

Syllabus for B. Sc. CBCS general electives (GE) Papers of Food Technology

General electives GE

Choose any one from Paper 1, 2 and 3 for odd semester

GE-1/2 Paper 1: Chemistry, fundamentals of nutrition and microbiology in Food Technology

GE-1/2 Paper 2: Food Process Technology

GE-1/2 Paper 3: Fundamentals of Food Engineering

Choose any one from Paper 4, 5 and 6 for even semester

GE-1/2 Paper 4: Food Packaging Technology

GE-1/2 Paper 5: Waste management in Food Industries

GE-1/2 Paper 6: Analytical techniques and quality control, safety and evaluation of foods

GE-1/2 Paper 1: Chemistry, fundamentals of nutrition and microbiology in Food Technology (Credits: Theory- 4, Practical 2)

Theory

Unit 1

Introduction to different food groups and importance of food chemistry; Water in foods and its properties. Carbohydrates: Classification and properties, Monosaccharides: Glucose, Fructose; Oligosaccharides: Maltose, Lactose, Sucrose; Polysaccharides: Starch, Cellulose, Gums, Pectin.

Unit 2

Proteins: Amino acids, Classification of protein, Structure of protein, Denaturation, Qualitative analysis of protein, Protein estimation-Kjeldahl's method.

Unit 3

Lipids: Classification, Fatty acids: Saturated, Unsaturated, Polyunsaturated fatty acids, Rancidity, Hydrogenation, Refining of fats & oils; Saponification number, iodine value, Reichert-Meissl number, Polenske value.

Unit 4

Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Vitamins as antioxidants. Food Pigments & Flavouring Agents: Importance, types and sources of pigments – their changes during processing and storages.

Unit 5

Nutrition- Introduction to human nutrition. Digestion, absorption and assimilation of nutrients.

Unit 6

Microorganisms in Food, Introduction, historical developments in food microbiology; General characteristics of yeasts, molds and groups of bacteria in food industry. Starter cultures. Microbiological Techniques in Food Industry.

Unit 7

Basic concept of food processing and preservation (Heat, Refrigeration storage, chemical preservation).

Unit 8

Food spoilage or deterioration by bacteria and fungus: fruit and vegetables, milk and meat.

Practical

1. Determination of moisture content in food samples.
2. Determination of Saponification value, Iodine value, acid value of lipids.
3. Estimation of starch in foods.
4. Microscopic examination of bacteria and molds from food.
5. Standard plate count of food sample.
6. To Study the steps in Mushroom production.

Suggestive Readings

1. Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2
2. Food Chemistry by L. H. Moyer
3. Hand Book of Analysis of fruits & vegetables by S. Ranganna
4. Food Chemistry by Linhinger
5. Food Biochemistry by J. K. Dickson
6. Food Microbiology and Biotechnology: Safe and Sustainable Food Production by Guadalupe Virginia Nevárez-Moorillón, Arely Prado-Barragán, José Luis Martínez-Hernández, Cristobal Noé Aguilar
7. Modern Food Microbiology, 5th Edition, CBS Publishers by James M. Jay
8. General Microbiology, 5th Edition, MacMillan by Stanier, R.Y. (1996).
9. (1988). Food Microbiology. 4th Ed. McGraw Hill by Frazier J & Westhoff DC.

GE-1/2 Paper 2: Food Process Technology (Credits: Theory-4, Practical-2)

Theory

Unit 1: Storage of cereals, Infestation control; Drying of grains, Processing of rice and rice products. Milling of wheat, corn, barley, oat; Production of wheat products, including flour and semolina. Puffed cereals from broken rice.

Unit 2: Feed for livestock from wheat bran and germ, Production of starch, modified starch, Extraction of prolamin (Zein & kafirin); Potato processing (potato chips, flakes, powder) and storage.

Unit 3: Storage and handling of fresh fruits and vegetables, Production of fruits and vegetable juices, Preparation of jam, jelly, marmalade, and tomato products (sauce and ketchup), Production of pectin, vitamins from apple pomace; Production of citrus oil from peels of citrus fruits, candied peel.

Unit 4: Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment

of fish; Spoilage of fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, smoking, curing, fermentation (fish sauce).

Unit 5: Fish byproducts - production of fish meal, fish protein concentrate, fish protein hydrolyzate fish liver oil and fish silage; Production of chitin, chitosan; Production of non-food items from fish processing wastes.

Unit 6: Slaughtering of animals; Meat cuts and portions of meat, muscle; Classification, composition and nutritional value of poultry meat; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products (sausages and sauces); Frozen meat & meat storage; By-products from meat industries and their utilization.

Unit 7: Composition of milk; Varieties of milk; Checks for purity of milk; Handling of freshly produced milk; Cleaning and sanitization. Thermal processing of fluid milk – Pasteurization (LTLT and HTST), sterilization and UHT techniques; Packaging of fluid milk; Fermentation of milk and fermented milk products – Cheese, yogurt, etc including probiotic dairy products. Processing of evaporated and dried milk products – Milk powder, SCM, etc.; Cream, butter, ghee, Ice-cream, Traditional Indian sweets, Infant formulae as additives in milk products. Dairy processing by-products.

Unit 8: Processing of oils – Degumming, refining, bleaching, deodorization, fractionation; Pyrolysis of fats, toxicity of frying oil. Plastic fat – Winterization, hydrogenation, esterification, inter-esterification and emulsification.

Practical

1. Preparation of orange squash.
2. Preparation of mango jam.
3. Preparation of guava jelly.
4. Preparation of tomato ketchup.
5. Preparation of mango pickle.
6. Preparation of dried carrot.
7. Preparation of dry onion/ chilli/ garlic.
8. Preparation of bread.
9. Manufacture of ice cream.
10. Manufacture of Rosogolla and Sandesh.
11. Preparation of sponge cake.

Suggested Readings

1. Food Science by Potter
2. Principles of Food Science, Vol-I by Fennema Karrel
3. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon
4. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
5. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
6. Developments in Meat Science – I & II, Lawrie R; Applied Science Pub. Ltd.
7. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
8. Fish Processing Technology, Rogestein & Rogeste

9. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub.
10. Milk & Milk Processing; Herrington BL; 1948, McGraw-Hill Book Company.
11. Modern Dairy Products, Lampert LH; 1970, Chemical Publishing Company.
12. Developments in Dairy Chemistry – Vol 1 & 2; Fox PF; Applied Science Pub Ltd.
13. Outlines of Dairy Technology, De S; Oxford.
14. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley & Sons.
15. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.
16. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); Torrey S; 1983, NDC.

GE-1/2 Paper 3: Fundamentals of Food Engineering (Credits: Theory-4, Practical-2)

Theory

Unit 1: Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.

Unit 2: Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers.

Unit 3: Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, ultra-fine grinders, fluid jet pulverizer, cutting machines (slicing, dicing, shredding, pulping).

Unit 4: Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (agitators, impellers powder-liquid contacting devices), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

Unit 5: Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine.

Unit 6: Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation;

Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids.

Unit 7: Membrane separation: General considerations, materials for membrane construction, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, per-evaporation and osmotic dehydration.

Practical

1. Determination of the particle density/true density and porosity of solid grains and powdery material.
2. Determination of terminal velocity of grain sample.
3. Determination of fineness modulus and uniformity index.
4. Operation of tray dryer and drying process calculations.
5. Operation of vacuum dryer and drying process calculations.
6. Study of spray dryer and drying process calculations.
7. Study of microwave dryer operation.
8. Study of osmosis in fruit.
9. Determination of solid gain and moisture loss during osmosis.
10. Power requirement in size reduction of grain using Rittinger's law, Kick's law and Bond's law
11. Determination of mixing index of a feed mixer
12. Determination of cleaning effectiveness / efficiency
13. Study of centrifugal separator

Suggested Readings

1. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
2. R.L. Earle. 2004. Unit Operations in Food Processing. The New Zealand Institute of Food Science & Technology, Nz.
3. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
4. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
5. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed. Butterworth–Heinemann, Oxford, UK.
6. Mohsenin, Nuri N. 1980. Thermal Properties of Foods and Agricultural Materials. Gordon and Breach Science Publishers, New York.
7. Mohsenin, Nuri N. 1984. Electromagnetic Radiation Properties of Foods and Agricultural Products. Gordon and Breach Science Publishers, New York.

8. Mohsenin, Nuri N. 1986. Physical Properties of Plant and Animal Materials : Structure, Physical Characteristics and Mechanical properties, 2nd Ed. Gordon and Breach Science Publishers, New York.

GE-1/2 Paper 4: Food Packaging Technology (Credits: Theory-4, Practical-2)

Theory

Unit 1: Functions of packaging; Type of packaging materials; Selection of packaging material for different foods; Selective properties of packaging film; Methods of packaging and packaging equipment.

Unit 2: Mechanical strength of different packaging materials; Printing of packages; Barcodes & other marking; Interactions between packaging material and foods; Environmental and cost consideration in selecting packaging materials.

Unit 3: Food packaging systems: Different forms of packaging such as rigid, semi rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods.

Unit 4: Manufacture of packaging materials; Potential of biocomposite materials for food packaging; Packaging regulations; Packaging and food preservation; Disposal of packaging materials.

Unit 5: Packaging equipment and machinery: Vacuum, CA and MA packaging machine; gas packaging machine; seal and shrink packaging machine; form and fill sealing machine; aseptic packaging systems; bottling machines; carton making machines.

Unit 6: Testing of packaging; Rigid and semi rigid containers; Flexible containers; Sealing equipment; Labelling; Aseptic and shrink packaging; Secondary and transport packaging.

Practical

1. The Industrial training will be undertaken by each student during the summer recess. A report on the training which is required to be submitted shall consist of- A general overview of the industrial plant, the products & raw material sources of the plant, detail description of different processing and other equipment, scheduling of plant operations, conclusion. A viva will be conducted after submission of the report and presentation of a seminar.

OR

2. Each student shall undertake project work assigned to him related to design or R&D or industrial problem solving in the area of food science and technology under the supervision of a faculty member or faculty members. In principle, the research / design

work has to be carried out by the student himself taking advice from his supervisor when problem arises. Evaluation shall include an oral presentation followed by a brief viva.

Suggested Readings

1. Food and Packaging Interactions by Joseph H. Hotchkiss, (ACS symposium series - 365, April 5-10, 1987, American chemical society, Washington DC, 1988.)
2. Packaging foods with plastics by winter A. Jenkins & James P Harrington – Technomic publishing co. Inc, Lancaster. Basel.
3. Flexible food packaging (Question & Answers) by Arthur Hirsch VNB – Van Nostrand Reinhold, New York (An AVI Book), ISBN 0-442-00609-8.
4. Food Packaging and Preservation (theory & practice) by M.Mathlouthi-Elsevier Applied science publisher, London and New york.
5. Food Packaging Materials (Aspect of Analysis & Migration of contaminants) by N.T.crosby applied science publishers LTD. London.
6. Plastics in Packaging by A.S Athlye, TMGH, New Delhi.
7. Packaging (specifications, purchasing & Quality Control) 3rd edition by Edmond A Leonard- Marcel Dekker, INC- Newyork & Basel.
8. Plastics in packaging by forwarded by H.B Ajmera & M.R Subramanium – Indian institute of packaging. Published by A.P.Vaidya, Secretary IIP, E2, MIDC, Industrial Area (Andheri (East), Bombay-400093.
9. Food Packaging- Stanley Sacharow & Roger C. Griffin- The AVI Publishing company Inc. 1970. 10. Principles of packaging development- Griffin & Sacharow. (The AVI Publishing company, Inc. 1972).

GE-1/2 Paper 5: Waste management in Food Technology (Credits: Theory-4, Practical-2) Theory

Unit 1:

Introduction: Waste & its consequences in pollution and global warming, Types of food processing wastes, non-degradable & biodegradable wastes.

Unit 2:

Classification and characterization of food industrial wastes from fruit and vegetable processing industry, beverage industry, fish, meat and poultry industry, sugar industry and dairy industry.

Unit 3:

Waste disposal methods – physical, chemical and biological; Economical aspects of waste treatment and disposal, solid waste storage and disposal methods- land-filling, burial, incineration, recycling

Unit 4:

Treatment methods of solid wastes: Biological composting, drying and incineration; Design of solid waste management system: Landfill digester, Vermicomposting pit.

Unit 5:

Treatment methods for liquid wastes from food process industries; Design of activated sludge process, rotating biological contactors, Trickling filters, UASB, Biogas plant.

Unit 6:

Types, availability and utilization of by-products of cereals, legumes & oilseeds, Utilization of by-products from fruits and vegetables processing industries

Unit 7:

Types, availability & utilization of by-products of meat industry, poultry industry and fish processing units.

Unit 8:

Waste water treatment: standards for disposal of water, physical, chemical and biological characteristics of waste water Biofilters and bioclarifiers, Ion exchange treatment of waste water, Drinking-water treatment, Recovery of useful materials from effluents by different methods.

Practical

1. The Industrial Training will be undertaken by each student during the summer recess during the semester. A report on the training which is required to be submitted shall consist of- A general overview of the industrial plant, the products & raw material sources of the plant, Detail description of different processing and other equipment, Scheduling of plant operations, Conclusion. A viva will be conducted after submission of the report and presentation of a seminar.

OR

2. Each student shall undertake project work assigned to him related to design or R&D or industrial problem solving in the area of waste managements in food industries under the supervision of a faculty member or faculty members. In principle, the research / design work has to be carried out by the student himself taking advice from his supervisor when problem arises. Evaluation shall include an oral presentation followed by a brief viva.

Suggestive Readings

1. Food Industry Wastes: Disposal and Recovery; Herzka A & Booth RG; 1981, Applied Science Pub Ltd.
2. Water & Wastewater Engineering; Fair GM, Geyer JC & Okun DA; 1986, John Wiley & Sons, Inc.
3. Wastewater Treatment; Bartlett RE; Applied Science Pub Ltd.
4. Symposium: Processing Agricultural & Municipal Wastes; Inglett GE; 1973, AVI.
5. Food Processing Waste Management; Green JH & Kramer A; 1979, AVI.

6. Environmental Biotechnology: Principles and Applications; Rittmann BE & McCarty PL; 2001, Mc-Grow-Hill International editions.
7. Environmental Biotechnology; Bhattacharyya B C & Banerjee R; Oxford University Press.

GE-1/2 Paper 6: Analytical techniques and quality control, safety and evaluation of Foods (Credits: Theory-4, Practical-2)

Theory

Unit 1

Nature and Concept of Food analysis, Basic instrumentation: Principle for pH meter, Dialysis, ultra-filtration, Reverse osmosis. Centrifugation; Calorimetry: Bomb calorimeter, Principle of Rheological Analysis- Rheological parameters, rheological methods.

Unit 2

Preparation of Chemical solutions: Concept of molar, molal, and normal solutions, pH and Buffers; importance and measurement of pH.

Unit 3

Chromatographic Techniques: General principles. Types of Chromatography, Partitions and adsorption chromatography, Paper, TLC, gas liquid, ion exchange and affinity chromatography.

Unit 4

Spectroscopy: Beers and Lambert's Law. General principles of colorimeters and spectrophotometers (UV-visible, IR, NMR, Mass).

Unit 5

Quality Assurance: Introduction, Importance and Difference. Food Quality and Food Safety: Scope and difference. Raw materials & Finished product quality: Quality parameters and evaluation procedures: Appearance, color, texture, viscosity, consistency, flavor.

Unit 6

Food safety management, applications of HACCP in food safety, concept of food traceability for food safety, Food safety and Standards Act 2006: salient provision and prospects

Unit 7

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarius commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

Practical

1. Preparation and standardization of solution.
2. Thin layer chromatography for separation of a mixture of amino acids.
3. Column chromatography: Separation of beta carotene.

4. Extraction of caffeine from coffee/tea.
5. To identify adulteration of milk, fat, oil and butter by biochemical methods.
6. Sensory evaluation of cooked street foods and packaged foods from different shops.

Suggested Readings

1. Principles of Instrumental Analysis by D.A. Skoog and D.M. West
2. Fundamentals of Analytical Chemistry by D.A. Skoog and D.M. West
3. Industrial Methods of Analysis by Willard, Meritt, Dean and Settle
4. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker
5. Pearson's Composition and Analysis of Foods, Longman Scientific and Technical. 9th Edition, England by Kirk, R.S and Sawyer, R.
6. Food and Agricultural Organization Manuals of Food Quality Control No. 2 Additives Contaminants Techniques, Rome.