SYLLABUS FOR PAPER-I

A. Food Laws and Standards of India and International Food Laws:

I. Food Safety and Standards Act of India, 2006: Provision, definitions and different sections of the Act and implementation.

II. FSS Rules and Regulations (2011) as amended from time to time -

   a) Licensing and registration: Central license, State license, Registration, Responsibilities of the FBO, Role of Designated officer, Food Safety Officer and Food Analyst.

   b) Standards of Quality and Safety of Food & Food Products laid down in the FSS Regulations, 2011. The different food categories in the Act. The relevance of the standards (Vertical and Horizontal) quality and safety parameters to particular foods including current food safety issues.

   c) Regulations of food additive: What is an additive, various groups of additives and their technological functions, INS number: food colors, antioxidants, sweeteners, preservatives, processing aids. Food processing aids. The Indian Food Code and using the hierarchy to understand the category wise approval of Food additives.

   d) Packaging and labelling rules and regulations: List of ingredients, nutritional information, special label declarations, claims-Health, nutrition, nutrient led claims, use of words and phrases on label

   e) Regulations for Contaminants, Toxins and Residues and restriction of sales.

   f) Food Safety and Standards (Food or Health Supplements, Nutraceuticals, Foods for Special Dietary Uses, Foods for Special Medical Purpose, Functional Foods and Novel Food) Regulations, 2016Food Safety and Standards (Food Recall Procedure) Regulation, 2017Food Safety and Standards (Import) Regulation, 2017

   g) Food Safety and Standards (Organic Food) Regulation, 2017.
   Food Safety and Standards (Fortification of Foods) Regulations, 2018
   Food Safety and Standards (Alcoholic Beverages) Regulations, 2018

   h) Laboratory sampling and analysis: The role of Referral labs, FSSA notified laboratories and State Food Laboratories and functions. Receiving legal samples, sample custody and sample custodian. Storage of sample. Required documentation and registration, storage of the sample Analyses as per FSS Rules and Regulations (2011).

III. Other National Laws and Standards

   a) Agricultural Produce Act, 1937 (Grading and Marketing)

   b) Export (Quality Control & Inspection), Act, 1963 and Rules

   c) Bureau of Indian Standards relevant to Food Safety (Water, Infant Formula etc0

   d) Legal Metrology Act

IV. International Food Control Systems/ Laws, Regulations and Standards/ Guidelines with regard to Food Safety:

   a) CODEX Alimentarius Commission: History, Members, Standard setting and Advisory mechanisms: JECFA, JEMRA, JMPR

   b) WTO agreements: SPS/TBT

   c) Role of OIE, IPPC.

B. Planning Organization and setting up of Food Analysis Laboratory including NABL / ISO / IEC-17025: 2017 and laboratory safety.

I. Understand the requirements for setting up a laboratory for the legal defensibility of analytical data. The ideal structure design, environment, layout for chemical and microbiological testing, Air handling etc

II. What is accreditation, Different accreditation bodies (NABL, APLAC, ILAC). Requirements for ISO/IEC 17025:2017, documentation, pre-requisites for accreditation, management requirements, technical requirements, measurement of traceability

III. Laboratory safety: Personnel and laboratory hygiene, emergency planning, General hazards in a food laboratory, safety equipment,storage of chemicals, acids, flammables etc, handling compressed gases, centrifuge, chemical and biological spills and waste disposal.

C. Physical, Chemical and Instrumental analysis

I. *Sampling and sample preparation*: Definition, types of sample, sampling plan, subsampling, designing a sampling plan, concept of sample size and representative. Sample preparations – particle size, homogeneity, dissolution technology anddecomposition, storage of samples.Solid Phase Extraction- Introduction, sorbents, matrix solid phase dispersion and applications.

II. *Statistics and statistical terms:* Systematic and random errors. Mean distribution. Confidence interval. Confidence limits and confidence level. Outliers. Definition and calculation of: Average, Mean, Standard deviation, Relative standard deviation, Coefficient of variation, Confidence limits of a measurement, Statistical Tests, Linear correlation and regression curve fitting, fitting of linear equations. Choosing and using statistical tests, Analysis of Variance (ANOVA),

III. *Basic principles of Classical Methods of food analysis*: Law of mass action, Le chateliers principle, stoichiometry, volumetric and gravimetric analysis. Preparation of standards, working standards and solutions of known concentration (percent, molar, molal, normal, ppm and ppb) and their dilution. Proximate analysis, physical methods for extraneous matter analysis

IV. *Classical analytical techniques: Gravimetry, Titrimetry, Refractometry and Polarimetry*: Principle, Instrumentation and applications of each technique in food analysis

V. *UV-Visible and Fluorescence Spectrometry*: Electromagnetic spectrum, Beer and Lambert's Law, Absorbance, Transmittance, Molar absorptivity (Molar Extinction coefficient), E 1%, λ Max. Components and functioning of an UV-vis spectrophotomer: Single beam and double beam. Components of a UV-VIS spectrum. Calibration curve and applications in food analysis.

VI. *Raman spectroscopy*: Principle Theory Instrumentation, techniques and Applications of Raman spectroscopy in food analysis

VII. *Chromatographic techniques*: Fundamentals of chromatographic separations and their classification. The plate theory. Capacity factor and resolution factor. Chromatographic efficiency. Van Deemter's equation. Partition coefficient etc. Principles and applications of paper (Ascending, Descending, Radial, Two dimensional) Partition, Thin layer chromatography, HPTLC, size exclusion and ion exchange chromatography. Applications in food analysis

VIII. *High Performance Liquid Chromatography (HPLC)*: Basics of liquid chromatography, HPLC columns and Stationary phases (solid, liquid) – Bonded phase supports, mobile phases, isocratic and gradient elution, Detectors: UV absorption, Fluorescence detector, RI detectors, electrochemical detectors, Photo diode array, Evaporative light scattering detector, PHRED anatomy of a chromatograms. Modes of separation Normal and Reverse

Phase. Sample Preparation Techniques, Applications in quantitative food analysis of aflatoxins, vitamins, sugars, sweeteners, preservatives etc.

IX. *Gas chromatography:* Basics of Gas chromatography, Mobile phase and criteria for its selection – Sample introduction techniques – Stationaryphases– Supports for liquid stationary phases, Selection of columns. Detectors FID, TCD, FPB, ECD, TID. Temperature programming in GC – Derivatization and sample preparation in GC –Fatty acid profile and quantitative analysis of fatty acids in fats and oils.

X. *Mass Spectrometry:* Basics of mass spectrometry, Components of a mass spectrometer, Ionization and ion sources: Electrospray, chemical, Fast Atom Bombardment, MALDI, Atmospheric Pressure Chemical ionization and other ionization methods. Mass analyzers: Quadrupole Analyzers, Ion Trap Analyzers, Electrostatic Trap or 'Orbitrap', Time-of-Flight Analyzers, Hybrid Instruments. Detectors: Photographic plate, Faraday cup Electron multipliers. Data acquisition, Data conversion, Data reduction andLibrary search. Tandem Mass Spectrometry and its applications.

XI. *Hyphenated Techniques:* Mass Spectrometry and Chromatography Coupling. GC-MS/MS, LC-MS/MS, Capillary electrophoresis-MS, Isotopic Ratio mass spectrometry. Analytical Information: Mass Spectrometry Spectral Collections, high resolution, quantitative data, fragmentation and spectrum interpretation.

XII. *Atomic absorption Spectroscopy, Atomic emission spectroscopy, ICP-MS:* Principles-Atomization process, Atomic line widths and radiation sources for AAS, temperature gradients, cells detectors, interferences, Background correction methods and modifications in instrumentations, Atomic EmissionSpectroscopy: Atomic spectra, Population distribution with temperature, Sources, spark laser microprobe for atomic emission, Spectrometers, Merits, demerits, and applications. Basic principles and instrumentation of ICP-MS; data acquisition and interpretation; applications of ICP-MS for analysis of metallic contaminants in food. Sample preparation, microwave digestion.

XIII. *Biological Techniques (DNA/protein based):* Fundamental principles and instrumentation of the systems; measurement techniques and result interpretations of Polymerase Chain Reaction (PCR), Real-time Polymerase Chain Reaction (PCR) technique; Enzyme Linked Immunosorbent Assay (ELISA); Radioimmunoassay (RIA). Use of PCR for detection of genetically-modified organisms (GMO); meat and fish speciation and other applications in analysis of food adulteration.

XIV. *Measurements of Rheological properties:* Instrumental Measurement of Texture of Foods, Visco Analysis, viscometer, texture analyser etc.

XV. *Quality assurance and Quality control:* Introduction to quality control in analytical chemistry. Terminology in analytical measurements: True value, Measured value, Accuracy, Precision, Uncertainty, Random errors. Sample traceability, Internal quality control, Certified reference materials. Spiked reference samples. Recovery studies, Method validation/verification (LOD, LOQ, specificity, selectivity, linearity, range, robustness, repeatability, reproducibility. External and internal standards, Control chart. Proficiency testing, z scores

D. Case studies for interpretation and providing opinion based on an analysis report as per FSSR 2011

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