology: Principles & Applications. Prentice Hall, New Jersey.
- Frazier, W. C. and Westhoff, D. C. (1995). Food Microbiology (4th ed.). TMH, New Delhi.

### ***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*



*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the structure of rice and its quality parameters for storage, export etc
- Explain the physical and chemical characteristics of rice quality
- Discuss the rice milling process and its related equipments
- Formulate different value-added products from rice

#### UNIT – I

Rice grain structure and quality, Post-harvest processing of paddy, Paddy- threshing, drying and storage, Different types of rice available in world and Indian market, Cooking quality of rice, Regulatory framework for rice quality (Export/Import Quality of basmati rice)

#### UNIT – II

Parboiling process, different methods of parboiling; Advantages of parboiling, Importance of grain dryers; types of dehuskers – rubber roll sheller, centrifugal sheller & under runner disc sheller; paddy cleaners

#### UNIT – III

Raw and Rice milling studies with laboratory equipments, Machinery for rice milling: Hullers & Modern rice milling machinery – grain scalpors / cleaners, rice polishers, rice graders, by-products of rice milling, rice bran oil

#### UNIT – IV

Value added products from rice – traditional foods, extruded products, health drinks, convenient food products, Ageing of rice, Packaging of rice, bagging, BIS Grades of rice; quick cooking rice, Storage of rice

#### **Recommended Readings:**

- C. Wayne Smith, Robert H. Dilday, Rice: Origin, History, Technology, and Production, John Wiley & Sons.
- Julliano, B.O., Rice Chemistry and Technology, AACC, USA.

- Matz, S.A. (1970). Cereal Technology, AVI Publishing Co.
- Kulp K. (2000). Handbook of Cereal Science and Technology, 2<sup>nd</sup> Edition, CRC Press.
- Dendy D. A. V. & Dobraszczyk B. J., (2001). Cereal and Cereal Products. Aspen.
- Kent, N.L., Technology of Cereals, CBS Publisher.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**2BVFPE05**

**Rice Grain Structure, Quality and Milling Lab**

**Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe different techniques for studying rice grain structure
- Understand the experimental/laboratory and industrial rice milling
- Operate and maintain various equipments of rice grain milling and analysis
- Evaluate the different factors affecting the milling yield and cooking quality of rice

**List of Practicals:**

- Quality evaluation of paddy grain and milled rice on the basis of physical and chemical characteristics
- Comparison of different rice samples produced in the market and discussion
- Sorter and grader for rice; Grading of Rice
- Dehusking of rice
- Factors affecting milling of Rice; Effect of drying conditions on milling
- Rice polishing
- Efficiency of different process in lab
- Calculation of milling yield
- Cooking quality of rice
- Practical demonstration on rice milling process in rice mill
- Testing a rice mill for performance and quality

**Recommended Readings:**

- Kshirod R. Bhattacharya (2011). Rice Quality - A Guide to Rice Properties and Analysis, Woodhead Publishing Series.

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define importance, nutritional value, physical characteristics of major pulses and oilseeds
- Understand the processing techniques in pulse and oilseed processing
- Demonstrate the technology for oil extraction from oilseeds
- Develop new processes and applications for value added products and by-products from pulses and oilseeds

#### **UNIT – I**

Major pulses and oilseeds, Chemical composition and nutritional value; quality characteristics of pulses and oilseeds, Anti-nutritional factors in pulses and oilseed, methods to reduce the anti-nutritional factors, Regulations and guidelines for pulses and oilseeds and their products

#### **UNIT – II**

Present status of pulse milling industry in India; Processing of pulses: Home scale, cottage scale and commercial methods of de-hulling; Modern techniques in dal mills; Dry and wet milling of pulses; Cooking quality of dhal, Pulses by products utilization

#### **UNIT – III**

Nutritional composition of different oilseeds, Post-harvest technology of oil seeds, Traditional and advanced methods of oil extraction, oil refining and packaging, Edible oil technology

#### **UNIT – IV**

Utilization of oil seed meals for different food uses; Protein concentrates and isolates. Technology for diary analogues and other food applications, Storage practices for pulses and oilseeds.

#### **Recommended Readings:**

- Salunkhe D. K., Kadam S. S., Chavan J. K. (1985). Post-Harvest Biotechnology of Legumes, CRC Press.

- Tiwari, B. K., Gowen, A., & McKenna, B. (Eds.) (2020). Pulse foods: processing, quality and nutraceutical applications. Academic Press.
- Chakraborty A. (2008). Post-Harvest Technology of Cereals, Pulses and Oil seeds, 3<sup>rd</sup> Edition, Oxford & Ibh Publishing Co. Pvt. Ltd.
- Smartt J. & Nwokolo E. (1996). Food and Feed from legumes and oilseed, Chapman and Hall Publishers.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**2BVFPE07 Pulses and Oilseeds Structure, Quality and Milling Lab Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define quality characteristics of major pulses and oilseeds
- Understand the process and technologies for pulse and oilseed processing
- Demonstrate the technology for oil extraction from oilseeds
- Develop new processes and applications for value added products and by-products from pulses and oilseeds

**List of Practicals:**

- Evaluation of different quality characteristics of pulses and oilseeds
- Cleaning, Grading and sorting of pulses
- Dehulling of pulses, machine efficiency of dehuller
- Pulse milling, particle size analysis of pulse flour
- Cooking quality of pulses
- Anti-nutritional factors in pulses
- Methods to minimise the anti-nutritional factors in pulses
- Development of protein concentrate and isolates
- Preparation of protein rich food products
- Preparation of dairy analogues
- Value added products from by-products of pulse milling industry
- Extraction of oils from oilseed
- Visit to a Pulse milling industry

**Recommended Readings:**

- Salunkhe, D. K., Kadam S. S., Chavan J. K. (1985). Post-Harvest Biotechnology of Legumes, CRC Press.

- Tiwari, B. K., Gowen, A., & McKenna, B. (Eds.) (2020). Pulse foods: processing, quality and nutraceutical applications. Academic Press.
- [https://old.fssai.gov.in/Portals/0/Pdf/Manual\\_Cereal\\_25\\_05\\_2016.pdf](https://old.fssai.gov.in/Portals/0/Pdf/Manual_Cereal_25_05_2016.pdf), Manual of Cereal and cereal products by FSSAI, New Delhi.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the morphology, composition, nutritive value and properties of major and minor millets and their processed products and by-products
- Understand the importance, working and problems associated with the processing of millets and pseudocereals like dehulling/threshing, milling etc. for improving their utilization
- Apply theoretical knowledge of millets and pseudocereals for developing value added products at the industrial level for wider applications
- Evaluate the changes resulted from various treatments and select the best suitable condition to minimize loss and improve quality
- Create problem solving strategies according to the current and future prospects of grain processing sector

#### UNIT – I

Status and future prospects of minor grains processing in India and worldwide. Minor grains: Introduction, Types (major and minor). Corn: morphology, nutritional composition, physico-chemical properties, importance and nutraceutical properties. Milling, processing, products and by products.

#### UNIT – II

Sorghum, Barley, Pearl millet: morphology, nutritional composition, physico-chemical properties, importance and nutraceutical properties, milling and technology. Processing, value added products and by products. Equipment's used for processing of millets.

#### UNIT – III

Finger, Foxtail millet, Kodo, Teff, Proso, Barnyard, little millet: Milling and technology of processing. Value added products: breakfast products, fortified food, weaning food, special food, fermented food. By products utilization of millets. Food application of millets.



## UNIT – IV

Pseudocereals: Introduction, chemistry and structure of pseudocereals, physico-chemical properties, importance and nutritive value, processing and value-added products, food application of pseudocereals.

### **Recommended Readings:**

- Wrigley, C. (2004). Encyclopedia of Grain Science. Academic Press, London, UK.
- White, P. J. and Johnson. L. Lawrence A. (2003). Corn: Chemistry and Technology, 2nd Ed., AACC International, Inc., St. Paul, MN, USA.
- David A.V. Dendy and Bogdan J. Dobraszczyk. (2001). Cereal and Cereal Products: Technology and Chemistry. Springer-Verlag, US.
- Kent, N.L. and Evers, A.D. (1994). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
- Matz, Samuel A. (1991). The Chemistry and Technology of Cereals as Food and Feed, 2nd Ed. Springer Science + Business Media, NY, USA.

### ***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define principles and procedures of millet processing and qualitative and quantitative analysis of millets and their products
- Understand the importance of formulating and analyzing processed products of millets and pseudocereals
- Operate and maintain various equipment's of millet processing
- Evaluate the industrial problems related to millet processing
- Develop millet based new products having nutraceutical properties

**List of Practicals:**

- Physical parameters of minor grains (size, shape, geometric mean diameter, surface area, volume, sphericity, 1000 kernel weight, bulk density, porosity, tapped density, sphericity and roundness)
- Proximate analysis (moisture, Ash, crude fat, crude fibre, and crude protein and carbohydrate)
- Functional properties (Hydration capacity, Hydration Index, swelling capacity, Swelling Index)
- Cooking Quality of Millets
- Pearling index
- Processing of millets: germination, roasting, fermentation
- Preparation of value-added products of minor grains
- Traditional and convenient foods
- Visit to millet processing industry
- Starch extraction and modification from pseudocereals and their food applications

**Recommended Readings:**

- Wrigley, C. (2004). Encyclopedia of Grain Science. Academic Press, London, UK.

- White, P. J. and Johnson. L. Lawrence A. (2003). Corn: Chemistry and Technology, 2nd Ed., AACC International, Inc., St. Paul, MN, USA.
- David A.V. Dendy and Bogdan J. Dobraszczyk. (2001). Cereal and Cereal Products: Technology and Chemistry. Springer-Verlag, US.
- Kent, N.L. and Evers, A.D. (1994). Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of this course, the students will be able to:

- Understand the importance of various aspects of business management
- Identify marketing strategies according to the food product
- Evaluate the import, export and legal matters of various commodities
- Design and formulate small/large scale food business project report

#### **UNIT – I**

Business: meaning, nature and scope, forms of business organization, commerce industry and trade, business combination and rationalization, introduction to management, planning and decision making, organizing and communicating, organizational leadership, managerial control. Objectives, importance in respect to Indian economy and globalization. agricultural and food policy, new product development, value analysis, quality control and improvement, process selection. forecasting; new business forecasting, cost forecasting, product forecasting, food commodity trading

#### **UNIT – II**

Introduction to human resource management, selection, recruitment, training, development and performance appraisal of human resources, Marketing management; attributes of marketing of agricultural input and marketing of agricultural product. market research for food business. different type of management in food business; production, management, retail and supply chain management, inventory management (introduction, functions, attributes, needs)

#### **UNIT – III**

Introduction to industrial relations, functions of financial management, understanding financial statements, analysis and interpretation of financial statements, responsibility accounting and reporting, web-based accounting and reporting. elementary knowledge of income tax, sales tax, patent rules, excise rules, factory act and payment of wages act etc. Entrepreneurship development programs (EDP); meaning, characteristics and functions of an entrepreneur, Government schemes, policies and incentives for promotion of entrepreneurship, on small and medium enterprises (SMEs)/ small scale industries (SSIs).

Characteristics of Indian food processing industry. Social responsibility of food processing business.

#### UNIT – IV

World trade agreements related with food business, export trends and prospects of food products in India. Consumer behaviour towards food consumption, consumer surveys by various institutes and agencies. Govt. institutions related to international trade; APEDA, tea board, spice board, wine board, MOFPI etc. Management of export-import organization; registration, documentation, export import logistics, export and import policies relevant to food sector. World Food Day - importance and action plans. legal aspects of small business; International business, export procedures and documentation, import procedure and documentation, international transfer pricing, international taxation, business environment and public utilities.

#### **Recommended Readings:**

- Greg, A.B., Orlen, G. and Gorman, D. (2002). Introduction to Food and Agribusiness Management: Prentice Hall of India, New Delhi.
- Khanks, S.S. (1999). Entrepreneurial Development. S. Chand and Company, New Delhi.
- Acharya, S.S. and Aggarwal, N. L. (1987). Agricultural Marketing in India. Oxford & ISH Publishing CO., New Delhi.
- Edward, W.C. (1993). Marketing in the International Environment. Prentice Hall of India, New Delhi.
- Kotler, P. (1994). Marketing Management. Prentice Hall of India, New Delhi.
- Jordan, L. (2015). Food Industry: Food Processing and Management. Callisto Reference; Illustrated edition.
- Jeffrey, D. H. (2014). Economics and Management of the Food Industry. Taylor & Francis Ltd.

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*questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define food preservatives, additives, flavouring agents, sweeteners, nutrients and thickeners for healthy foods
- Classify the role of different food additives in food processing industry with their roles
- Apply various techniques for commercial production of different food additives
- Compare role of various food additives in health maintenance and cure of diseases
- Select the additives according to their mode of action and compatibility with food products

#### UNIT – I

Food Additives: definitions, classification and applications, food preservatives-classifications, antimicrobial agents, types and their action, safety concerns, regulatory issues in India, international legal issues; Antioxidants (synthetic and natural, mechanism of oxidation inhibition), anti-browning agent (types and mode of action, application); Chelating agents: types, uses and mode of action; Colouring agents: color retention agents, applications and natural colorants, sources of natural color, misbranded colors, color extraction techniques, color stabilization.

#### UNIT – II

Flavoring Agents: flavors (natural and synthetic flavors), flavor enhancers, flavor stabilization, flavor encapsulation; Flour improvers: leavening agents, humectants and sequesterant, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents.

#### UNIT - III

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products; Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

## UNIT - IV

Nutrient supplements & thickeners: polysaccharides, bulking agents, antifoaming agents, synergists, antagonists; additives food uses and functions in formulations, permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases).

### **Recommended Readings:**

- Branen A. L., Davidson P. M., and Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
- Gerorge A. B., (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
- Gerorge A. B., (2004). Fenaroli's Handbook of Flavor Ingredients 5th Ed. CRC Press.
- Morton I. D. and Macleod A. J., (1990). Food Flavours. Part A, B & C. Elsevier.
- Stephen A. M., (2006). Food Polysaccharides and Their Applications. Marcel Dekker.

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and describe yoga and stress
- Explain relevance and scope of yoga in modern age
- Interpret the impact of yoga, stress, eustress, distress and factors affecting yoga and stress
- Select and evaluate various yoga practices and their effects

#### UNIT – I

Yoga it's Meaning and Definitions; Aim and Objectives of Yoga; Relevance and scope of Yoga in modern age; Place, Timing and costumes of Yogic practices Misconceptions about Yoga and their solutions; Difference between Yogic and non-Yogic system of exercises

#### UNIT – II

Bahiranga Yoga:Yama, Niyama, Asana, Pranayama and Pratyahara (its meaning, results and utilities), Antaranga Yoga: Dharna, Dhayana and Samadhi (its meaning, results and utilities)

#### UNIT – III

Stress: An overview, concept of stress, types of stress: distress and eustress and stages of distress and its consequences; Shirley's general adaptation syndrome; fight and flight response during stress, stress reactions, factors that affect our stress, Psychosocial causes of stress

#### UNIT – IV

Integrated approach for management of Stress through Panchkosha; Effect of various Yoga practices (shatkarma, asana, pranayama, mudra-bandha) on Mind and Body: Various relaxation techniques; Instant Relaxation Technique, Quick Relaxation Technique, Deep Relaxation Technique, Yoga Nidra

#### **Recommended Readings:**

- Saraswati V. (1998), YogVijyan, Yoga nicketan trust, Rishikesh.
- Saraswati S.S.,Four Chapters of Freedom, BYS, Munger.
- Sao A.K., Sao A., Tanav evam Yoga, Radha Publications, Delhi.

- Fink G. (2019), Stress: Physiology, Biochemistry, and Pathology (1<sup>st</sup> edition), Kindle Academic Press Publisher.
- Gulati S. (2017), Art of Stress management (1<sup>st</sup> edition), Rupa Publications India.
- Nagendra H.R. and Nagarathna R. (2008), Perspective of Stress and its Management (2<sup>nd</sup> edition), Swami Vivekananda Yoga Publication Trust, Bangalore.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

### **3BVFPE 04    Functionality of Wheat Flour Components and Bakery Ingredients**

**Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of this course, the students will be able to:

- Understand the importance, role and interaction of each wheat flour component with each other
- Know about the various types of food products made using baking technology
- Demonstrate and use wheat components for the formulation of different bakery and confectionary products
- Examine and experiment the importance of minor ingredient in the bakery and how it effects the overall product

#### **UNIT – I**

Wheat proteins and enzymes structure: composition and classification, structural properties of protein functionality in bakery products, role of proteins in making of bread, biscuits, cakes and cookies. Manufacturing techniques of wheat gluten: general process, industrial process, uses and functionality of gluten. Enzymes in wheat.

#### **UNIT – II**

Wheat lipids & starch structure: wheat lipids, effects of lipids on rheological properties, functionality of defatted flours, role of wheat flour lipids fractions, effects of lipids on biscuit, cookies and cake quality, wheat starch, role of damaged starch in bakery products.

#### **UNIT – III**

Functionality of major ingredients: structure, role of water in the formation and processing of wheat bread, biscuit and cookie dough. Contribution of water during processing, baking, cooling and freezing of dough, Baker's yeast – production, functions and properties of yeast, functions of salt, sweeteners, fat/shortening.

#### **UNIT – IV**

Functionality of minor ingredients structure: Milk and milk products general functions, role of NFDM (non-fat dry milk), whey products, role of butter milk powder, malt and malt products, yeast food, oxidising agents, reducing agents, surfactants and anti-microbial agents.

**Recommended Readings:**

- Eliasson, A.C. and Larsson, K. (1993). Cereals in Bread making, Marcel Dekker, Inc. New York.
- Dobraszczyk B.J., Dendy DAV. (2001). Cereal and Cereal Products: Chemistry and Technology. Aspen Publisher, Inc Maryland.
- Pomeranz, Y. (1998). Wheat: Chemistry and Technology, Vol. I, 3rd Ed., American Assoc. Cereal Chemists, St. Paul, MN, USA.
- Pomeranz, Y. (1989). Wheat is Unique. AACCC Inc. St. Paul MN. USA.
- Phillips, R.D. and Finley, J.W. (1989). Protein Quality and the effects of processing, Marcel Dekker, New York.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

### **3BVFPE 05    Functionality of Wheat Flour Components and Bakery Ingredients Lab**

**Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of this course, the students will be able to:

- Understand basic working principles of bakery and confectionery equipments
- Analyse various product properties
- Evaluate quantitatively the various nutrients of the final products
- Differentiate product properties based on use of ingredients

**List of Practicals:**

- Introduction to bakery equipments and confectionery equipments
- Chemical analysis of flour: moisture, ash, protein content
- Estimation of starch and damaged starch content in given flour sample
- Flour color analysis: Single Kernel Characterization System (SKCS)
- Gluten quantity and quality evaluation
- Particle size analysis of flour and its importance in baked products
- Evaluate the performance of given yeast sample
- Dough and gluten strength tests by using different equipments like Extensograph, Alveograph, Mixograph
- Evaluate the flour starch viscosity profile by using Amylograph, Rapid Visco Analyzer
- Effect of different types of fats on baked product analysis
- Effect of mixing speed on dough characteristics
- Impact of different types of mixers on dough quality
- Evaluate the effect of different types of additives on dough and baked product quality
- Visit to bakery units

**Recommended Readings:**

- Zhou, W., Hui, Y. H. (2014). Bakery Products Science and Technology, 2nd Edition, Wiley Blackwell Publishers.
- Pyler, E. J. and Gorton, L.A. (2009). Baking Science and Technology. Vol.1 Fourth EditionSOS land Publications.
- Stanley, P.C. and Linda, S. Y. (2008). Baked Products: Science Technology and Practice. John Wiley & Sons Publishers.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe rheological characteristics of dough
- Conceptualize the process role in rheology
- Understand the functionality of various constituents in rheology

#### UNIT – I

Basic approaches to dough rheology: Dough structure and basics of rheology. Empirical and dynamic rheology, Creep and recovery, Viscometry, stress relaxation, oscillatory measurements

#### UNIT – II

Rheology of dough and gluten, Importance of dough and gluten viscoelasticity in gas retention and bread making.

#### UNIT – III

Bakery ingredients and dough rheology: Effects of water, yeast, oxidation and compounds with disulfide and thiol groups, sugar and emulsifiers on rheological properties of dough.

#### UNIT – IV

Influence of proteins, gluten, starch and enzymes on rheological properties of dough. Effects of mechanical work, mixing time and temperature on dough rheology

#### **Recommended Readings:**

- Pyler, E. J. (1988). Baking science & Technology. Sosland Pub. Co.
- Khetarpaul, N. (2005). Bakery science and cereal technology. Daya Books.
- Manley, D. (2000). Technology of biscuits, crackers and cookies. Woodhead Publishing Ltd.
- Davidson, I. (2018). Biscuit, cookie and cracker production: process, production and packaging equipment. Academic Press.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*



*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe properties and functions of the basic ingredients used in baked goods
- Resize recipes to meet production, market needs and equipment capacities
- Demonstrate proper storage techniques for all baked products

#### **UNIT – I**

Classification and processing technology of biscuits, Ingredients, Hard & soft dough biscuits, Unit operations in product development, product packaging, quality evaluation

#### **UNIT – II**

Cookies & Crackers, Types, Ingredients, Process of cookie preparation, Unit operations in product development, Product packaging, quality evaluation

#### **UNIT – III**

Cakes, Types of cakes, Ingredients, Processing & technology of cakes, Formula balancing, Cake quality evaluation, Cake defects & remedies

#### **UNIT – IV**

Regulatory guidelines for soft wheat products, Market potential, Storage practices, Hazards associated with soft wheat products, safety perspective

#### **Recommended Readings:**

- Pyler, E. J. (1988). Baking Science & Technology. Sosland Pub. Co.
- Khetarpaul, N. (2005). Bakery Science and Cereal Technology. Daya Books.
- Manley, D. (2000). Technology of Biscuits, Crackers and Cookies. Woodhead Publishing Ltd.
- Davidson, I. (2018). Biscuit, Cookie and Cracker Production: Process, Production and Packaging Equipment. Academic Press.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**3BVFPE08**

**Soft Wheat Products and Processes Lab**

**Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Understand the behaviour of ingredients in product formulation and quality
- Develop formulations as per specific requirement of consumer and industry
- Design new soft wheat products

**List of Practicals:**

- Market survey of different soft wheat products
- Role of ingredients in biscuits
- Effect of ingredients on product quality
- Particle size standardization for soft wheat products
- Formulation of high fiber cookies
- Preparation of crackers
- Preparation of different types of cakes
- Design of soft wheat products for specific target groups
- Quality evaluations of various soft wheat products
- Effect of storage conditions on soft wheat products quality

**Recommended Readings:**

- Pylar, E. J. (1988). Baking science & technology. Sosland Pub. Co.
- Khetarpaul, N. (2005). Bakery science and cereal technology. Daya Books
- Davidson, I. (2018). Biscuit, cookie and cracker production: process, production and packaging equipment. Academic Press.

**3BVFPE09**

**Industrial Training Report and Seminar**

**Credits: 0+0+2**

***Evaluation: Internal (100)***

**Course Outcomes:** After the completion of the course, the students will be able to:

- Develop the knowledge on legal aspects and government policy relating to entrepreneurship
- Understand the significance and Knowledge of employee relations and legislation related to employees in modern food industries and business operations
- Outline the nature, scope and structure of modern industry and the production function
- Judge the process of entrepreneurship and the institutional facilities available to an entrepreneur in India

**4BVFPE01**

**Food Safety and Total Quality Management**

**Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and describe Quality, management philosophies, HACCP, accreditation and certification
- Explain relevance and scope of audit training and management in food Sector
- Interpret the effect of Quality, management philosophies and certification on food industries
- Select and evaluate various steps used in food industries for accreditation and certification

#### **UNIT – I**

Introduction to Quality: Defining quality, Quality control & quality assurance, Total Quality Management: Objectives, principles, implementation; Benefits of TQM, Quality Tools, Quality Circle

#### **UNIT – II**

Other Management Philosophies: 5S, Six sigma, Lean manufacturing, Just-In-Time (JIT), Kanban, International Organization for standardization (ISO): Introduction, ISO standards, benefits, procedure. ISO 9000, PRP for Food Safety: GAP – objectives, principles, benefits; GLP – need, history, objectives, principles, bodies; GHP – objectives, principles; GMP – objectives, GMP in food industry

#### **UNIT – III**

HACCP: Introduction, History of HACCP, Definitions related to HACCP system, Principles of HACCP, application of HACCP system, implementation steps for HAACP system, Benefits of HACCP, ISO 22000: Introduction, History, benefits, Objectives, ISO 22000 family of standards series, ISO standard document, Role of BIS in ISO 22000 GFSI, FSSC 22000, IFS, SQF, AIB, GRMS, PAS 96

#### **UNIT – IV**

Accreditation and Certification: Introduction, Benefits, accreditation organizations, Certification, Types of certifications, Certification Bodies in India FSSAI, QCI, BIS, AGMARK Documentation Auditing and Surveillance: Introduction, Definition, Objectives of

auditing, Types of Audit, Principles of Auditing, Audit Program Procedures, Audit Activities, Audit Competencies, Lead Auditor, Surveillance.

**Recommended Readings:**

- Vasconcellos J.A. (2003). Quality Assurance for Food Industry – A Practical Approach, CRC Press, Boca Raton
- Alli I. (2003). Food Quality Assurance -Principles and Practices, CRC Press, Boca Raton
- Corlett D.A. (1998). HACCP User’s Manual, An Aspen Publication, Maryland
- Gould W.A. and Gould W.B. (2001). Total Quality Assurance for the Food Industry, 3<sup>rd</sup> Edition, CTI Publications
- Clute M. (2008). Food Industry Quality Control Systems, CRC Press, Boca Raton
- Early R. (1995). Guide to Quality Management Systems for Food Industries, Blackie Academic

***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe basic concepts of engineering thermodynamics and the practical application of thermodynamic laws
- Illustrate the implementation of 1<sup>st</sup> law of thermodynamics for different flow processes and apply the basic concepts of heat engine, heat pump and refrigerator used in engineering field
- Evaluate the ideal thermodynamic air standard cycles and mathematical relationships between different thermodynamic properties
- Construct the various thermodynamic models using various properties

#### UNIT – I

Basic Concepts: Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property– Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasistatic, Reversible and Irreversible Processes, Working Substance, Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility. Problems. First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, PMM-1, Steady flow energy equation, 1st Law Applied to Non- flow process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process. Problems

#### UNIT – II

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir, Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMM-2, Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries, Thermodynamic Temperature Scale, Entropy, Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Problems

### UNIT – III

Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avogadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas, Vander Waal's Equation of state, Reduced Coordinates, Compressibility factor and law of corresponding states, Mixture of Gases, Mass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of non-reactive gases. Problems

### UNIT – IV

Thermodynamic Air Cycles: Introduction, Assumptions in Thermodynamic Cycles, Classifications of Thermodynamic Cycles, Reversible Cycle, Irreversible Cycle, Working of an Ideal Engine, Stirling Cycle, Ericsson Cycle, Bryton Cycle, Otto Cycle, Diesel Cycle, Dual Combustion Cycle. Problems. Thermodynamic Relations: Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversion curve

#### **Recommended Readings:**

- Bejan A. (2006). Advanced engineering thermodynamics, 4<sup>th</sup> Edition, Wiley Publications.
- Chattopadhyay P. (2011). Engineering thermodynamics, Revised 1<sup>st</sup> edition, Oxford University Press.
- Cengel Y. and Boles M. (2008). Thermodynamics: An Engineering Approach, 8<sup>th</sup> edition, Tata McGraw Hill.
- Nag P.K. (2013), Engineering Thermodynamics, 5<sup>th</sup> edition, Tata McGraw Hill.
- Moran M.J., Shapiro H.N., Boettner D.D and Bailey M.B. (2010), Fundamentals of Engineering Thermodynamics, 7<sup>th</sup> Edition, Wiley Publications.

#### ***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- State the environment related issues and challenges in sustainable development
- Demonstrate the understanding of various environment hazards and means of protection against these hazards
- Apply irreplaceable tool to provide first-hand knowledge on various environmental aspects in the entire learning process
- Analyze impacts of human business and developmental activities on the environment
- Design and evaluate strategies for sustainable management of environmental ecosystems

#### UNIT – I

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, Food webs and ecological pyramids; Introduction, types, characteristics features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries).

#### UNIT – II

Renewable and non-renewable resources, Natural resources and associated problems ,Forest resources: Use and over-exploitation, deforestation, case studies, Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

### UNIT – III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

### UNIT – IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies. Different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness.

#### **Recommended Readings:**

- Bharucha, E. (2005). Environmental Studies for Undergraduate Courses, University press pvt. Ltd. (India).
- Mishra, D. D. (2008). Fundamental concepts in Environmental studies, S. Chand publications.
- Rana, S .V .S. (2013). Essentials of Ecology and Environmental Science, PHI Learning Pvt. Ltd Delhi.
- Kumar, A. De (1994). Environmental Chemistry, Wiley Eastern Limited.
- Miller, T. G. (2013). Environmental Science, Wadsworth Publishing Co, 13<sup>th</sup> edition.
- Sharma, P. D. (2003). Ecology and Environment, Rastogi publications, 13<sup>th</sup> edition.

***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the basic operations in bread formulation
- Discuss the various developments in bread making process
- Explain the general bread spoilage and staling process
- Formulate the different varieties of breads

#### UNIT – I

Bread making process: Status of bakery industry, bread formulation, basic bread making procedure – mixing, fermentation, proofing and baking. Functions of mixing, types of mixer, functions of moulding and dividing, functions of proving, changes during mixing, fermentation and baking unit operations.

#### UNIT – II

Developments in bread making processes: Straight dough process, sponge dough process and chemical dough development process, frozen dough process, micro-wave process. Advantages and limitations of various bread processes, Packaging of bread.

#### UNIT – III

Variety bread products: Multigrain bread-high fibre bread, cracked wheat bread, sour dough bread, milk bread, composite flour bread, high protein bread, wheat germ bread, sugar free bread, low calorie bread low salt bread and gluten free bread. Formulations and processing of variety breads. Assessment of quality of bread.

#### UNIT –IV

Bread spoilage and staling: Microbial spoilage of bread - mold, bacteria and yeast spoilage, Control of microbiological spoilage of bread. Bread staling – crust and crumb staling, role of bread ingredients in staling. Staling inhibitors - enzymes, emulsifiers, pantosans, alcohol and sugars, freezing of bread.

**Recommended Readings:**

- Cauvain S.P. and Young L.S. (2007). Technology of Bread Making, 2<sup>nd</sup> edition, Springer US Publications.
- Owens G. (2001). Cereals Processing Technology, 1<sup>st</sup> edition, Woodhead publishing agency.
- Pomeranz Y. (1988). Wheat Chemistry and Technology (Volume-2), 3<sup>rd</sup> edition.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Discuss the various methods of bread manufacturing
- Examine the effect of ingredients on the overall quality and shelf life of bread
- Operate the various equipments used in manufacturing and quality evaluation of dough and bread
- Formulate different types of speciality breads

**List of Practicals:**

- Effect of major and minor ingredients on the quality of bread
- Preparation of bread by using different methods
- Sensory and physico-chemical quality evaluation of bread
- Determination of rheological properties of bread dough
- Effect of hydrophilic ingredients on bread quality
- Preparation of different types of bread like high fibre bread, multigrain bread, gluten free bread etc.
- Preparation of different types of fancy and speciality breads
- Effect of storage conditions on bread quality
- Effect of major ingredients on bread staling
- Effect of minor ingredients on bread staling
- Effect of staling agents on bread quality
- Studies on frozen dough in context of shelf life and rheological properties

**Recommended Readings:**

- Jago W. (2015). A Text-book of The Science and Art of Bread-making: Including The Chemistry and Analytic and Practical Testing of Wheat, Flour and Other Materials Employed in Baking, Andesite Press.
- Cauvain S.P. and Young L.S. (2007). Technology of Bread Making, 2<sup>nd</sup> edition, Springer US Publications.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the role of various raw materials used in preparation of confectionery products
- Explain the manufacturing process and technological aspects of sugar boiled and chocolate confectionery
- Examine the factors affecting the quality of various confectionery products
- Develop new confectionary products according to existing food safety rules and regulations

#### UNIT – I

Status of confectionery industry in India; Raw materials for confectionery products- essential and optional ingredients and their role; FSSAI specification of raw materials; confectionery types, equipments used in confectionery industry.

#### UNIT – II

Types of candies: boiled sweets, hard candy, brittle; Sugar Panned confectionery products and their manufacturing technology, manufacturing process of toffees, caramels, fudge lozenges, liquorice, chewing gum, bars; Sugar free confectionery.

#### UNIT – III

Production and Quality Standards of Cocoa Mass, Cocoa Butter and Cocoa Powder, Chocolates: General manufacturing process, conching, tempering, enrobing etc., types of chocolate, quality consideration and parameters, chocolate defects and their control measures, chocolate Panned confectionery products

#### UNIT – IV

Legal standards (FSSAI) for confectionery products (sugar boiled confectionery, chocolate etc.), sugar boiled confectionery defects and their preventive measures, plant layout for confectionery industry, packaging requirements for confectionery products, types of packaging in confectionery

#### **Recommended Readings:**

- Minifie, B.W. (1989). Chocolate, Cocoa and Confectionery: Science and Technology (3<sup>rd</sup> Edition), Springer Publications

- Edwards W.P. (2000). The Science of Sugar Confectionery, Royal Society of Chemistry publishers
- Jha M. (2012). Modern Technology of Confectionery Industries With Formulae & Processes, 2<sup>nd</sup> edition, Asia Pacific Business Press

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*



*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Apply the various methods for quality analysis of raw materials and finished products in confectionery industry
- Examine the effect of ingredients on the overall quality and shelf life of confectionery products
- Operate the various equipments used in manufacturing and quality evaluation of confectionery products
- Formulate different types of sugar and chocolate based confectionery products

**List of Practicals:**

- Preliminary testing of raw materials – cane sugar, cocoa, gur/jaggery, glucose etc.
- Preparation of different types of candy
- Preparation of fondant and fudge
- Preparation of milk and dark chocolate
- Testing of sugar boiled confectionery and chewing gum – reducing sugar, sucrose, filth in candy, added synthetic colour, alcohol in syrups, paraffin, shellac
- Testing of chocolate and cocoa based products – rancidity, cocoa solids, chocolate component of filled chocolate and microbiological testing etc.
- Testing of edible ices –reducing sugar, sucrose, microbiological testing etc.
- Shelf-life studies of different confectionery products

**Recommended Readings:**

- FSSAI (2012). Beverages (coffee, tea, cocoa, chicory, sugar and sugar products and confectionery products), Manuals of methods of analysis of Foods, Lab Manual 4.
- Jha M. (2012). Modern Technology Of Confectionery Industries With Formulae & Processes, 2<sup>nd</sup> edition, Asia Pacific Business Press.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Understand and compare different types and characteristics of packaging materials w.r.t bakery products
- Explain the different levels and packaging styles for bakery products
- Examine the shelf life of different bakery products using different packaging techniques
- Design and develop the packaging as per requirement of specific bakery products

#### UNIT – I

Importance, essential features and characteristics of an ideal package and packaging materials w.r.t. baked products, Criteria for selection of packaging materials in baked products, causes of bakery products deterioration, General classification of packaging materials suitable to the moist and dry products, Packaging styles: enfold wrapping, pillow pack wrapping, packaging for odd sized packets.

#### UNIT – II

Type of packaging specific to product: Biscuit packaging, bread and cake packaging, Flexible films: cellulose films, plastic films, metalized films, laminates, aluminium foils, Materials used within packs for added protection, overwraps for transportation and storage: cartons, multipacks, fiberites, shrink wraps, tins, Plain cardboard packaging, active packaging, flushing with inert gases, gas packaging, display packaging, vertical sachet or pouches, poly bags, shrink wrapped/ over wrapped boxes and trays, tube packaging.

#### UNIT – III

Methods and machineries involved (primary, secondary and tertiary) in packaging. Types of packs: types of pack seals, horizontal pack seal, vertical form fill seal packs, roll packs, block bottom bags, cartooning machines setting up machines for changes, Packet coding, Post packaging operations: check weighing, foreign matter detection, palletisation.

#### UNIT – IV

Selection of packaging materials and standards for baked products, Recent packaging techniques to extend the shelf life of the product, Technologies – MAP and hermetic packaging, Recent

trends in the field of packaging (active packaging, intelligent packaging, RFID), label regulations and designing for bakery products, nutritional labelling.

**Recommended Readings:**

- Robertson G. L., (2006). Food Packaging: Principles and Practice, 2<sup>nd</sup> edition, Taylor and Francis Group.
- Ahvenainen R., (2003). Novel food packaging techniques, Woodhead Publishing Ltd.
- Paine F.A. and Paine H.Y. (1992). A Hand Book of Food Packaging, Blackie Academic & Professional.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe various analytical procedure related to the quality testing of bakery product packaging
- Choose the best packaging material as per the product requirement in consideration with storage conditions
- Evaluate shelf life of bakery products through use of various packaging techniques
- Examine the role and effectiveness of various packaging systems with respect to bakery foods

**List of Practicals:**

- Study of foods package/label information of different baked food products
- To measure thickness of paper and paperboard
- Determination of GSM of packaging material
- Physical test for plastics films i.e. puncture resistance, tearing resistance, bursting strength and seal integrity
- Determination of gas transmission rates of packaging films
- Determination of water vapour permeability (WVTR) of packaging material
- To find the amount of coating on a tinplate
- Determination of grease resistance of paper
- To check physical characteristics of various market packages available in the market
- Identification and study of characteristics of packaging films used for bakery products
- Different packaging styles and equipments employed in various baked products: bread, biscuits, buns, muffins, doughnuts etc.
- Study of various active packaging techniques for extending shelf life of bakery products

**Recommended Readings:**

- Griffin C. R. and Sacharow, S. (1972), Principles of Package Development, The AVI Publishing Company Inc.
- Paine F.A. and Paine H.Y. (1992), A Hand Book of Food Packaging, Blackie Academic & Professional
- Ranganna S. (2017), Handbook of Analysis and Quality Control for Fruit and Vegetable Products, 2<sup>nd</sup> Edition, McGraw Hill Education

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe various technological aspects of traditional and modern snack foods
- Explain the working of extruders and the factors affecting their efficiency
- Apply the understanding of various processing techniques to manufacture various snack foods
- Operate the equipment of importance in the snack food industry

#### UNIT – I

Extrusion: Introduction to extruders and their principles, types of extruders, Extruders in the food industry: History and uses, Single screw extruder: principle of working, factors affecting extrusion process, co-kneaders, Twin screw extruder: Feeding, screw design, screw speed, screw configurations, Pre-conditioning of raw materials used in extrusion process: operations and benefits and devolatilization, Chemical and nutritional changes in food during extrusion. Addition and subtraction of materials, shaping and forming at the die. Post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.

#### UNIT – II

Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products), Breakfast cereal-manufacturing processes (traditional and modern methods), High shear cooking process and steam cookers, Texturized vegetable protein: definition, processing techniques, Direct expanded (DX) and third generation (3G) snacks: types, Concept of junk & fried foods and their impact on human health.

#### UNIT – III

Technology for grain-based snacks: Whole grains- roasted, toasted, puffed, popped, flaked, Coated grains- salted, spiced and sweetened, Formulation, processing and quality assessment of chips and wafers, papads, instant premixes of traditional Indian snack foods.

#### UNIT – IV

Technology for fruit and vegetable-based snacks- chips, wafers; Technology for coated nuts- salted, spiced and sweetened chikkies, Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping.

**Recommended Readings:**

- Booth R.G. (1997). Snack Food, CBS Publications, New Delhi.
- Raymond W. L. & Rooney L.W. (2001). Snack Foods Processing, CRC Publications, London.
- Lusas E.W. & Rooney L.W. (2015). Snack Foods Processing, CRC Publications, London.
- Guy R. (2001). Extrusion Cooking: Technologies and Applications, Woodhead Publications, USA.
- Riaz M.N. (2000). Extruders in Food Applications, Technomic Publications, Lanchester.

***Note for Paper Setters:***

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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Paraphrase the process of new product design
- Assess the market strategies for product launch
- Define the need of continuous improvement

#### UNIT – I

Concept of product development, Product success and failure, managing for product's success, Innovation strategy - possibilities for innovation, building up strategy, product development programme.

#### UNIT – II

Product development process, Product strategy, Product design and process development, Shelf-life studies, Product commercialization, Product launch and evaluation.

#### UNIT – III

Knowledge and the food system, Knowledge management, Technological knowledge (product qualities, raw material properties, processing), Packaging requirement, Distribution and marketing.

#### UNIT – IV

Role of consumers in product development, Consumer behaviour, Food preferences, Integration of consumer needs in product development and sensory needs, Legal aspects of new product launch.

#### **Recommended Readings:**

- Saguy, I. S., & Graf, E. (1990). Food product development: from concept to the marketplace. Springer Science & Business Media.
- Lawless, H. T., & Heymann, H. (2013). Sensory evaluation of food: principles and practices. Springer Science & Business Media.
- Fuller, G. W. (2016). New food product development: from concept to marketplace. CRC Press.



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*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and explain the concept of entrepreneurship and its related theories
- Analyse the business environment in order to identify business opportunities
- Interpret the legal and financial conditions for starting a business venture
- Evaluate effectiveness of different entrepreneurial strategies

#### **UNIT – I**

Entrepreneurship: Definition of Entrepreneur, Internal and External Factors, Functions of an Entrepreneur, Entrepreneurial motivation and Barriers, Classification of Entrepreneurship, Theory of Entrepreneurship, Concept of Entrepreneurship, Development of entrepreneurship; Concept of entrepreneur, Manager and Intrapreneur (differences in their roles, responsibilities and Career Opportunities).

#### **UNIT – II**

Creativity and Entrepreneurial Plan: The business plan as an entrepreneurial tool, Contents of a business plan, Idea Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic, Marketing, Financial and Technical; Project Planning: Evaluation, Monitoring and Control segmentation. Creative Problem Solving: Heuristics, Brainstorming, Synectics, Value Analysis, Innovation. Project Feasibility and Project Appraisal.

#### **UNIT – III**

Support System for Entrepreneurs: sources of capital, venture capital; Institutional Assistance and Support: role of Commercial Banks, institutional Assistance for Small Enterprises; Role of E-commerce in Business: Concept and Overview, opportunities and problems in e-commerce; Marketing Support for Entrepreneurs: Marketing Institutions and Assistance, Export Houses, Trading Houses.

#### **UNIT – IV**

International Entrepreneurship Opportunities: The nature of international entrepreneurship, Importance of international business to the firm, International versus domestic's entrepreneurship, Social responsibility of entrepreneurs, entrepreneurial development programs,

Business and professional ethics, Case studies on Indian Start-ups and successful entrepreneurs in India.

**Recommended Readings:**

- Khanka S.S. (1999). Entrepreneurial Development, S.Chand & Company Ltd., New Delhi.
- Drucker P.F. (2006). Innovation and Entrepreneurship, Harper Business Publications.
- Holt D. (1991). Entrepreneurship: New Venture Creation, Prentice Hall, India.
- Desai V. (2011). The Dynamics of Entrepreneurial Development and Management, 6<sup>th</sup> edition, Himalaya Publishing House.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and describe various physical and rheological properties of food and biomaterials
- Explain psychrometrics, dielectric, surface and colorimetric properties of foods
- Judge the processing technique to be adopted for various foods according to their properties
- Design the various equipments by considering the various properties of foods

#### **UNIT – I**

Mass, volume, area related properties of foods and their measurement techniques; Rheological properties of food: stress, strain, Hooke's law, elasticity, Plasticity, ductility; flow behaviour: Newtonian and Non-Newtonian fluid, Time dependent and independent flow behaviour

#### **UNIT – II**

Thermal properties of food: specific heat capacity, thermal conductivity, enthalpy, thermal diffusivity, experimental approach to measure thermal properties; Thermodynamic properties of food: Thermodynamic food-water system, sorption energy, significance of thermal properties; Psychrometrics: Properties of dry air, composition of air, specific heat of dry air, enthalpy of dry air, properties of water-vapour, properties of air-vapour mixtures, psychrometric chart, application of psychrometric chart in food processing

#### **UNIT – III**

Dielectric properties of food: principle, measurement, frequency and temperature dependence, composition dependence of dielectric properties; assessment of food quality by using dielectric properties, effects of processing and storage on dielectric properties of foods

#### **UNIT – IV**

Surface properties: surface tension, fundamental consideration, Gibbs adsorption equation and contact angle measurement techniques; colorimetric properties of food: measurement of colour, colour spectrum etc.

**Recommended Readings:**

- Rao M.A., Rizvi S.S.H., Datta A.K. & Jasim A. (2014). Engineering properties of foods, 4<sup>th</sup> edition, CRC Press.
- Lewis M.J. (1990). Physical Properties of Foods and Food Processing Systems, Woodhead Publishing.
- Devahastin S. (2011). Physicochemical aspects of food engineering and processing, CRC Publication.
- Singh R.P. & Heldman D.R. (2009). Introduction to Food Engineering 4<sup>th</sup> edition, Academic Press.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe actions taken to maintain foods with the desired properties or nature for long as needed
- Employ preservation methods that make use of heat/cold, drying, acid, added chemicals, controlled air, pressure and high energy radiation
- Judge the best method of food preservation on the basis of various properties
- Develop food handling practices that reduce the potential for food borne illness

#### UNIT – I

Introduction to food processing: basic principles, importance & techniques of preservation; Use of preservatives: Sugar and salt preservation, use of chemical preservatives in food, smoking, sulphur fumigation and pickling, purposes and advantages, classification of foods, types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality.

#### UNIT – II

High temperature processing: principles of thermal processing, pasteurization and sterilization, microbial destruction in batch and continuous sterilization; methods of heat transfer, heat resistance in microorganisms, factors affecting heat resistance in micro-organisms, Thermal Death Time (TDT) curve; ultra-heat treatment UHT processing; Industrial applications of canning and bottling: commercial canning operation, spoilage of canned food and its quality evaluation; food irradiation (commercial applications, quality/technological aspects); application of ultra violet (UV) rays in food, microwave heating, its mechanism, effects and applications in food preservation.

#### UNIT – III

Low temperature processing: low temperature requirement for different foods, refrigeration, components of refrigerators, chilling and freezing of food, freezing principles, low and fast freezing, freezing process, determining freezing load, refrigeration systems, freezing rate, estimation of freezing time of foods, types of freezers, thawing of frozen food, advantages of cold preservation.

## UNIT – IV

Processing by moisture removal: evaporation, concentration and dehydration, drying equipments, types of dryers, their advantages and disadvantages, evaporation and functions, continuous, multiple effect, falling and rising film evaporators, water activity in foods: role of water activity in food preservation, control of water activity by addition of solutes and moisture removal, moisture sorption isotherm, measurements of water activity; intermediate moisture food, principles.

### **Recommended Readings:**

- Norman N. P. and Joseph H. H., (1997). Food Science 5th edition, CBS Publication, New Delhi.
- Frazier W. C. and Westhoff D. C., (1996). Food Microbiology 4th Ed, Tata McGraw Hill Pvt. Ltd., New Delhi.
- Fellows P. J., (2002). Food Processing Technology: Principles and Practice 2nd Ed, Woohead Pub. Ltd.
- Sivasankar B., (2002). Food Processing & Preservation, Prentice Hall of India.
- Khetarpaul N., (2005). Food Processing & Preservation, Daya Publications.

### ***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe the basic principles of equipments used during food processing
- Understand the use of different processing techniques
- Test the adequacy of different processing treatments
- Evaluate the effects of preservation techniques on food quality
- Develop different processing parameters on the basis of food properties

**List of Practicals:**

- Sampling techniques and preparation of test sample
- Demonstration of various food processing equipments
- Assessment of adequacy of blanching, pasteurization and sterilization for different foods
- Dehydration of food and preparation of concentrate and powder
- Physico-chemical analysis of dehydrated foods
- Freeze drying of food samples
- Standardisation of procedure for thawing of frozen foods
- Physical and chemical evaluation of canned/ bottled foods
- Pickling and curing of foods
- Estimation of preservatives in food sample
- Measurement of specific gravity and water activity sample
- Preparation of the sugar syrup of different degree brix
- Preservation of vegetable with the help of fermentation technique (Sauerkraut)
- Effect of edible coating processing on food quality



**Recommended Readings:**

- FSSAI. (2012). Fruits and vegetables products. Manuals of methods of analysis of Foods. Lab manual 5.
- FSSAI. (2012). Beverages (coffee, tea, cocoa, chicory, sugar and sugar products and confectionary products). Manuals of methods of analysis of Foods. Lab manual 4.
- Frazier W. C., and Westhoff D. C., (1996). Food Microbiology 4th Ed, Tata McGraw Hill Pvt. Ltd., New Delhi.
- Fellows P. J., (2002). Food Processing Technology: Principles and Practice 2nd Ed, Woohed Pub. Ltd.

**5BVFPE06 Post-harvest Handling and Storage of Fruits and Vegetables Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define factor affecting post-harvest physiology, composition, nutritive value and composition of fruits and vegetables
- Select best suitable maturity and operating conditions for attaining quality products
- Apply theoretical knowledge of fruits and vegetables at the industrial level to broaden applications by producing value added products
- Evaluate the changes resulted from various processing techniques
- Create problem solving strategies and methods in accordance with the current and future prospects of fruits and vegetables

**UNIT – I**

Scope of fruit and vegetable processing industry in India- present status, constraints and prospects. Fruits and vegetables- classification, types, structure and composition of fruits and vegetables- chemical composition and nutritive value and importance in our diet, Post-harvest technology and its significance, pesticide residues for import and export of fruits and vegetables, pre-harvest factors affecting post-harvest quality of fruits and vegetables.

**UNIT – II**

Physiological development – fruit ripening, respiration, role of ethylene, fruit maturity- definition, methods of maturity determination, maturity indices for selected fruits and vegetables, chemical changes during maturation. Methods of storage- controlled atmospheric storage, modified atmospheric storage and hypobaric.

**UNIT – III**

Pre-processing treatment and operations: equipments, cleaning methods, sorting, grading, peeling and blanching, methods of pre-cooling, minimal processing of fruits and vegetables, packaging of fruits and vegetables.

**UNIT – IV**

Processing technology of jam, jelly and marmalades, fruit preserves and candied fruits, chutneys, pickles, pickling with vinegar and fermentation- sauerkraut, sauces and ketchups, Processing

technology of fruit products- unit operations involved in preparation of fruit beverage, types of beverages, processing of syrups, fruit juice concentrate, fruit juice powder, carbonated beverages, fruit cheese, fruit leather, FPO specifications.

**Recommended Readings:**

- Giridharlal, S. and Tandon, G. L. (2009). Preservation of fruits and vegetables. ICAR, New Delhi.
- Srivastava. P., R., and Kumar, S. (2017). Fruit and vegetable preservation - 3rd Edition. International Publishers, Delhi.
- Thompson, A.K., (2003). Fruits and vegetables; Harvesting, handling and storage. Blackwell Publishing.
- Norman. N. P. (1997). Food Science.5<sup>th</sup>edi. CBS publishers and distributors, New Delhi.
- Hui, Y. H., (2006). Handbook of fruits and fruit processing. Blackwell Publishing.
- Arthey, David, Arthust and Philip, R. (2005). Fruit processing- Nutrition, products and quality management, Springer. 2<sup>nd</sup>ed.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**5BVFPE07**

**Post-harvest Handling and Storage of Fruits and Vegetables Lab**

**Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Remember principles and procedures of processing and qualitative and quantitative analysis of fruits and vegetable
- Understand importance of preparation and analysis of processed products of fruits and vegetables
- Operate and maintain various equipments of processing and analysis in fruits and vegetables sector
- Evaluate the changes and problems related to the processing of fruits and vegetables
- Create new products and methods for value addition

**List of Practicals:**

- Orientation to different fruit processing equipments, their functions and uses,
- Determination of pectin in given food sample
- Determination of moisture, total solids
- Determination of Vitamin C
- Determination of Lycopene
- Estimate the titratable acidity, TSS of fruit and vegetable products
- Preparation of fruit juices, squashes and cordial
- Clarification of fruit juice
- Preservation and processing of certain vegetables by drying
- Preparation of tomato ketchup, puree and paste and their preservation
- Preparation of pickles and chutneys
- Preparation of jam, jelly and marmalade and their storage study
- Blanching of the given sample and assessment of its adequacy

- Enzymatic browning of fruits and vegetables and its control
- Preparation of preserve and dried fruit products (leather, bars, candy)
- Freezing of fruits and vegetables
- Determination of reducing and total sugars
- Visit to local fruit and vegetables processing industries

**Recommended readings:**

- FSSAI. (2012). Fruits and vegetables products. Manuals of methods of analysis of Foods. Lab manual 5.
- FSSAI. (2012). Beverages (coffee, tea, cocoa, chicory, sugar and sugar products and confectionary products). Manuals of methods of analysis of Foods. Lab manual 4.
- Giridharlal, S. and Tandon, G. L. (2009). Preservation of fruits and vegetables. ICAR, New Delhi.
- Srivastava. P., R., and Kumar, S. (2017). Fruit and vegetable preservation - 3rd Edition. International Publishers, Delhi.
- Thompson, A.K., (2003). Fruits and vegetables; Harvesting, handling and storage. Blackwell Publishing.
- Norman. N. P. (1997). Food Science. 5<sup>th</sup>edi. CBS publishers and distributors, New Delhi.
- Hui, Y. H., (2006). Handbook of fruits and fruit processing. Blackwell Publishing
- Arthey, David, Arthust and Philip, R. (2005). Fruit processing- Nutrition, products and quality management, Springer. 2<sup>nd</sup>ed.

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Describe different material handling equipments in food industry
- Understand the concept of size reduction, sieving and air classification
- Operate and maintain various equipments of wheat grain milling and analysis
- Evaluate the physical and chemical characteristics of wheat grain and flour

### UNIT – I

Material handling – theory, classification of various material handling equipments – conveyors (gravity and powered conveyors), elevators (bucket and screw type elevators), pneumatic conveyors; Cleaning – types of contaminants, methods of cleaning- dry cleaning methods: screening, aspiration, magnetic cleaning and abrasive cleaning, wet cleaning methods: soaking, spray washing, flotation washing and ultrasonic washing, combination methods.

### UNIT – II

Sorting and grading: advantages, methods; Size reduction- benefits, forces, criteria, energy requirement by Rittinger law, Kick's law, Bond's law, mode of operation of size reduction equipment – open circuit and closed circuit grinding, free crushing, choke feeding and wet milling; Size reduction of solid foods, fibrous foods and liquid foods; Effects of size reduction on solid and liquid foods; Sieving terminology, effectiveness of screen, particle size analysis, fineness modulus, equipments, Air classification.

### UNIT – III

Mixing- terminology, equipments – mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators), mixers for high viscosity pastes (pan mixer, horizontal mixer and dough mixer), mixers for dry solids (tumbler mixer & vertical screw mixer), effects of mixing on foods; Filtration- terminology (feed slurry, filtrate, filter medium, filter cake and filter); Methods/equipments: pressure filtration, vacuum filtration and centrifugal filtration; Expression factors affecting efficiency, methods of expressing the liquid from solid-liquid food system – hydraulic pressing, roller pressing and screw pressing.

## UNIT – IV

Evaporation- functions, factors affecting the rate of heat transfer, factors influencing the economics of evaporation, equipments – open pans, horizontal tube, vertical tube and plate evaporator, single and multiple effect evaporators; Dehydration- objectives, terminology, basic theory, drying curves; Dehydration systems- Tray drier, tunnel drier; Drying time calculations; Freeze drying- conventional drying vs. freeze drying, equipments used.

### **Recommended Readings:**

- Earle R. L. (1983). Unit Operations in Food Processing, 2nd Edition, Pergamon Press.
- Singh R. P. & Heldman D. R. (1984). Introduction to Food Engineering, Academic Press.
- Toledo R. T. (1980). Fundamentals of Food Process Engineering, AVI Publication.
- Saravacos G. D. and Maroulis Z. B. (2011). Food process engineering operations: contemporary food engineering series, CRC Press, Boca Raton.
- Das H. (2005). Food processing operations analysis, Asian Books Publications, New Delhi.
- Berk Z. (2013). Food process engineering and technology, 2nd edition, Academic press, New Delhi.

### ***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**5BVFPE09**

**Industrial Training Report and Seminar**

**Credits: 0+0+2**

*Evaluation: Internal (100)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Develop the knowledge on legal aspects and government policy relating to entrepreneurship
- Understand the significance and Knowledge of employee relations and legislation related to employees in modern food industries and business operations
- Outline the nature, scope and structure of modern industry and the production function
- Judge the process of entrepreneurship and the institutional facilities available to an entrepreneur in India



*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Select the best appropriate conditions and instrumentation for favourable growth kinetics.
- Describe the different techniques of production and recovery of primary and secondary metabolites
- Operate and manage fermenters economically and beneficially
- Create problem solving strategies, methods and models in accordance with the current and future prospects in bioprocess engineering

#### **UNIT – I**

Introduction to Fermentation Technology: Fermentation overview, Introduction to fermentation processes, industrially important microorganisms-Isolation, screening and preservation of industrially important microorganisms. Principles of over production of primary and secondary metabolites with relevant examples.

#### **UNIT – II**

Fermentation Systems: Batch and Continuous system, Fed batch culture, multistage systems, Feedback systems, Solid substrate fermentation. Instrumentation and control of fermentation processes.

#### **UNIT – III**

Production and Recovery of Primary and Secondary Metabolites: Industrial Alcohol, Beer, Wine, Citric Acid, Acetic acid, lactic acid, Industrial enzymes, Bio insecticides, Biopolymers. Fermentation raw materials: Media for industrial fermentation, Criteria used in media formulation, sterilization, raw materials and process control, Downstream processing - Separation processes and recovery methods for fermentation products.

#### **UNIT – IV**

Fermenter Design: Bioreactor configuration, design features, Criteria in Fermenter design, Requirement for aeration and mixing, Energy Transfer, Other fermenter designs - Tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors.

**Recommended Readings:**

- Stanbury P.F., Hall S., Whitaker A. (1998). Principles of Fermentation Technology, 2<sup>nd</sup> Edition, Butterworth Heinemann Ltd.
- Ward O.P. (1999). Fermentation Biotechnology – Principles, Process and Products, Prentice Hall Publishing, New Jersey.
- Rehm H.J., Reed G.B., Puehler, A. and Stadler (1993). Biotechnology, Vol. 1-8, VCH Publication.
- Prescott S.C. and Dunn G.C. (1992). Industrial Microbiology, 4<sup>th</sup> Edition, CBS Publication, New Delhi.
- Domain A. I. and Davies J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2<sup>nd</sup> Edition, ASM Press, Washington D.C.
- Glazer and Nikaido (1998). Microbial Biotechnology, WH Freeman & Company, New York.
- Cruger W. and Kruger (2002). Biotechnology - A Textbook of Industrial Microbiology, 2<sup>nd</sup> Edition, Panima Publishing Corporation, New Delhi.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**6BVFPE02**

**Food Logistics and Supply Chain Management**

**Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define and describe the food supply chain, food logistics and different influencing factors
- Explain the main concepts and theoretical approaches defining the value chains and supply chains structures, strategies & dynamics and the basic features of the main supply chain management tools and indicators
- Apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations
- Evaluate the role of the main factors influencing the food supply chain management and its sustainability

#### **UNIT – I**

Introduction: Food Supply Chains & Food Logistics, Evolution of food supply chain, Relationship between Food & the economy, International Definition of Food Supply Chain, Significance & Drivers, the actors in Food Supply Chain (FSC) – Producers, Processors, Retailers & Distributors, Consumers; Types of Food Supply Chains, Factors Influencing Food Supply Chain

#### **UNIT – II**

Food Logistics – Movement of Food, Packaging in Logistics, Temperature Controlled Supply Chains; TTI's. Food Sourcing and procurements: Sourcing- Low-cost sourcing, Outsourcing, In-sourcing, Single sourcing, Multiple sourcing, Partnerships, Warehouse strategies, Procurement (Purchase) - Kralgic Matrix, Supplier Segmentation, Sustainable Procurement

#### **UNIT – III**

Risk Management: risks of Logistics and supply chain management in food industry. Technology Trends in food supply chain: Traceability and use of technology- Traceability, ERP, Bar-coding, RFID, GPS, e-Procurement, Food Regulations & Safety - Minimum Quality Standards, Regulations & Standards.

## UNIT – IV

Sustainability & Future Challenges: Attributes to consider when designing food supply chain- Perishability, Seasonality in production, Edible nature of product, Heterogeneity- Info Asymmetry. Sustainability Challenges in Food Supply Chain: Sustainable Food Supply Chains, Developing Sustainability within food supply chains- Production, Processing, Logistics & Retail, Sourcing, Food Sector & Economic Regeneration; Logistics Infrastructure Food Cluster & Enterprise Zone, Food Parks & Hubs.

### **Recommended Readings:**

- Dani S., Food Supply Chain Management & Logistics (From Farm to Fork), Published by Kogan Page, New Delhi.
- Handfield R.B. & Nichols E.L. (1999), Introduction to Supply Chain Management, Prentice Hall Publications.
- Chopra S. & Meindel P. (2002), Supply Chain Management: Strategy, Planning and Operation, Prentice Hall Publications.
- Eastham J.F., Sharples L. & Ball S.D. (2001), Food Supply Chain Management, Published by Butterworth Heinemann, New Delhi.

### ***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After the completion of the course, the students will be able to:

- Define waste management and effluent treatment in food industry
- Classify and describe content of the waste and its application in food industry
- Using various methods employed for the treatment of industrial wastes
- Examine the different waste produced in the industries

#### **UNIT – I**

Waste generation in food processing industries; concept, scope, health and environmental concern in waste management and effluent treatment; Physicochemical quality of wastewater from different food processing industries- temperature, pH, dissolved oxygen, biological oxygen demand, chemical oxygen demand; Grease content, metal content, forms of phosphorus and sulphur in waste waters.

#### **UNIT – II**

Physicochemical unit operations- screening, grit chamber, equalization, sedimentation, floatation, coagulation, flocculation, filtration, disinfection; Adsorption and ion exchange; Aeration and gas transfer; Membrane separation processes.

#### **UNIT – III**

Biological treatment/Secondary treatment: aerobic and anaerobic biological treatment processes; Oxidation ditches; Activated sludge process; Biological oxidation- trickling filters; Bio- towers; Rotating biological contractors, aerated lagoons; Anaerobic sludge blanket processes.

#### **UNIT – IV**

Tertiary treatments: advanced wastewater treatment process- sand, coal and activated carbon filters, phosphorus, sulphur, nitrogen and heavy metals removal; Disinfection processes- theory, characteristics of disinfectants; Environmental protection act and specifications for effluent of different food industries, treatment, reuse and disposal of solids and biosolids.

**Recommended Readings:**

- Metcalf & Eddy (2013). Wastewater Engineering treatment and Resource recovery, 5<sup>th</sup> edition, McGraw Hill.
- Marriott N.G. (2006). Principles of Food Sanitation, 5<sup>th</sup> edition, CBS Publication.
- Lawrence K.W., Howard H.Y. & Yapijakis C. (2005). Waste Treatment in the Food Processing Industry, CRC Press.
- Wang & Lo H. (2006). Waste treatment in the food processing industry, CRC Press, Taylor & Francis Group.
- Loannis & Arvanitoyannis S. (2008). Waste management for the food industries, Elsevier publishers.

***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*

**6BVFPE 04 Processing and Value Addition of Fruits and Vegetables Credits: 4+0+0**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After completion of the course, the students would be able to:

- Understand the importance of processing and value addition of fruits and vegetables
- Choose appropriate processing method for preservation of fruits and vegetables
- Select ingredients and additives according to final product requirements
- Evaluate prepared products according to finished product guidelines

**UNIT – I**

Indian and global scenario on importance and scope of processing of horticultural crops: Quality requirements of raw materials for processing; general properties of fruit and vegetables (chemical composition and nutritional aspects, structural features), sourcing and receiving at processing plants; primary processing (grading, sorting, cleaning, washing, peeling, slicing and blanching) and minimal processing. Importance and functions of raw materials: water, sweeteners, salt, food acids.

**UNIT – II**

Processing and preparation of fruits specific processed products using locally available and under-utilized fruits. Fruit powders using spray drying. IQF and frozen fruits and vegetables using aseptic packaging, canning, processing for pulp, puree and concentrates.

Vegetable specific processing technologies; Processing of vegetables for preparation of vegetable juices, puree, chutneys, pickles, ketchup, sauce and sauerkraut and vegetable canning. vegetables, intermediate moisture fruits and vegetables.

**UNIT – III**

Fruit & Vegetable Processing Equipment: Fruit Processing line, Fruit and Vegetable Washer, Brush Roller, Washer, Fruit and vegetable Pulper, Chopper, Slicers, Conveyors, Exhauster, Roller Bucket Elevator, Flight Elevator, Screw Elevator, Mixing Tank, Vacuum Pan, Belt Type Blancher, Cooler, Preheater, Steam Jacketed Kettle, Pasteuriser, Pasteurizer, Retort, Pulp Filling Machine, Juice Filling Machine, Pouch Packing Machine, Bottle Washer, Bottle Filler, Lug off capping Machine, Can Reforming Machinery, Seamer, Food Packaging machine, Crate Washer.

## UNIT – IV

Recent trends in processing and packaging of fruit and vegetable-based value-added products. Quality control/quality assurance and International trade, good manufacturing practices (GMP), hygiene requirements, hazard analysis and critical control points (HACCP) with specific emphasis on fruit and vegetable products, preservatives, colours (permitted and prohibited) in India. Layout and other requirements of fruit and vegetable processing unit.

### **Recommended Readings:**

- Sudheer, K.P. and Indira, V. (2007). Post-Harvest Technology of Horticultural Crops. New India Publishing Agency, New Delhi.
- Verma, L.R. and Joshi, V.K. (2000). Post-Harvest Technology of Fruits and Vegetables – Handling, Processing, Fermentation and Waste Management. Indus Publishing Company. New Delhi.
- Chadha, K.L. (2009). Handbook of Horticulture. IARI Publications, New Delhi.
- Thompson, A.K. (1996). Post-Harvest technology of fruits and vegetables. Blackwell Science Ltd. London
- Dauthy, M.E. (1995). Fruit and vegetable processing. FAO Agricultural Services Bulletin No.119. Food and Agriculture Organization of the United Nations
- Ranganna, S. (2017). Handbook of Analysis and Quality Control for Fruit and Vegetable. 2<sup>nd</sup> Edition. McGraw Hill Education.

### ***Note for Paper Setters:***

*Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. Out of remaining eight (08) questions, a candidate is required to attempt four (04) questions by selecting one from each unit. All questions including compulsory question i.e. question number one shall carry equal marks i.e. fourteen (14) marks each.*



**6BVFPE 05 Processing and Value Addition of Fruits and Vegetables Lab Credits: 0+0+2**

*Evaluation: Internal (30), External (70)*

**Course Outcomes:** After completion of the course, the students would be able to:

- Differentiate products based on processing techniques
- Estimate components of processed foods
- Formulate various fruits & vegetables based processed products
- Evaluate quality parameters of different processed products

**List of Practicals:**

- Familiarization with tools and equipments used in fruits & vegetables processing laboratory; their handling, precautions and maintenance
- Preparation and packaging of perishables for storage under different conditions for shelf-life studies
- Preparation, packaging and preservation of fruit beverages such as fruit juice, squash, RTS, nectar, cordial, crush, sherbets, cocktail, carbonated fruit beverages and syrup by using appropriate methods and determine the acidity, TSS, vitamin-C and sugar content of the finished products
- Preparation and preservation of tomato products viz. tomato ketchup, sauce, culinary paste and assess for quality parameters
- Preparation, drying and storage of fruits and vegetables with appropriate methods such as drying, cabinet drying and solar drying and determine the moisture content
- Preparation and packaging of jam, jelly and marmalades and determination of acidity, TSS and pectin content
- Explain and understand the process of wine preparation and canning process of fruits and vegetables and Identify defects by physical observation & its causes in canned foods and explain food safety standards
- Preparation of synthetic vinegar by using appropriate tools and check the quality and explain other methods of vinegar production and its types

- Prepare and preserve (murabba), candy, fruit bar, toffee, candy, crystallised, fruit peel and glazed fruit/ vegetables
- Prepare fruits/ vegetables pickles and determine acidity content
- Check physical quality parameters in market samples of frozen fruits and vegetables
- Examine the tetra pack with respect to the materials of construction and dimension and its types
- Preparation of edible coating of fruits and vegetables to enhance shelf life thereof
- Preparation of soup powders using spray dryer

**Recommended Readings:**

- FSSAI (2016). Manual of Methods of Analysis of Foods of Fruit and Vegetable Products. Food Safety and Standards Authority of India, Ministry of Health and Family Welfare Government of India New Delhi.
- Ranganna, S. (2017). Handbook of Analysis and Quality Control for Fruit and Vegetable. 2<sup>nd</sup> Edition. McGraw Hill Education.
- Rangana, S. (1979). Manual Analysis of Fruits and Vegetables Product. Tata McGraw Hill Co. Ltd., New Delhi.
- FSSAI. (2012). Fruits and vegetables products. Manuals of methods of analysis of Foods. Lab manual 5.
- Srivastava. P., R., and Kumar, S. (2017). Fruit and vegetable preservation - 3rd Edition. International Publishers, Delhi.

**6BVFPE 06**

**Major Project (Industrial/ Institutional)**

**Credits: 0+0+12**

***Evaluation: External (100)***

**Course Outcomes:** After the completion of the course, the students will be able to:

- Outline and indicate about new ideas on current issues in India
- Compare and expand their knowledge base with literature review on the current topic
- Apply the research methodology and research plan in practice to resolve the problem
- Appraise new research and study on various problems pertaining to research area