Maulana Abul Kalam Azad University of Technology, WB(Formerly known as West Bengal University of Technology)
Syllabus of B.Sc. in B.Sc. (Hons.) in Food Science & Technology
Effective from academic session 2023-24

Semester I

BFST 101: Food Chemistry
(CREDITS 3)

Course Objectives:

1. To recall the basic knowledge about the classification, structure and properties of different food components.

Course Outcomes (COs):

CO1: Demonstrate the properties and reactions of the various food components.
CO2: Apply the basic principles and properties of starch, proteins, fats and oils, pectic substances and spices and condiments.
CO3: Develop products with minimum nutritional loss based on the knowledge of food chemistry.
CO4: Evaluate the food quality on the basis of knowledge of different nutrients present in food.
CO5: Design diet chart from the knowledge of different nutrients calorific value and other health benefits.

Theory:

Module I: Basic concept on Food and Nutrition(4 lectures)
Classification of Food, Classification of Nutrients.
Introduction to Digestion & Absorption of nutrients. Water - Functions, daily requirements, Water balance.

Module II: Carbohydrates (**7 lectures**)
Carbohydrates - Definition, Classification, Structure and properties. Glucose, fructose, galactose. Disaccharides - Maltose, lactose, sucrose. Polysaccharides - Dextrin, starch, glycogen. Resistant starch. Carbohydrates - Sources, daily requirements, functions. Effects of too high and too low carbohydrates on health. Digestion and absorption of carbohydrate

Module III: Lipids (6 lectures)
Definition, Classification, structure & Properties. Fatty acids-composition, properties, types. Lipids - sources, daily requirements, functions. Role & nutritional significances of PUFA, MUFA, SFA. ω-3 and ω-6 fatty acids, essential oil

Module IV: Proteins (6 lectures)
Definition, Classification, Structure & properties. Amino acids- Classification, types, functions, essential amino acids. Proteins - Sources, daily requirements, functions. Basic concepts of protein structure folding and denaturation

Effect of too high - too low proteins on health. Digestion & absorption. Assessment of Protein quality (BV, PER, NPU). Factors affecting protein bio-availability including anti-nutritional factors.

Module V: Vitamins, Minerals and dietary fibre(5 lectures)

Vitamins – water soluble and fat soluble vitamins, Bio-Chemical and Physiological Role Physiological role, bio-availability and requirements, sources, deficiency, & excess of them.

Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium, Copper).

Dietary Fibre - Classification, sources, composition, properties & nutritional significance.

Revision: 2L
Total Lectures: 30L

PRACTICAL: BFST-191: Food Chemistry Lab
(Credit: 2)

Course Outcomes (COs):

CO1: Recall the basic concept of food chemistry to relate with real life food analysis.
CO2: Illustrate the different food analysis parameters for food quality estimation.
CO3: Identify laboratory equipment and the safety & measures.
CO4: Examine different products through laboratory analysis / experiments
CO5: Build himself / herself as a Food analyst / lab co-coordinator.

List of Experiments:

1. Determination of Moisture content in food
2. Determination of soluble and insoluble Ash content in food
3. Determination of reducing, non-reducing, and total sugar content in food
4. Detection / Estimation of Fat in food.
5. Determination of Vitamin C content in food.
6. Detection / Estimation of Total Protein content.

Recommended Readings:

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
2. Food Chemistry by L. H. Meyer
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Bio Chemistry by Lehninger

5. Chemical changes in food during processing by Richardson
6. Nutrition and Dietetics by Rose, 2007.

BFST-102: Technology of Foods
(CREDITS 5: THEORY – 4; Tutorial – 1)

Course Objectives:

1. To impart basic knowledge of:
    a. Food Dispersions.
    b. Sensory science.
    c. Food Science.
    d. Food Sanitation.
    e. To understand evolution of food processing.

Course Outcomes (COs):

CO1: Define Food Science precisely to integrate knowledge from various fields applied to the study of the foods.
CO2: Identify the methods of waste water management and application of renewable energy technology in food processing.
CO3: Apply modern thermal and non-thermal Technology, Minimal processing for implementation in Food Processing and Food Engineering area.
CO4: Evaluate the Food and water quality, CIP system, and methods of Sanitization and sensory analysis.
CO5: Discuss the method of sensory evaluation of food and their nutritional contribution as food.

Theory:

Module I: Food dispersions (5 lectures)
Characteristics, sols, gels, pectin gels, colloidal sols, stabilization of colloidal system, syneresis, emulsions, properties of emulsions, formation of emulsion, emulsifying agent, food foams, application of colloidal chemistry to food preparation.

Module II: Unit Operations in foods (6 lectures)
Introduction to unit operations, Unit operations techniques in food processing, physical change or chemical transformation such as separation, crystallization, evaporation, filtration, distillation.

Module III: Thermal Food processing (6 lectures)
Conventional thermal processing methods, Outline of Different drying technology of food (Spray drying, drum drying, tray drying), conduction, convection and radiation Mechanism of heat transmission: conduction, convection and radiation, nusselt number prandtl number, classification of heat

exchangers and their description.

Module IV: Non-Thermal Food processing (7 lectures)
Minimal processing of foods with non-thermal methods-safety criteria in minimally processed foods-like vegetables-seafood-effect on quality. Modern electrical equipment for food processing. OTG, Pulsed electric field (PEF) for food preservation and sterilization, Microwave processing, Radiation treatment of packaged food and safety

Module V: Low Temperature Preservation (6 lectures)
Food refrigeration, freezing, thawing, cold storage technology. freeze drying. Plate freezers, air blast freezers.

Module VI: Water disposals and sanitation (6 lectures)
Waste water, break point, chlorination, physical and chemical of impurities, BOD, COD, waste water treatment, CIP system, sanitizers used in food industry. Low cost technology for food industry energy consumption, renewable energy, solar energy

Module VII: Sensory evaluation of Food (4 lectures)
Objectives, type of food panels, characteristics of panel member, layout of sensory evaluation laboratory, sensitivity tests, threshold value, paired comparison test, duo trio test, triangle test, hedonic scale

Total Theoretical Lectures: 40L

Tutorial: 10L

Total Lectures: 40L + 10L = 50L

Recommended Readings:
1. Essentials of Food & Nutrition (Volume 1 & 2) by Swaminathan.
2. Food Chemistry by L.H. Muyer.
3. Fundamentals of Food engineering Subir K Chakrabarty.
4. Bawa. A.S, O.P Chauhanetal.Food Science. New India Publishing agency, 2013
5. Roday,S. Food Science, Oxford publication, 2011.
6. B. Srilakshmi, Food science, New Age Publishers,2002.
7. Meyer, Food Chemistry, New Age, 2004

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Semester II

BFST-201:Food Microbiology

(CREDITS 3)

Course Objectives:

1. **To** define the general characteristics and growth characteristics of microbes.
2. To apply the fundamentals of spoilage microorganisms and their effects on food and to explain the effect of beneficial organisms.
3. To analyse the causes of food and water borne diseases and handling of waste disposal.

Course Outcomes (COs):

CO1: Recall the different types and morphology of microorganisms and magnification capacity of different types of microscopes.
CO2: Identify the factors affecting the growth in controlling the growth curve of microorganisms.
CO3: Analyze to preserve the perishable foods from different types of microbial spoilage
CO4: Apply hurdle technology in food science
CO5: Adapt the beneficial effects of microorganisms in the processing and development of fermented foods.

Theory:

Module I: Introduction and scope of food microbiology(5 lectures)

Introduction of microbiology and its relevance to food industry. General characteristics of bacteria, fungi, virus, protozoa, and algae. Isolation and Identification of microorganisms, staining of microorganisms, Morphological characteristics important in food bacteriology, Industrial importance.

Module II: Growth of microorganisms(5 lectures)

Growth curve-Intrinsic Factors (Substrate Limitations), nutrient content, pH and buffering capacity, antimicrobial barriers and constituents, water Activity, relative humidity, temperature, gaseous atmosphere, Different types of media for microbial growth, Sterilization, Pasteurization, D.F. Z values, Microbial Food Safety

Module III: Microbiology of different foods (6 lectures)

Cereal and cereal products, Sugar and sugar products, Vegetables and fruits, Meat and meat products, Fish, egg and poultry, Milk and milk products, food spoilage.

Environmental microbiology: Food and water borne diseases caused by E coli, Samonella, botulinum sp, shigella, hepatities), Air and air borne diseases, Soil and soil borne diseases, Sewage and diseases.

Waste product handling: – Planning for waste disposal, Solid wastes and liquid waste, Waste treatment and disposal, Biological oxygen demand (BOD)-Preliminary treatments, Chemical treatment.

Microbial intoxication and infections: Sources of contamination of food, mycotoxins, toxin production and physiological action, sources of infection of

food by pathogenic organisms, symptoms and method of control.

Module IV: Hurdle technologies (5 lectures)
Principles and applications, Hurdle effect in fermented foods, shelf stable products, intermediate moisture foods, application of hurdle technology. Food as a substrate for microorganism, factors affecting growth of microbes: pH, water activity, O-R potential, nutrient contents, inhibitory substance and biological structure**.**

Module V: Beneficial effect of organism & Food safety (6 lectures)
Some applications of microorganisms-Food products: Alcoholic drinks, Dairy products, Bread, Vinegar, Pickled foods, Mushroom, Single-cell protein
Products from microorganisms: Introduction to probiotics, prebiotics and synbiotics, Enzymes, Amino acids, Antibiotics, Citric acid,
Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of micro-organisms.

Revision 2L

Total Lectures: 30L

PRACTICAL: BFST-291: Food Microbiology Lab
(CREDITS: 2)

CO1: Identify various instruments using in Food Microbiology laboratory and to study the morphology and special characteristics of microorganisms with staining procedures.
CO2: Apply the knowledge of preparing culture media with aseptic inoculation techniques for microbial growth determination.
CO3: Analyze the bacterial growth curve.
CO4: Evaluate the occurrence of microorganisms in different food items and water sample qualitatively as well as quantitatively.
CO5: Estimate quality of water by microbial methods

List of Experiments
1. Study of equipment in a *microbiology* lab- microscope, Autoclave.
2. Preparation of laboratory media (agar and broth) for cultivation of bacteria, yeasts and molds.
3. Serial dilution and isolation of bacterial colony from food sample by pour plate and streak plate method
4. Staining of bacteria: gram-staining and morphology
5. Zone of inhibition study for antibiotics
6. Bacterial cell count by Heamocytometer and colony counting

7. Estimation of BOD of Waste water

Recommended Readings:

1. Frazier, W. C. and Westhoff, D. C. (1988): 4th edition, Food Microbiology, McGraw Hill Inc.
2. Jay James. N. (1986): 3rd edition, modern Food Microbiology, Van Nestrand Reinhold Company Inc. 3. Pelczar, M.I. and Reid, K. D. (1978): Microbiology, McGraw Hill Company, New York.
4. Benson Harold, J. (1990): Microbiological Application, Publishers, U.S.A
5. Colling, C.E. and Lyne, P.M. (1976): Microbiological Methods Butterworth. London.

BFST-202: Basic Chemistry
(CREDITS 3)

Course Objectives:

1. Understanding of the fundamental theories and basic concepts of Thermodynamics.
2. Understanding of the fundamental theories and applications of the concepts of Dilute solutions, Colligative properties, Electrochemistry, Ionic Equilibrium.
3. To get an insight into the instrumental methods of spectral analysis and learning about the basic laws of photochemistry and various photochemical processes.
4. Learning about the chemistry of colloids and emulsions.

Course Outcomes (COs):

CO1: Recall the fundamental theories and basic concepts of Thermodynamics, Dilute solutions, Colligative properties, Electrochemistry, Ionic Equilibrium, Reaction Mechanisms, chemistry of colloids and emulsions, the basics of nanotechnology and the chemistry of nanomaterial.
CO2: Explain the concepts of Thermodynamics, Dilute solutions, Colligative properties, Electrochemistry, Ionic Equilibrium, Reaction Mechanisms in food processing, food chemistry, quality control arenas.
CO3: Apply the concept of instrumental methods of spectral analysis and photochemistry.
CO4: Analyze and evaluate the mechanism of chemical reactions and their kinetics.
CO5: Create emulsions and colloids for food related applications.

Theory:

Module I: Dilute solutions– Colligative properties (3 lectures)
Dilute solution, concentration expressions (normality, molarity, molality, percentage) Lowering of vapor pressure of solution, elevation of boiling point,

freezing point depression, definition, principles, and laws of osmotic pressure.

Module II:
Acid, base, salt and ionic equilibrium: (**6 lectures**)
Ionic equilibrium: Solubility and solubility product, common ion effect, determination of solubility product by EMF method, ionic product of water, pH, pOH, hydrolysis of salt solutions: Strong acid and weak base, weak acid and strong base, weak acid and weak base, concepts of buffer.

Module III: Thermodynamics (**7 Lectures**)
Systems: Introduction, Open, Close, Isolated system. Different thermodynamic process; Definition with examples of Isothermal, Adiabatic, Isobaric, Isochoric process. Extensive and Intensive property. First Law of Thermodynamics: Statement and mathematical form.
Internal energy: Definition, Example, Enthalpy: Definition, Example. Introduction to 2^{nd} law of thermodynamics.

Module IV: Reaction Mechanisms (**4 lectures**)
Reaction Dynamics: Reaction Laws: Rate and Order. Molecularity. Zero, First, and Second order Kinetics.

Module V: Colloid chemistry (**4 lectures**)
Definition of colloid, principle of colloid formation, types of colloid, colloid preparation, stability of colloid, association of colloid and emulsion.

Module VI: Photochemistry (**4 lectures**)
Instrumental methods of spectral analyses, Photochemistry: Lambert's law and Beer's Law, Laws of photochemistry, Photochemical processes.

Revision 2L

Total Lectures: 30L

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Practical: BFST-292: Basic Chemistry Lab
(CREDITS: 2)

Course Objectives:

1. To learn the chemistry of determination of different physical and chemical paremeters.
2. Application of different methods like acidimetry, alkalimetry, spectrophotometry in food related quality parameters.

Course Outcomes (COs):

CO1: Find the physical properties like surface tension, viscosity of materials.
CO2: Analyze the quality of water by hardness measurement and chloride content.
CO3: Develop the concept of acidimetry and alkalimetry and apply the same for determination of strength of acid or base.
CO4: Apply the concept of pH.
CO5: Estimate the oxidation reduction titration for preparation of a primary standard and using the same to determine the strength of a secondary standard material.

List of Experiments

1. Determination of surface tension
2. Determination of viscosity.
3. Determination of hardness of water.
4. Determination of chloride content of water.
5. Calibration of pH meter and estimation of pH of unknown solution.
6. Titration of weak acid by strong alkali.
7. Preparation of standard $K_2Cr_2O_7$ solution and standardization of Mohr's Salt solution.

Recommended Readings:

1. Engineering Chemistry: Bandyopadhyay and Hazra
2. Physical Chemistry: P.C. Rakshit
3. Organic Chemistry: Finar, vol-1
4. Engineering Chemistry: B.Sivasankar, Tata Mc Graw Hill, 2008
5. A Text book of Engineering Chemistry: S.S.Dara, 10th Edition, S.Chand & Company Ltd., New Delhi, 2003.

6. Engineering Chemistry Simplified: S. Nandi and R. Bhattacharyya, Chayya Prakashani Pvt. Ltd.
7. Advanced practical chemistry, 3rd edition by Subhas C Das.
8. An advanced course in practical chemistry by Ghoshal, Mahapatra and Nad.