

**CURRICULUM OF STUDIES FOR QUALIFYING THE EXAMINATION FOR  
APPOINTMENT TO FOOD ANALYST UNDER  
PROVISION OF FSS RULES, 2011**

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**I. SCHEDULE OF THE EXAMINATION:**

**1. Theory: Two Days**

(i) **Paper I:** Food Laws and Standards in India, Planning Organization and set up of Food Analyst Laboratory, Food Preservation, Processing and Packaging, Labeling/Claims, Nutrition and Food Hygiene, Sanitation.

(ii) **Paper II:** Food Chemistry, Food Microbiology, Food Contaminants and Instrumentation and Instrumental methods of analysis.

**2. Practical and Viva-voce : Two Days**

**II. TIME DURATION:**

- Theory paper shall be of 3 hours duration each.
- Practicals and viva-voce will be for period of 2 working days for 6 hrs each day.
- Viva-voce shall be conducted during practicals only.

1101

**PAPER- I FOOD LAWS AND STANDARDS IN INDIA, PLANNING ORGANIZATION AND SET UP OF FOOD ANALYST LABORATORY, FOOD PRESERVATION, PROCESSING AND PACKAGING, LABELING/CLAIMS, NUTRITION AND FOOD HYGIENE, SANITATION.**

**I. Food Laws and Standards in India:**

- a. Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, 2011.
- b. Agricultural Produce Act, 1937 (Grading and Marketing).
- c. Sugar (Control), Order.
- d. Export (Quality Control & Inspection), Act, 1963 and Rules.
- e. Bureau of Indian Standards.
- f. Legal Metrology Act.
- g. International Food Control Systems/ Laws, Regulations and Standards/ Guidelines with regard to Food Safety: Codex Alimentarius (Sanitary and Phytosanitary and Technical Barrier to Trade)

**II. Planning Organization and set up of Food Analyst Laboratory, including NABL/ISO/IEC-17025:2005.**

**III. Food preservation and processing their principles, methodology and technology:**

- a. Food Preservation and Processing their principles, methodology and technology.
- b. Principles of Packaging and various Food Packaging materials: rigid and flexible such as plastic films, metal containers, glass containers, paper and card board containers, jute containers, etc.
- c. Basic principles of nutrition and role of various nutrients in human metabolism; Essential amino acids and fatty acids, PER, Nutrition deficiency diseases.

**IV. Food Hygiene, Sanitation:**

- a. HACCP, Quality Control Tools, GLP, GHP, GMP, FSMS, TQM, KAIZEN.
- b. Food sanitation and control.
- c. Industrial Strategies of Ensuring Safe Food and Food plant sanitation

**PAPER- II FOOD CHEMISTRY, FOOD MICROBIOLOGY, FOOD ADDITIVES & CONTAMINANTS, AND INSTRUMENTATION AND INSTRUMENTAL METHODS OF ANALYSIS.**

**I. Food Chemistry:**

- a. Introduction to chemistry of foods: composition and factors affecting the composition of foods,
- b. Moisture in foods and methods of moisture determination.
- c. Chemistry of simple and complex Carbohydrates: Disaccharides and trisaccharides, their classification and commercial sources. Chemistry of cellulose, starches, isolation and, other polysaccharides.
- d. Chemistry of amino acids and proteins. Classification of proteins, chemical and physical properties of proteins,
- e. Physical and chemical properties of fats, rancidity and flavour reversion, processing of oil bearing materials, refining of oils and fats, fat hydrolysis and inter-esterification, hydrogenation, shortenings and spreads.
- f. Fiber: Classification and importance in human diet.
- g. Enzymes: Classification and properties of food enzyme, factors affecting enzyme activity, uses of enzymes in food industry.
- h. Food and energy: PEV and GEV of food constituents, Bomb calorimeter and its functioning
- i. Minerals in foods.
- j. Chemistry of Vitamins and their estimation.
- k. Behaviour of macronutrients and micronutrients under different food processing condition.
- l. Plantation products including tea, coffee, cocoa, spices
- m. Natural occurring toxicants in foods
- n. Food Colors: Natural & synthetic
- o. Food additives and their chemistry
- p. Artificial Sweeteners: Chemistry and analysis
- q. Genetically modified and organic foods

Knowledge of Chemistry, composition, definition and accepted standards of quality and safety in the following foods:

- a. Various types of milk as defined in the FSS Regulations, 2011, common dairy products like cream, malai, dahi, chhana, cheese, icecream, condensed milk, milk powders, khoa, infant milk food, table butter, desi butter, ghee, etc.
- b. Asafoetida, compounded asafoetida and spices and condiments both whole as well as powdered, curry powder, garam masala, etc.
- c. Edible vegetable oils as laid down in the FSS Regulations, 2011 e.g. Vanaspati,
- d. Cereals and cereal products, pulses and pulse products, food grains, pearl barley, barley powder biscuits, corn flakes, corn flour, custard powder macaroni, malted milk foods, rolled oats, bread, bakery shortenings, etc.
- e. Vinegars.
- f. Catechu.
- g. Gelatin, sweets and confectionaries like Lozenges, toffees, chewing gum.
- h. Non alcoholic and alcoholic beverages (carbonated waters both sweetened and unsweetened)
- i. Starchy foods like arrowroot, tapioca, etc.
- j. Sweetening agents, cane sugar, bura, honey, ice candy, gur (jaggery), dextrose, golden syrup, icing sugar, saccharin, non-nutritive sweeteners etc.
- k. Tea including Kangra tea, coffee, cocoa, etc.
- l. Fruit and vegetable products like jams jellies, chutney, tomato ketchup, fruit juices, pickles, etc.
- m. Common salt, iodized salt, beans, edible silver leaf, groundnut kernel.
- n. Edible color, vegetable color like annatto, carotene, chlorophyll, riboflavin, caramel, etc.
- o. Baking powder, various prepared foods, chicory canned foods, meat, fish, eggs and their products, margarine.
- p. Basic principles of nutrition and role of various nutrients in human metabolism.
- q. Nutraceuticals, Functional Foods, Food Supplements, Dietary Supplements, Genetically Modified Foods.

*Suggested Reference Books:*

1. Principles of Food Chemistry" (John deMan, 3rd edition, Aspen Publishers Inc., Gaithersburg, Md.).
2. Food Chemistry, 3rd edition", O.R. Fennema, Ed. Marcel and Dekker, Inc., New York, NY. 1996
3. Introduction to the Chemical Analysis of Foods, S. Suzanne Nieleon, ed., Jones and Bartlett, London, UK. 1994
4. Food Chemistry, Translation from the second German edition, H.-D. Belitz and W. Grosch, Springer-Verlag, Berlin, 1987.
5. Basic food chemistry Frank A Lee
6. Mechanism and theory in food chemistry by W.S.Wang
7. Fundamentals of food chemistry by fenemma
8. Food chemistry by Belity & Grosch

**II. Food Additives & Food contaminants:**

- a. Food additives their chemistry, role and application Preservatives, antioxidants, emulsifying and stabilizing agents, buffering agents, bleaching, maturing agents and starch modifiers, Food colors, flavors, anti-caking agent etc.
- b. Food contaminants their occurrence, their health hazards prevention and detection:
  - a. Metals and toxic Metals e.g. Cd, Hg, As, etc.
  - b. Pesticide residues e.g. Dioxin, Aldrin, Malathion etc.
  - c. Mycotoxins, Argemone, Khesari dal, Ergot, Kernel bunt, Dhatura, etc.
  - d. Allergens, Antibiotic & hormone residues, Veterinary drug residue, other new contaminants and toxins (For Example; Cyclopiazonic acid in buckwheat flour).
  - e. Naturally occurring Toxins (NOTS) like Hydrocyanic acid, Hypericine, Safrole, Agaric acid etc. & Deoxynivalenol (DON)

**III. Food Microbiology:**

- a. Factors That Influence Microbes in Foods
- b. Microbial indices of spoilage & safety
- c. Spores and their significance
- d. Detection and Enumeration of Microbes in Foods

- e. Rapid and Automated Microbial Methods
- f. Indicator Microorganism and Microbiological Criteria: *Campylobacter* Species, *Salmonella* Species, Enterohemorrhagic *E. coli*, *Yersinia enterocolitica*, *Shigella* Species, *Vibrio* Species, *Enterobactersakazaki*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium botulinum*, *Clostridium perfringens*, *Bacillus cereus*, Fermentative Organisms, Spoilage Organisms, Molds, Viruses (Rotavirus) and Prions.
- g. Microbial Contaminants (e.g. Yeasts and Molds) their composition, physiological significance in foods and detection.
- h. Food spoilage and food poisoning and their control; Spoilage of canned food, cereals, fruits, vegetables, egg, meat and fish, dairy products, processed foods, etc.,
- i. Food poisoning- Endotoxin, Staphylococcal poisoning, botulism and Salmonella is Mycotoxins produced by fungi-Aflatoxin in stored food and grains
- j. Food borne intoxicants and infection: Mechanisms by which microbes and their toxins can cause food borne illnesses.
- k. Starter cultures and how they are used in food and dairy fermentations.
- l. Use of microbiological specifications / standard / guidelines in quality assurance/ quality control programs.

*Suggested reference books:*

- 1. Betty C. Hobbs, Food Microbiology, Arnold-Heinemann Publishing Private Limited, New Delhi.
- 2. Frazier and Wasthoff, Food Microbiology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- 3. Hammer B.W. and Babal, Dairy Bacteriology, Prentice Hali Incorporated, London.
- 4. Jay J.M. Modern Food Microbiology, CBS Publishers and Distributors, New York.
- 5. Prescott Lansing M. Harley John P. and Klein Donald A. Microbiology, WCB McGraw-Hill New York.
- 6. Salle A.J. Fundamental Principles of Bacteriology, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- 7. Varnam A.H. and Evans M.G. Food borne Pathogens, Wolfe Publishing House, London.

8. Montville, Thomas J. and K.R. Matthews. 2005. Food Microbiology: An Introduction, 1st ed., ASM Press, Washington, DC. ISBN 1-55581-308-9
9. Food Microbiology: Fundamentals and Frontiers, 2 ed, ASM Press, Washington, DC ISBN- 1-55581-208-2 )
10. Jay, James M., M.J. Loessner, & D.A. Golden. 2005 Modern Food Microbiology, 7<sup>th</sup> ed, Springer Science +Business Media, New York, NY.ISBN 0 387 23180 3.
11. Deibel, Robert H., and Jon A. Lindquist.1981. General Food Microbiology Laboratory Manual.
12. Alpha Editions, Burgess Publishing Company, Inc. Minneapolis, Minn ISBN 0-8087-5559-5
13. Goff, James H., Robert P. Story and M.G. Johnson.2008 Food Microbiology Laboratory Manual,14th Edition to supplement above Deibel and Lindquist 1981 manual.

**IV. Instrumentation, Instrumental and Molecular methods of analysis of food products:**

Modern Chemical and biological analysis including instrumentation and theory relating to modern chemical analysis, including, but not limited to, the following areas:

- i. Sampling
- ii. Sample preparation, analyte extraction and pre-concentration procedures
- iii. Calibration, standardization, Quality Assurance (QA)/ Quality Control (QC) and validation procedures.
- iv. Certified reference materials/standard reference materials
- v. Classical analytical methods, including cryoscopy, Gravimetry, Refractometry and Titrimetry.
- vi. Spectroscopic methods including UV-Visible spectrometry (Lambert-Beer law), IR Spectrometer, FTIR Spectrometer, Near IR Spectrometer and Raman spectroscopy, fluorescence spectroscopy.
- vii. Atomic spectrometry, including atomic absorption, atomic emission and atomic fluorescence for determination of heavy metal contaminants in foods such as lead, cadmium, mercury, arsenic, zinc, copper , tin, etc.
- viii. Chromatographic separation techniques including:, high performance liquid chromatography (HPLC) and ion chromatography, Paper, Thin

- layer, Ion-exchange and size exclusion, reverse phase and normal phase HPLC, Gas chromatography (GC), amino acid analyzer.
- ix. Non-chromatographic separation techniques including distillation and electrophoresis
  - x. Mass spectrometry, both elemental mass spectrometry (e.g. ICP-MS) and molecular mass spectrometry
  - xi. Hyphenated techniques e.g. GC-MS, LC-MS, Tandem MS, MALDI-ToF, LC-MS/MS, GC-MS/MS, ICP-MS, LC-Triple quad (LC-QQQ)
  - xii. Electroanalytical techniques including polarimetry and voltametry
  - xiii. Radioanalytical chemistry and X-ray based techniques
  - xiv. DNA based methods of analysis: PCR, Real Time PCR, Multiplex PCR
  - xv. Enzyme and immunological techniques e.g. enzyme assays, ELISA.
  - xvi. Microbiological assay
  - xvii. Methods for data handling, including statistical analysis, the assessment of measurement uncertainty and simple chemometrics e.g. PCA
  - xviii. Recent developments in analytical science

*Suggested reference books:*

1. Skoog, West, Holler and Crouch (2000), *Analytical Chemistry: an Introduction* (Harcourt Inc, Florida), 7th Edition.
2. Skoog, Holler and Crouch (2007) *Principles of Instrumental Analysis*, (Thomson Brooks/Cole), 6th Edition.
3. Robards, Haddard (1994) *Principles and Practice of Modern Chromatographic Methods*, Academic Press.
4. Lajunen (1992) *Spectrochemical Analysis by Atomic Absorption and Emission*, Royal Society of Chemistry.
5. Fifield and Kealey (2000) *Principles and Practice of Analytical Chemistry*, Blackie, 5<sup>th</sup> Edition.
6. Christian (1994) *Analytical Chemistry* (John Wiley & Sons, Chichester) 5<sup>th</sup> edition.
7. Harris (2002) *Quantitative Chemical Analysis* (Freeman, New York) 6<sup>th</sup> Edition.
8. Kellner (ed) (1998) *Analytical Chemistry* (Wiley-VCH, Weinheim).
9. Miller and Miller (2000) *Statistics and Chemometrics for Analytical Chemistry* (Prentice-Hall, Harlow) 4<sup>th</sup> Edition.



PRACTICAL

1. Physical , Chemical, Microbiological and microscopic examination of the following food commodities:

Carbonated water, baking powder, starch foods, asafoetida, spices and condiments, sweetening agents including artificial sweeteners, plantation products like coffee, tea etc., animal fat, edible oils and fats, dairy products, fruit products, common salt, food grain including cereal products, pulses etc., vinegar, gelatin, confectionery, colors, vitamins, flavors, preservatives, pesticides, anti-oxidants, emulsifying and stabilizing agents etc.

2. Detection and estimation of various adulterants, contaminants in foods.
3. Proximate analysis of food and nutritional labeling.
4. Detection and estimation of vitamins, minerals and other nutrients.
5. Analysis of food involving use of common analytical instruments.

## LIST OF ANALYSIS

- Analysis of Artificial sweeteners e.g. Aspartame in diet drinks and light foodstuffs.
- Preservatives in Food stuff like Benzoic Acid.
- Aflatoxin and Mycotoxins contamination in food.
- Melamine in milk and milk products.
- Accurate Mass Analysis for scanning of non-target compounds.
- Identification & Characterization of unknown compounds.
- Plant growth regulator (Hormones) analysis e.g. Ethylene.
- Quantifications for Pesticides Analysis (Organ chlorine and Nitrogen, Sulphur containing) compounds Sub ppb level in Food Stuffs including Fruits and Vegetables.
- Samples received (Referral/Appellate samples) from Designated Officer under Section 40 (C) of FSS Act, 2006.
- Non-Protein Amino acid in food including beta-N-oxalylamino-L-alanine a Neuro Toxic Amino Acids responsible for Lathyrism.
- Quantifications of Herbicides, Pesticides and Synthetic Color.
- Non permitted dyes in food like Sudan Red Dyes in Curry and Chili Powder.
- Antibiotic, Antibacterial drug residues in Food, Animal Feed testing.
- Specialized Veterinary Samples received from Ante-mortem and Post- mortem inspection.

**LIST OF INSTRUMENTS REQUIRED**

1. HPLC High Performance with UV-Visible Detector
2. HPLC with UV-visible and Fluorescence Detector-Amino Acid for system and for Protein Analysis.
3. HPLC with Refractive Index and Evaporating Light Scattering Detector (ELSD) Detector- For Sugar Analysis.
4. LC-QQQ MS/MS (Triple Quadrupole Detector).  
(1 for Pesticide, 1 for Aflatoxins and 1 for Antibiotics).
5. LC-QToF- Quadrupole Time of Flight 1 No. for Non -Target Pesticide Analysis.
6. Ion Chromatograph.
7. RTPCR - Real Time Polymerase Reaction system --for GM food and Pathogen Detection.
8. GCMS - QQQ ( MS/MS) Gas Chromatograph Triple Quad system- Pesticide Analyzer
9. GCMS - QQQ (MS/MS ) Gas Triple Quad System - for Dioxins, PAH and PCB analysis
10. GC- QToF system for Non Target Compounds Analysis.
11. GCMS Single Quad with ECD and FPD Detector.
12. GC with FID, ECD, NPD Detector.
13. DNA Sequencer.
14. Bioanalyzer- DNA/RNA/Protein Analysis.
15. Colony Counter.
16. Fourier Transform Infrared spectroscopy (FTIR)
17. Graphite Furnace Atomic Absorption (GFAA)
18. LC-ICP-MS (liquid chromatography-Inductively Coupled Plasma-Mass Spectrometry)
19. UV-Visible Spectrophotometer
20. Kjeldahl Digester system
21. Near Infra Red for moisture
22. Gel Electrophoresis system
23. Flow Cytometer
24. Imaging System- Microscope
25. Nuclear Magnetic Resonance (NMR) system
26. Micro Wave Digesters
27. Rotary Evaporator

28. Balances
29. pH meter
30. Hot Plate
31. Centrifuges
32. Oven
33. Refrigerator
34. Deep Freezer
35. Water Bath

## ANALYSIS TO BE CARRIED OUT IN LABORATORIES

1. Water soluble vitamins analysis in food (Vitamins C (ascorbic acid), Folic Acid, Vitamins B1, B2 and B6).
2. Fat soluble vitamins analysis in food (Vitamins A, D & E).
3. Assessment of spore contamination in pepper by determination of dipicolinic acid.
4. Analysis of Artificial sweeteners e.g. Aspartame in diet drinks and light foodstuffs.
5. Anthocyanins
6. Analysis of sweeteners in food and Beverages.
7. Preservatives in Food stuff.
8. Analysis of Acidulants.
9. Analysis of Antioxidants in Chewing Gum.
10. Amino acid in Food including BOAA beta-N-oxalylamino-L-alanine a toxic Amino Acids.
11. Protein analysis
12. Quantifications of
  - a. Melamine Analysis, Herbicides
  - b. Method Setup for pesticides
  - c. Synthetic Color
  - d. Flavoring Agents
  - e. Antioxidant
13. Analysis of Alcoholic and Non – Alcoholic Drinks
14. Analysis of Synthetic Antioxidants in Vegetable oils: For dietary supplements and other Fruits matrixes.
15. Analysis of Non-Nutritive Food Additives , Synthetic/Artificial Food Colors
16. Quantification of sugars and carbohydrates in dietary supplements, Nutritional values declaration, Baby food.
17. Quantification and confirmation for below mentioned analytes
18. Trace level Water soluble and Fat soluble Vitamin analysis in Various Food analysis
19. Vitamin B12 analysis in Food Like Baby Food
20. Aflatoxins and Mycotoxins contamination in Food
21. Illegal dyes in Food like Sudan Red Dyes in Curry and Chilli Powder
22. Antibiotic, Antibacterial drug residues in Food, Animal Feed testing
23. Melamine in milk and milk products
24. Plant growth regulator analysis ( PGR)
25. Acrylamide in potato chips, Bisphenol A in Food

26. Accurate Mass Analysis for scanning of non-target compounds
27. Identification & Characterization of unknown compounds
28. Residual Pesticide & Herbicide analysis in food and water.
29. Aflatoxins and Mycotoxins contamination in Food- B1, B2, G1 and G2
30. Animal Feed testing Veterinary Drugs
31. Plant growth regulator (Hormones) analysis -- (Recently Indian Grapes were rejected by EU govt due to PGR- Hormones problem).
32. Capsaicinoids ( Alkaloids) in Peppers
33. Synthetic Dyes in food Natural Color.
34. Analysis of inorganic, anions, organic acids, amino acids- critical ones, carbohydrates
35. Rapid Monitoring of Carbohydrates in Food
36. Quantifications for Pesticides Analysis (Organochlorine and Nitrogen, Sulphur containing) compounds Sub ppb level in type of Food Grains, Milk, Milk Products, Fruits and Vegetables.
37. Quantification in low ppb level of Dioxins, Furans and PAH and PCB's Analysis in Food like *Dioxins in Guar Gum, Egg and Egg Products*.
38. Pesticides in package drinking water and other Food matrixes.
39. Scanning( Qualitative) of target pesticides, Melamine's, Dioxins, Furans, PAH's analysis
40. Identifications of Flavors compounds in any drink and developing new flavor compounds.
41. Identification, confirmation Volatiles in Food Matrix and Packaged Drinking Water e.g. Benzene, Toluene.
42. Identification, confirmation of Bacteria Aerobic and Anaerobic, yeast in Food and others products.
43. Confirmation of food's origin and authenticity
44. Analysis of toxic and non-toxic species of As and Cr.
45. Measurement of Macro and trace elements in plant digest
46. Measuring trans fat content using the AOAC method for classifying and discriminating food adulterants
47. Analysis of emulsions in food and beverage processing
48. Microanalysis & qualifications of
  - a. foods/beverages,
  - b. flavors,
  - c. food packaging,
  - d. foodborne pathogens,

- e. edible oil testing,
  - f. food Contaminants/adulterants,
  - g. fermentation control,
  - h. food additives, and
  - i. nutritional supplements
49. Multiplexpathogen detection and GMO's.
50. Quantifications of DNA/RNA/Protein
- a. Halal Meat testing,
  - b. Milk and Milk protein content( Adulteration),
  - c. Basmati Rice (Adulteration),
51. Screening and characterization to a new level by revealing how atoms are *organized in space*
52. Analysis for new molecule development
53. Quantification of carbohydrates, organic acids and polar substances in variety of foods or drinks.
54. Quality control of dairy products – baby food, yoghurt, milk or lactose-free foods
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