MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	St. Peter's College, Kolencherry					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Abraham Mathew					
Contributors	Vimal Mohan					
Course Name	Bio-Instrumentation and Quality Analysis 1					
Type of Course	DSE					
Specialization title	Bio-Instrumentation and Quality Analysis					
Course Code	MG3DSEBOTA05					
Course Level	200					
Course Summary	This course explores key laboratory concepts, including solution preparation, buffer formulation, and pH measurement using various techniques. Students learn acid-base titration, endpoint determination, and gravimetric analysis methods, focusing on applications in analytical chemistry. The course also covers colorimetric and spectrophotometric principles, introducing Beer-Lambert's law and instruments like UV-Visible, IR and Atomic Absorption spectrophotometers. Students will gain knowledge of accurate chemical analysis, ensuring proficiency in concentration calculations, instrument calibration, and laboratory safety.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of experiments and apparatus in biology					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	List various laboratory instruments. Summarize characters of solutions and its concentrations.	K	PO1
2	Illustrate the concept of pH and buffers.	U	PO1
3	Investigate different Titration and gravimetric analysis	A	PO2
4	Appraise intricacies of Colorimetric and spectrophotometric analysis	AN	PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

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CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Solutions			
	1.1	Glass wares and plastic wares used in lab– beakers, conical flasks, pipettes, burette, measuring cylinder, test tubes, Petri dishes, mac-cartney bottles, reagent bottles, volumetric flasks, funnel, separating funnel, round bottom flasks, flat bottom flasks, watch glass, wash bottle. Washing, drying, storing of glass wares and plastic wares. Laboratory oven principle, working and uses.	5	["1"]
	1.2	Water – normal water, distilled water, RO water, ultrapure water; properties of water. Solutions- concepts of normality, molarity, molality, percentage, ppm, ppb and ppt.	5	["1"]
	1.3	Understanding a chemical- properties, molecular formula, molecular weight, precautions and storage. Weighing of salts – use of weighing balance- physical and electronic. Preparation of solutions –pipetting methodology, use of standard flasks, use of magnetic stirrer and hot plate. Storage of solutions.	5	["1"]
2	pH and Buffers			
	2.1	Concept of pH. Strong acid, strong base, weak acid, weak base. Henderson- Hasselbach equation. Measuring pH- litmus paper, pH paper, pH meter. Principle and working of pH meter, calibration of instrument.	5	["2"]
	2.2	Buffer- concept, buffering action, buffering capacity. Properties of a good buffer. Composition and use of common buffers- citrate buffer, acetate buffer, phosphate buffer, Tris- HCl buffer, carbonate-bicarbonate buffer, phosphate buffered saline	5	["2"]
	2.3	Preparation of buffer – phosphate, acetate, carbonate-bicarbonate and phosphate buffered saline of various pH and molarity. Adjusting the pH of buffer. Dilution of buffer, storage of buffer	5	["2"]

Module	Units	Course Description	Hrs	CO No.
3	Titration and gravimetric analysis			
	3.1	Fundamental concepts of acid-alkali titration - Acid-Base Neutralization, Equivalence Point vs. Endpoint, Stoichiometry and Concentration Calculations Titration Curves and pH Transition Endpoint Determination Techniques - Visual Indicators: indicators such as phenolphthalein, methyl orange, or bromothymol blue. Instrumental Methods: potentiometric titration, conductometric titration, and spectrophotometric methods—using electronic sensors to determine endpoint. Types of Acid-Base Titrations: Direct and Back Titration.	5	["3"]
	3.2	Titration Methodology - Experimental Setup and Apparatus, Safety protocols. Applications of Acid-alkali titration.	5	["3"]
	3.3	Fundamental Concepts and Principles of gravimetric analysis: . Types of Gravimetric Analysis- Precipitation Gravimetry, Volatilization Gravimetry, Electrogravimetry, Thermogravimetry. Methodology and Procedural Steps- Sample Preparation, Precipitation and Reaction Procedures, Filtration, Washing, and Drying Techniques, Weighing and Accuracy. Applications in Analytical Chemistry and Industry- Environmental Analysis, Pharmaceutical and Food Industries, Material Science and Geology.	5	["3"]
4	Colorimetric and Spectrophotometric analysis			
	4.1	Electromagnetic spectra, use of monochromator in wavelength segregation. Colorimeter- Beer lamberts law and principle of colorimetry. Use and working of colorimeter. Limitations and precautions for use of colorimeter.	5	["4"]
	4.2	Spectrophotometer- Principle and applications of Absorption spectroscopy- UV Visible spectrophotometer, IR spectrophotometer, Atomic absorption spectrophotometer	5	["4"]
	4.3	Principle and applications of Emission spectroscopy- Fluorescence spectrophotometer Principle and applications of Scattering spectroscopy- Raman spectrophotometer	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types

MODE OF ASSESSMENT
Mode of Assessment: Theory

A. Continuous Comprehensive Assessment (CCA)
• Theory – 30 Marks
● Involvement and responses in class room transactions ● Home Assignments ● Oral presentation/ Viva/Quiz/Open book test ● Field Study / Group discussion on a recent research or review article (<5 years) related to the course ● Any other method as may be required for specific course / student by the course faculty

B. End Semester Evaluation (ESE)
• Theory – 70 Marks
Assessment Methods – WRITTEN EXAM
Duration of Examination – 2.00 Hrs
Pattern of examination for Theory – Non-MCQ
Different parts of written examination – Part - A , B , C
Answer Type:
∘ PART - A
∘ One or two Sentences - (10 out of 12) – 10 × 2 = 20
∘ PART - B
∘ Short answer - (8 out of 10) – 8 × 5 = 40
∘ PART - C
∘ Essays - (1 out of 2) – 1 × 10 = 10

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- We, St. Peter's College, Kolencherry, agree to appoint a new course coordinator for the proposed Bio-Instrumentation and Quality Analysis in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, St. Peter's College, Kolencherry and Abraham Mathew, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.

MGU-UGP (HONOURS)

Syllabus

MAHATMA GANDHI UNIVERSITY

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Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	St. Peter's College, Kolencherry					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Abraham Mathew					
Contributors	Vimal Mohan					
Course Name	Bio-Instrumentation and Quality Analysis 2					
Type of Course	DSE					
Specialization title	Bio-Instrumentation and Quality Analysis					
Course Code	MG4DSEBOTA05					
Course Level	200					
Course Summary	This course provides a comprehensive exploration of essential laboratory techniques for separating, detecting, and quantifying chemical and biological samples. Students will gain a solid understanding of both the underlying principles and practical applications of each method. Learners will be equipped with a well-rounded skill set in modern analytical techniques, preparing them for advanced study or professional roles in scientific research, clinical diagnostics, and quality control.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of experiments and apparatus in biology					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Define and explain the fundamental principles and applications of Filtration, Centrifugation and Cell disruption techniques	K	PO1
2	Investigate on the various chromatographic techniques and their applications	A	PO1
3	Analyse Electrophoresis and Blotting techniques	AN	PO2
4	Analyse various Cell imaging and Cell counting techniques	AN	PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	-	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-
CO 4	-	2	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Filtration, Centrifugation and Cell disruption techniques			
	1.1	Methods of filtration- conventional filtration using filter paper, use of filter aids. Tangential filtration. Ultra filtration. Applications of Filtration techniques.	5	["1"]
	1.2	Principle of centrifugation- centrifugal force, RPM, RCF. Types of rotors. Principle, working and use of bench top centrifuge, mini centrifuge, refrigerated centrifuge and ultracentrifuge. Applications of Centrifugation.	5	["1"]
	1.3	Cell disruption techniques- Solid shear, liquid shear, use of abrasives, freeze-thawing, osmotic shock, ultrasonication, use of detergents and use of enzymes	5	["1"]
2	Chromatography			
	2.1	Principles of Chromatography – stationary and mobile phases, retention time, and separation mechanisms, Partition coefficient, RF value. Adsorption chromatography- Column chromatography, TLC and High-Performance Thin-Layer Chromatography (HPTLC). Partition chromatography- Paper chromatography.	5	["2"]
	2.2	Advanced Chromatographic Techniques – Gas chromatography (GC), High-performance liquid chromatography (HPLC), Ion exchange chromatography, Size exclusion chromatography	5	["2"]
	2.3	Detection of compounds, use of UV cabinet, calculation of RF value, Collection of fractions manually and by use of fraction collectors. Applications of Chromatography – use in pharmaceuticals, environmental science, food testing, forensic investigations, and biotechnology	5	["2"]
3	Electrophoresis and Blotting techniques			
	3.1	Concept of electrophoresis. Agarose gel electrophoresis. Preparation of reagents, gel staining and viewing of gel- working and use of trans-illuminator and gel documentation system.	5	["3"]
	3.2	Poly acrylamide gel electrophoresis – Native, SDS- non-reductive and reductive. Preparation of reagents, gel, staining and Visualization of gel. Isoelectric focusing and 2D Electrophoresis.	5	["3"]
	3.3	Principle, working and applications of Northern Blot, Western blot and Southern blot. Applications of Blotting techniques	5	["3"]
4	Cell Counting and Cell imaging Techniques			
	4.1	Camera lucida-types and applications. Cell image capturing and size measurement. Micrometer- principle and application	5	["4"]
	4.2	Hemocytometer, flow cytometer, scintillation counter, Electrical Impedance Counting (Coulter Counter)	5	["4"]
	4.3	Applications of Cell Counting Techniques: Cell Culture and Research- Growth Assessment, Drug Testing. Clinical Diagnostics - Hematology, Immunophenotyping. Biotechnology and Tissue Engineering - Quality Control, Single Cell Analysis.	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Theory/Hands on Work- 30 Marks ● Involvement and responses in class room transactions ● Home Assignments ● Oral presentation/ Viva/Quiz/Open book test ● Field Study / Group discussion on a recent research or review article (<5 years) related to the course **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ One or two Sentences - (10 out of 12) – 10 × 2 = 20 ◦ PART - B ◦ Short answer - (8 out of 10) – 8 × 5 = 40 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 10 = 10

References

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MGU-UGP (HONOURS)
Syllabus

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SYLLABUS						
SIGNATURE COURSE						
Name of the College	St. Peter's College, Kolencherry					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Abraham Mathew					
Contributors	Vimal Mohan					
Course Name	Bio-Instrumentation and Quality Analysis 3					
Type of Course	DSE					
Specialization title	Bio-Instrumentation and Quality Analysis					
Course Code	MG5DSEBOTA05					
Course Level	300					
Course Summary	This course offers a comprehensive understanding of plant metabolite profiles by exploring primary and secondary metabolites, their biosynthetic pathways, and ecological roles. The course focuses on extraction techniques from robust sample preparation to advanced methods such as Soxhlet, supercritical fluid, and microwave-assisted extraction. The course explores detection methodologies for qualitative and quantitative analysis via histochemical, chromatographic, and spectroscopic techniques. The curriculum emphasizes purification and quality analysis through HPLC, GC-MS, NMR, and other cutting-edge methods, while fostering skills in experimental design and sustainable practices in metabolic research.						
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of plant metabolites and metabolism.					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Differentiate the structure, biosynthesis, and functions of primary and secondary metabolites in plants, including their ecological relevance and applications.	U	PO1
2	Apply the fundamental concepts of plant metabolite extraction.	A	PO1
3	Analyse plant metabolite profiles by employing qualitative and quantitative detection methods	AN	PO2
4	Create integrated purification and characterization strategies—using techniques.	A	PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
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CO 2	3	-	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Primary and secondary metabolites in plants			
	1.1	Overview of Plant Metabolism: Definition of metabolism; primary vs. secondary metabolites, Historical perspectives and relevance in plant biology, Evolutionary significance and diversity of plant metabolites	5	["1"]
	1.2	Primary metabolites-carbohydrates, lipids, proteins, nucleic acid, Structure, function and biosynthesis mechanisms of primary metabolites.	5	["1"]
	1.3	Secondary metabolites-, alkaloids, flavonoid, phenolics, terpenoids. Biosynthesis and functions of secondary metabolites. Industrial applications, applications in agriculture and pharmacology	5	["1"]
2	Extraction of primary and secondary metabolites			
	2.1	Principles of Extraction: Fundamental concepts of solubility, polarity, and partitioning. Role of solvents and extraction parameters (temperature, time, pH). Sample preparation and Pre-extraction treatments- Collection, drying, and grinding techniques. Considerations for preserving metabolite integrity.	5	["2"]
	2.2	Extraction Techniques for Metabolites: Soxhlet Extraction, Cold Maceration and Hot Reflux method, percolation. Extraction of essential oil by Clevenger apparatus.	5	["2"]
	2.3	Advanced Extraction Techniques - Supercritical Fluid Extraction (SFE), Pressurized Liquid Extraction (PLE), Enzyme-Assisted Extraction (EAE), Ultrasound assisted extraction, Microwave assisted extraction, Super critical fluid extraction	5	["2"]
3	Detection of metabolites			
	3.1	Detection of carbohydrates- qualitative and quantitative, microscopic examination of storage polysaccharides, histochemical localization Detection of lipids- microscopic and histochemical localization	5	["3"]
	3.2	Detection of proteins- qualitative and quantitative estimation, histochemical localization Detection of nucleic acid- qualitative and quantitative methods.	5	["3"]
	3.3	Detection of secondary metabolites- alkaloids, phenolics, flavanoids, tannins, coumarins, saponins-qualitative methods.	5	["3"]

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Module	Units	Course Description	Hrs	CO No.
4	Purification, characterization and quality analysis of plant metabolites			
	4.1	Concentration of the metabolite- Rotary evaporation, lyophilization, Isolation of metabolite from extract- Solvent solvent extraction-cocurrent and counter current method. Precipitation.	5	["4"]
	4.2	Purification of metabolite- Chromatographic methods – partition and adsorption chromatography, ion exchange, size exclusion. High-Performance Liquid Chromatography (HPLC), Gas Chromatography, Eelectrophoresis. Detection of purity- TLC and HPTLC analysis.	5	["4"]
	4.3	Characterization of the purified metabolite- High-Performance Liquid Chromatography (HPLC), Gas Chromatography-Mass Spectrometry (GC-MS), LC-MS. Spectroscopic Methods: UV-Vis, Infrared (IR), and Nuclear Magnetic Resonance (NMR) spectroscopy.	5	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.
Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Theory/Hands on Work- 30 Marks ● Involvement and responses in class room transactions ● Home Assignments ● Oral presentation/ Viva/Quiz/Open book test ● Field Study / Group discussion on a recent research or review article (<5 years) related to the course **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Exam Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ∘ PART - A ∘ One or two Sentences - (10 out of 12) – 10 × 2 = 20 ∘ PART - B ∘ Short answer - (8 out of 10) – 8 × 5 = 40 ∘ PART - C ∘ Essays - (1 out of 2) – 1 × 10 = 10

References

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Affidavit

- We, St. Peter's College, Kolencherry and Abraham Mathew, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, St. Peter's College, Kolencherry, agree to appoint a new course coordinator for the proposed Bio-Instrumentation and Quality Analysis in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, St. Peter's College, Kolencherry and Abraham Mathew, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.

MGU-UGP (HONOURS)
Syllabus

MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	St. Peter's College, Kolencherry					
Faculty/ Discipline	Botany					
Programme	BSc (Hons) Botany					
Course Coordinator	Abraham Mathew					
Contributors	Vimal Mohan					
Course Name	Bio-Instrumentation and Quality Analysis 4					
Type of Course	DSE					
Specialization title	Bio-Instrumentation and Quality Analysis					
Course Code	MG6DSEBOTA05					
Course Level	300					
Course Summary	This course explores water, soil, and food quality analysis using modern analytical methods. For water, students learn testing parameters such as turbidity, pH, hardness, BOD, and COD, employing titration, flame photometry, atomic absorption, and ICP-MS, along with disinfection and wastewater treatment techniques including filtration, sedimentation, and reverse osmosis. Soil analysis covers formation processes, degradation, sampling, and determination of texture, density, pH, EC, and nutrient levels via titrimetric and spectrophotometric methods. Food quality evaluation focuses on nutritional composition, sensory assessment, and microbial analysis. Laboratory experiments provide hands-on experience, reinforcing sustainable environmental and quality management practices.						
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Basic knowledge of water, soil and food quality					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Describe and explain the fundamental concepts and parameters in water quality analysis and water treatment methodologies	U	PO1
2	Conduct standard laboratory procedures in Soil Quality Analysis	A	PO2
3	Conduct standard laboratory procedures in Food Quality Analysis	A	PO2
4	Create skill in the use of various instruments and in analysing the metabolites and quality parameters	AN	PO2

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

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CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	3	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-
CO 3	-	3	-	-	-	-	-	-	-	-
CO 4	-	3	-	-	-	-	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Water quality analysis and water treatment methodologies			
	1.1	Parameters used for water testing. Permissible amount of various content in water. Detection of turbidity, pH, hardness, total hardness, conductivity, temperature, BOD and COD.	5	["1"]
	1.2	Detection and quantification of chlorine, sulphate, phosphate, nitrate, nitrite and dissolved metal ions through titration, flame photometer, atomic absorption spectrophotometer and ICP-MS.	5	["1"]
	1.3	Significance and Applications of water quality analysis. Methods to decontaminate microbes from water. Waste Water treatment: Primary, secondary and tertiary. Filtration, flocculation, sedimentation, activated sludge, charcoal adsorption, chlorination, reverse osmosis.	5	["1"]
2	Soil Quality Analysis			
	2.1	Introduction to Soil Quality: Soil formation processes- weathering, parent material, climate, biotic influence, and time. Inherent (static) soil properties and dynamic (management-dependent) properties. Soil degradation factors- erosion, salinization, compaction, acidification and contamination Soil Sampling- Soil sampling strategies (grid, random, transect methods) and proper sample handling. Field tests and in situ measurements.	5	["2"]
	2.2	Physical and Chemical properties of soil: Physical Characteristics- Texture, structure, bulk density, porosity, and water-holding capacity. Techniques to measure infiltration rate, moisture content, and soil compaction. Chemical Parameters- pH, electrical conductivity (EC), cation exchange capacity (CEC), and nutrient analysis (nitrogen, phosphorus, potassium). Soil organic matter and carbon content. Chemical Analysis of soil samples: Titrimetric analysis, spectrophotometry, and chromatography for nutrient and contaminant determinations. Modern analytical instruments for detecting heavy metals and pollutants - atomic absorption spectrometers (AAS) and inductively coupled plasma mass spectrometry (ICP-MS)	5	["2"]
	2.3	Biological Characteristics and Microbial Analysis: Biological Indicators- Soil microbial biomass, enzyme activity assays, and diversity indices. Role of soil microorganisms in nutrient cycling, organic matter decomposition, and bioremediation. Methods for measuring microbial respiration, soil respiration tests, and bioassays. Impact of organic manure and compost on the biological quality of soil. Soil Quality Index (SQI). Instrumentation and Technologies in soil quality analysis - spectrophotometers, X-ray fluorescence (XRF), and remote sensing for soil analysis.	5	["2"]

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Module	Units	Course Description	Hrs	CO No.
3	Food Quality Analysis			
	3.1	Introduction to Food Quality: Definition & Importance, Quality Attributes - physical (texture, colour), chemical (nutrient composition, pH), and sensory characteristics (taste, aroma). Food Composition and Quality Attributes: Nutritional Components - Analysis of proteins, fats, carbohydrates, vitamins, and minerals. Chemical Properties: Methods for determining chemical constituents using titration, spectrophotometry, and chromatography. Physical Testing: Measurement of texture, moisture, and appearance using modern instrumental techniques. Sensory Evaluation: Brief account on descriptive and hedonic sensory testing methods.	5	["3"]
	3.2	Instrumental Analysis in Food Quality: Spectrophotometry- UV–Visible spectrophotometers to analyse food additives and nutrients. Chromatography Techniques- Gas chromatography, high-performance liquid chromatography (HPLC), for detecting contaminants, pH meters, texture analysers, and colorimeters for quality assessment.	5	["3"]
	3.3	Microbial examination of food: Commonly used media- Nutrient broth, nutrient agar, potato dextrose agar, MacConkey broth, EMB agar, MH media, LB broth. Sterilization of media and preparation of slants and plates, Methods employed in isolating microbes. Permissible amount of microbes in food. Detection of coliforms. Sources of microbes. Isolation techniques- serial dilution, pourplate, spread plate. Isolation of single colony by streak plate method. Use of laboratory oven, incubator, autoclave, laminar air flow, colony counter and anaerobic chamber	5	["3"]
4	Practical			
	4.1	Perform any 10 experiments from the list below. 1. Calibrating a pH meter using standard buffers and measuring pH of different solutions. 2. Separating amino acids, sugars, or organic acids using paper chromatography techniques. 3. Separating proteins or nucleic acids using agarose or polyacrylamide gel electrophoresis. 4. Separating biomolecules based on density using centrifugation. 5. Using UV/Vis spectroscopy to analyze macromolecules like proteins and nucleic acids. 6. Test BOD / COD of different water samples. 7. Estimation of moisture content of soil. 8. Estimation of soil nutrient quality using test kits. 9. Estimation of protein content of food sample. –Lowry’s method 10. Estimation of reducing sugar content of sugar sample. –Dinitrosalicylic acid Test. 11. Detection of phenolics, flavonoids, alkaloids, saponins in plant sample 12. Determination of Antioxidant Activity of food sample - DPPH Assay 13. Determine microbial load of food sample by Agar Plate Culture. 14. Isolation of single colony of bacteria by streak plate method	30	["4"]

MGU-UGP (HONOURS)
Syllabus

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Field based collection and interactions, Interactive lectures, flipped classroom, Lecture-based Learning, Project-Based Learning, Experiential Learning, Peer Teaching, invited lecture, Discussion-based Learning, Inquiry-Based Learning, Online Learning, Blended Learning, and other innovative learning approaches.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Involvement and responses in class room transactions ⋅ Home Assignments/preparedness ⋅ Oral presentation/Viva/Quiz/Open book test/written test Field study report /Group discussion on a recent research or review article (≤ 5 years) related the course ⋅ Any ot **• Practical – 15 Marks** Lab involvement and practical skills ⋅ Record/Any other method as may be required for specific course / student by the course faculty **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – Written Exam Duration of Examination – 1.50 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ∘ PART - A ∘ One or two Sentences - (10 out of 12) – 10 × 1 = 10 ∘ PART - B ∘ Short Essays - (6 out of 8) – 6 × 5 = 30 ∘ PART - C ∘ Essays - (1 out of 2) – 1 × 10 = 10 **• Practical – 35 Marks** Assessment Methods – Practical based assessments: 30 marks, Record: 5 marks Duration of Examination – 2.00 Hrs

MGU-UGP (HONOURS)

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