

**Shri Rawatpura Sarkar University,  
Raipur**



**Examination Scheme & Syllabus**  
**for**  
**Two Year Master of Science in**  
**Environmental Science Programme**  
**M.Sc. EVS Semester-III**

(Effective from the session: 2022-2023)



# Shri Rawatpura Sarkar University

Raipur, Chhattisgarh

Faculty of Science

Department of Chemistry

Two Year Master of Science in Environmental Science Programme

M.Sc. EVS Semester-III

Scheme of Teaching and Examination

Outcome Based Education (OBC) and Choice Based Credit System (CBCS)

(Effective from the session: 2022-2023)

SN	Course Code	Course Title	Hours/Week			Credit	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuation Evaluation	Semester End Examination	Total	
1.	SMS05301T	Environmental Pollution II: Air, Noise and Radiation	4	-	-	4	30	70	100	3.0
2.	SMS05302T	Environmental Impact Analysis and Environmental Audit	4	-	-	4	30	70	100	3.0
3.	SMS05331T	Water and Wastewater Technology	4	-	-	4	30	70	100	3.0
	SMS05332T	Remote Sensing and GIS								
4.	SMS05333T	Solid and Hazardous Wastes Management	4	-	-	4	30	70	100	3.0
	SMS05334T	Restoration Ecology and Watershed Management								
5.	SMS05335T	Sustainable Agriculture and Organic Farming	4	-	-	4	30	70	100	3.0
	SMS05336T	Wild Life Management and Conservation								
6.	SMS05381P	EVS Lab course: V	-	-	4	2	15	35	50	5.0
7.	SMS05382P	EVS Lab Course: VI	-	-	4	2	15	35	50	5.0
<b>Total teaching hrs/week: 28</b>			<b>Total Credits</b>			<b>24</b>	<b>Total Marks</b>		<b>600</b>	



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>ENVIRONMENTAL POLLUTION II: AIR, NOISE AND RADIATION</b>				
<b>Course Code</b>	<b>SMS05301T</b>				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>	
<b>Prerequisite</b>	<b>Basic knowledge of Environmental pollution</b>				
<b>Objective</b>	<ul style="list-style-type: none"> <li><b>Environmental pollution in advance and establish foundation to research in the respective domain.</b></li> </ul>				
<b>Course Content</b>	<p><b>UNIT 1</b></p> <p><b>Air Pollution:</b> Chemical composition of atmosphere. Greenhouse effect and global warming. Air pollution disasters. Atmospheric reaction. Ozone depletion. Quality and emission standards</p> <p><b>Classification and effect of air pollution:</b> Sources, classification and effects of air pollutants. Effects of gaseous and particulate air pollutants on plant, animal and human health. Economic effects of air pollution. Particulates, NO<sub>x</sub>, Sox, and Oxides of Carbon and hydrocarbons, wet and dry deposition on plants, animals and properties. Acid rain.</p> <p><b>UNIT II</b></p> <p><b>Vehicular pollution:</b> Automobile emissions, dispersion of vehicular pollutants. Carcinogenic potential, prevention and control of vehicular pollution, Emission, air fuel ratio, combustion chamber. Surface-volume ratio, combustion chamber deposits. Control of exhaust emissions. Catalytic converters. Alternative fuels, SPM pollution. Path of a particulate particle. Lead pollution.</p> <p><b>Industrial air pollution:</b> Point and non-point sources of air pollution, principle causes of industrial pollution, environmental problems of some industries – mining and metallurgy industry, cement industry, thermal power plants, nuclear power plants. Preventive measures for industrial pollution.</p> <p><b>UNIT III</b></p> <p><b>Analytical methods for air quality analysis:</b> Air monitoring instruments and techniques. Monitoring of sulphur dioxide, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, hydrocarbons and particulate matter, SPM, trace metals.</p> <p><b>Prevention and control of air pollution through different technologies:</b> Control of air pollution by fuel selection, principle and working of – cyclones, scrubbers, settling chambers and electrostatic precipitators. Control of gaseous pollutants – absorption, adsorption, condensation, vapor</p>				



## Two year Master of Science in Environmental Science programme

### M.Sc. Environmental Science Semester-III

2022-2023

	<p>incineration. Equipments for control of air pollution – Cyclones, Wet scrubbers, Electrostatic precipitators, fabric filters, absorption.</p> <p><b>UNIT IV</b></p> <p><b>Noise Pollution:</b> The physics of sound and hearing: Sound transmission, the auditory mechanism Noise sources, national standards Effects of noise: Reactions to noise- auditory effects, PTS, acoustic trauma, psychological effects- speech interference, annoyance, sleep interference, effects on performance, subjective response, acoustic privacy. Noise measurements: Basic definitions and terminology. Frequency, loudness Noise assessment and evaluation Noise control at source: Sound path receiver concept, control by design, control by redress Noise control in the transmission path: Acoustical separation, physical barriers, Isolators and Silencers Protecting the receiver: personal protection devices</p> <p><b>UNIT V</b></p> <p><b>Radiation pollution:</b> Radioactivity – types and measurement. Detection of nuclear radiations – G. M. counter, scintillation counter, semi-conductor detector. Radiation hazards and safety – natural and manmade. Types of radiations. Internal and external radiation hazards, safe handling methods, personal dosimetry, reactor safety. Interaction of radiation with matter. Units of measurements, half-life period, radiation dose measurement. Biological effects and health hazards associated with radiation. Interaction of radiations with biological cells, somatic and genetic effects. Classification of radioactive wastes – gas, solid, liquid. Control measures – treatment and disposal of radio-active waste, generation of waste from various sources. ICRP recommendations. AERB classification, maximum permissible dose. Three miles and Chernobyl accidents.</p>
<p><b>Course Outcome</b></p>	<ul style="list-style-type: none"> <li>On the completion of this course successfully student will be able to understand the development of the Environmental pollution.</li> </ul>
<p><b>Text Books</b></p>	<ol style="list-style-type: none"> <li>Peavy, H.S. Rowe, D.R. &amp; Tehobanoglous, G. (1985): Environmental Engineering, McGraw Hill, New York.</li> <li>Rao, C.S. (1991): Environmental Pollution Engineering. New Age International (P) Ltd., New Delhi</li> <li>Rao, M.N. &amp; Rao H.V.N.(1999) Air Pollution, Tata Mc Graw Hill Publishing Company Ltd, New Delhi</li> <li>Arthur S. (1968): Air Pollution. Academic Press, New York.</li> </ol>
<p><b>Reference Books</b></p>	<ol style="list-style-type: none"> <li>Perkin, H.C. (1974): Air Pollution. McGraw – Hill, New York.</li> <li>Sharma B.K :(2001), Environmental Chemistry, GOEL Publishing House, Meerut(UP)</li> <li>Mahandiyani V. (2006) Environmental Noise Pollution- causes, evils, legislations and controls. Deep and Deep Publications, New Delhi..</li> </ol>



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>ENVIRONMENTAL IMPACT ANALYSIS AND ENVIRONMENTAL AUDIT</b>			
<b>Course Code</b>	<b>SMS05302</b>			
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>
	<b>4</b>			<b>4</b>
<b>Prerequisite</b>	<b>Basic knowledge of Environmental law</b>			
<b>Objective</b>	<ul style="list-style-type: none"> <li>• Environmental Impact Analysis and Audit <b>in advance and establish foundation to research in the respective domain.</b></li> </ul>			
<b>Course Content</b>	<p><b>UNIT I</b></p> <p><b>Introduction:</b> Definition, aims and objectives of EIA. Concept of EIA and Scope of EIA. Hierarchy. Evolution of EIA. Terminologies used in EIA – Environmental inventory / baseline data study / environment setting / environmental impact assessment, environmental impact statement. EIA and sustainable development. Benefits of EIA. Drawbacks in EIA process.</p> <p><b>Legislation and Procedures:</b> National Environmental Policy Act (NEPA) of 1969, USA. EIA notification 1994, 2006 for India and implementation, EIA Guidelines. EIA legislative requirements and administrative procedures in India / States of India. Accreditation of EIA consultants by Quality Control of India – requirements and guidelines.</p> <p><b>UNIT II</b></p> <p><b>Methodology:</b> Methods of impact analysis. Description of the environmental setting. Baseline data collection for EIA procedure of baseline data collection. Guidelines used for collection of baseline data for different environment e.g. water, air, soil, hydrogeology, climate, micro-climate etc. Environmental risk assessment.</p> <p><b>Prediction and assessment of impacts:</b> Air, water, noise, biological, cultural and socio-economic, mining, blasting.</p> <p>Preparation and writing of EIA report</p> <p><b>UNIT III</b></p> <p><b>Public participation:</b> Public participation in environmental decision making, regulatory requirement, techniques, advantages and disadvantages of public participation.</p> <p><b>Case studies of EIA:</b> Industries like oil, petrochemical, iron and steel, fertilizer, sugar and distillery, projects of road /dams and housing etc</p> <p><b>UNIT IV</b></p> <p><b>Environmental management plan:</b> Planning and selection of appropriate resource management procedures for – Water, air, land, soil, solid wastes. Resources recovery and reuse. Ecology and biodiversity. Noise and</p>			



## Two year Master of Science in Environmental Science programme

### M.Sc. Environmental Science Semester-III

2022-2023

	<p>vibration. Occupational safety and health. Risk assessment. Disaster management plan. Prevention, maintenance and operation of environment control systems. Socio-economic factors – human settlements, culture, occupation, water, electricity supply, transport systems, education, communication, health care facilities. Environment Cell. Environmental budgets, to minimize environmental impacts..</p> <p><b>UNIT V</b></p> <p><b>Environmental Audit:</b> Definition of environmental audit and its importance for industries. Environment Compliance Audit. Types of audits. Audit tools and technology /general audit methodology and basic structure of audit. Elements of an audit process and its importance. Environment Audit in India – Development of environmental auditing in India, Concept of ISO 14000, requirements of Rule 14 for environmental audit under Environmental Protection Act, 1986. Definitions – signatory, consumption audit, pollution audit, hazardous audit, solid waste audit, disposal audit, cost audit, investment audit, voluntary.</p>
<b>Course Outcome</b>	<ul style="list-style-type: none"><li>• On the completion of this course successfully student will be able to understand the Environmental Impact Analysis and Environmental Audit</li></ul>
<b>Text Books</b>	<ol style="list-style-type: none"><li>1. Barthwal R.R. (2002): Environmental Impact Assessment, New Age International (P)Ltd . Pub New Delhi.</li><li>2. Agrawal S.K.(2002) Pollution Management- (Vol-3),A.P.H publishing</li><li>3. Gabriele Crognale P.C(1999). Environmental management strategies (The 21st century perspective) Printice Hall PTR</li></ol>
<b>Reference Books</b>	<ol style="list-style-type: none"><li>1. Prabhakar V.K. (2001) Environmental Management. Anmol Publication pvt ltd.</li><li>2. Kuhre W.L. (2000) ISO 14031 Environmental performance evaluation EPE,Prentice Hall, PTR.Upper Saddle River N.J</li></ol>



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>WATER AND WASTEWATER TECHNOLOGY</b>				
<b>Course Code</b>	SMS05331				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	4			4	
<b>Prerequisite</b>	<b>Basic knowledge of water quality parameters</b>				
<b>Objective</b>	<ul style="list-style-type: none"> <li>• <b>Water and wastewater technology in advance and establish foundation to research in the respective domain.</b></li> </ul>				
<b>Course Content</b>	<p><b>UNIT I</b></p> <p><b>Water:</b> Water Requirements for Domestic Consumption. Population forecasting by the following methods. Demographic method, Arithmetical progression method, Geometrical progression method, Logistic methods, Graphical projection method, Final prediction. Quality of water required for – (a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Shopping complex, Hotels, Restaurant), (e) Industrial (Dairy, Sugar, Pulp and Paper, etc.) (f) Specific requirement at pilgrimage place and recreation activities.</p> <p><b>Impact of future growth and development and change in quality of life on water requirements:</b> Types of solid in water and their impact on water quality. Need of water quality standards for domestic &amp; industrial purpose. Specifications for drinking water (physical, chemical &amp; bacteriological) by Bureau of Indian Standards &amp; World Health Organization. Packaged drinking water.</p> <p><b>UNIT II</b></p> <p><b>Water Sources :</b> Availability &amp; quality of Surface water (River, stream lake, dam) &amp; Ground water (Open well &amp; Borewell). Water source, quality of raw water, solids in water &amp; treatment process.</p> <p><b>Water Treatment:</b> Principal, Application &amp; Designing of following Unit Operation in water treatment. a. Collection &amp; pumping, b. Aeration, c. flocculation, d. Sedimentation, e. Filtration, f. Disinfections (Chlorination, UV, Ozonization), g. water softening.</p> <p><b>UNIT III</b></p> <p>Advance treatment methods : a. Demineralization, b. Ultra filtration, c. Reverse osmosis, d. Color &amp; odor removal by activated carbon, e. Iron removal. Selection of appropriate unit operations for the treatment and flow chart of water treatment plant.</p> <p><b>Wastewater technology :</b> for Preliminary &amp; Primary Treatment: Quantity &amp; Quality of sewage generated, Impact of Future growth &amp; development &amp;</p>				





## Two year Master of Science in Environmental Science programme

### M.Sc. Environmental Science Semester-III

2022-2023

	<p>change in quality of life on sewage quality &amp; quantity.</p> <p><b>UNIT IV</b></p> <p><b>Specification of treated wastewater :</b> for disposal into surface water, on land &amp; for treatment. a. Collection &amp; pumping, b. Screen chamber, c. Grit chamber, d. Oil &amp; grease removal, e. Dissolve air floatation.</p> <p><b>Wastewater engineering for Biological Treatment :</b> Principal, role of microorganisms, ecosystem &amp; designing of following biological Unit Operation in waste water treatment. a. Stabilization pond, b. Aerated lagoon, c. Activated sludge process, d. Trickling filter, e. Anaerobic treatment.</p> <p><b>UNIT V</b></p> <p><b>Industrial Wastewater:</b> Selection of appropriate unit operations for the treatment and flow chart of wastewater treatment plant for a. Dairy, b. Pulp &amp; Paper, c. Galvanizing.</p> <p><b>Biotechnology &amp; Waste Management:</b> Application of biotechnology for the Treatment of followings:a. High strength waste e.g. whey &amp; spent wash, b. Primary &amp; secondary sludge, c. Phenol &amp; cyanide removal. Different models of anaerobic digestion by combination of attached &amp; suspended growth.</p>
<p><b>Course Outcome</b></p>	<ul style="list-style-type: none"> <li>On the completion of this course successfully student will be able to understand the development of the Water and waste wastewater technology</li> </ul>
<p><b>Text Books</b></p>	<ol style="list-style-type: none"> <li>Environmental Geology: Indian Context by K.S.Valdiya ,Tata Macgraw Hill Environmental Science : E. D. Enger and B. F. Smith</li> <li>Introduction to Geochemistry : Krauskoph K. B.</li> <li>Geology and our environment, Davis, S. N. , Reiton, P. H.&amp; Pestrong, P. Mc.Graw Hill, NY</li> <li>Environmental Geology, Keller, E.,A., Bell &amp;Howell, Columbus, Ohio</li> </ol>
<p><b>Reference Books</b></p>	<ol style="list-style-type: none"> <li>Physical Geology, Strahler, A. N., John Harper &amp; Row Focus on Environmental Geology, Tank, R.W.Oxford Univ. Press</li> <li>Text Book of Geology, P. K. Mukherjee</li> <li>Environmental geology, Coates, D. R. , John wiley, NY</li> <li>Chamley, H. and Chamley, H. 2003. Geosciences, Environment and Man Elsevier Science &amp; Technology.</li> <li>Savindra Singh (2002): Geomorphology, Prayag Pustak Bhawan, Allahabad.</li> </ol>





**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>SOLID AND HAZARDOUS WASTES MANAGEMENT</b>				
<b>Course Code</b>	SMS05333T				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	4	-	-	4	
<b>Prerequisite</b>	Basic knowledge of Waste management				
<b>Objective</b>	<ul style="list-style-type: none"> <li>• <b>Solid and Hazardous Wastes Management in advance and establish foundation to research in the respective domain.</b></li> </ul>				
<b>Course Content</b>	<p><b>UNIT I</b></p> <p><b>Introduction:</b> Definition, Historical development, Source and type based classification, chemical and physical composition, Environmental and health impacts due to solid waste and handling of it. Characterization: physical &amp; chemical characteristics, implications for solid waste management. Factors affecting solid waste management: Climate, financial, cultural constraint, quality and quantity of waste</p> <p><b>UNIT II</b></p> <p><b>Municipal Solid Waste management in India:</b> Generation, Collection, segregation, Transportation, Transfer stations, processing and disposal. Assessment of existing situation &amp; possible areas for improvement.</p> <p><b>Resource Conservation and recovery :</b> Reduction, separation and recycling</p> <p><b>UNIT III</b></p> <p><b>Industrial solid waste management:</b> Pulp and paper, sugar, thermal power station, textile, food processing, mining, Agriculture</p> <p><b>Electronic waste management :</b> A growing problem, Sources and disposal methods</p> <p><b>UNIT IV</b></p> <p><b>Treatments and disposal :</b> Waste processing, Recovery of biological and chemical conversion products composting, biogasification, RDF system, hydrolysis, Pyrolysis, plasma gasification, incineration, sanitary landfills. Role of NGO, local, state and national level authorities in solid waste management. Designing of municipal solid waste management system a case study.</p> <p><b>Biomedical waste management:</b> Define, scope, categorization, segregation, packaging/colour coding and container used, treatment, transport and disposal, status in India.</p>				



## Two year Master of Science in Environmental Science programme

### M.Sc. Environmental Science Semester-III

2022-2023

	<p><b>UNIT V</b></p> <p><b>Hazardous waste management:</b> Identification and sources, characteristics and categorization, Collection, segregation, packaging, labelling, transportation, processing (3R), risk assessment and waste management treatment and disposal, storage and leak detection, Site selection criteria, manifest system and records, Indian scenario, Responsibilities of various authorities, E-waste, Radioactive waste.</p>
<b>Course Outcome</b>	<ul style="list-style-type: none"><li>• On the completion of this course successfully student will be able to understand the Solid and Hazardous Wastes Management</li></ul>
<b>Text Books</b>	<ol style="list-style-type: none"><li>1. Burton, I. (1993). The Environment as Hazard. Guilford Press.</li><li>2. Smith, K. (2003). Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge.</li></ol>
<b>Reference Books</b>	<ol style="list-style-type: none"><li>1. Henry J.G. and Heinke, G.W. (2004). Environmental Science and engineering. Pearson education, Delhi, India</li><li>2. Watts, M. (2017). On the poverty of theory: natural hazards research in context. In Environment (pp. 57-88), Routledge.</li></ol>



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>SUSTAINABLE AGRICULTURE AND ORGANIC FARMING</b>				
<b>Course Code</b>	<b>SMS05335T</b>				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	<b>4</b>	<b>-</b>	<b>-</b>	<b>4</b>	
<b>Prerequisite</b>	<b>Basic knowledge of agriculture and organic farming</b>				
<b>Objective</b>	<ul style="list-style-type: none"> <li><b>Agriculture and organic farming in advance and establish foundation to research in the respective domain.</b></li> </ul>				
<b>Course Content</b>	<p><b>UNIT I</b>  <b>Introduction to sustainable agriculture:</b> Definitions, Pre and Post Green Revolution in India, The “Green Revolution”, Monocultures in crop and livestock production, Sustainability concepts, Traditional sustainable agricultural concepts, Global concerns. Sustainable agriculture and precision farming. Livestock and sustainability</p> <p><b>UNIT II</b>  <b>Sustainable agriculture in India :</b> Public policy. Biodiversity issues. Organic agricultural production. Low-Input Sustainable Agriculture (LISA). Sustainable Agriculture Research and Education (SARE). Agro-Ecology. Permaculture and sustainable horticulture in India. Vermiculture and composting – creating the resource and the medium. Incentives. Concepts and misconceptions.</p> <p><b>UNIT III</b>  <b>Livestock and sustainable agricultural systems:</b> Domestic livestock ecosystems. Agropastoralism - The role of grazing herbivores in sustainable systems. Intensive v Extensive livestock keeping. Holistic Resource Management. Energy conversion.</p> <p><b>Marketing Habitat issues for sustainable agriculture and organic farming :</b> Irrigation problems, waste lands and their development; Habitat for organic farming: definition, principles and components; Farming systems: definition, principles and components, wetland, irrigated dryland and dryland situations.</p> <p><b>UNIT IV</b>  <b>Organic Farming :</b> Introduction, concept, relevance in present context; Organic production requirements; Biological intensive nutrient management-organic manures, vermicomposting, green manuring, recycling of organic residues, biofertilizers; Soil improvement and amendments; Integrated diseases and pest management – use of biocontrol agents, biopesticides pheromones, trap crops, bird perches; Weed management; Quality considerations, certification, labeling and accreditation processors, marketing, exports.</p>				



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

	<p><b>UNIT V</b></p> <p><b>Nutrients for organic farming:</b> Raising of vegetable crops organically through nutrient, diseases and pest management; vermi-composting; vegetable and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management.</p> <p><b>Creating stakeholders for sustainable agriculture :</b> Agronomy (crop rotations), Nutrient management, Weed control, Insect control, Water quality, Livestock production, Societal traders and institutions, Economic stakes, National Security - Food Production at Stake.</p>
<b>Course Outcome</b>	<ul style="list-style-type: none"><li>• On the completion of this course successfully student will be able to understand the development of agriculture and organic farming</li></ul>
<b>Text Books</b>	<ol style="list-style-type: none"><li>1. Modern Spectroscopy, J.M. Hollas, John Wiley.</li><li>2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience.</li><li>3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.</li><li>4. Physical Methods in Chemistry, R.S. Drago, Saunders College.</li></ol>
<b>Reference Books</b>	<ol style="list-style-type: none"><li>1. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.</li><li>2. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.</li><li>3. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBHOxford.</li><li>4. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.</li><li>5. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, harper &amp; Row.</li></ol>



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>EVS LAB COURSE: III</b>				
<b>Course Code</b>	<b>SMS05281P</b>				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	-	-	2	2	
<b>Prerequisite</b>	<b>EVS Lab Course: I</b>				
<b>Objective</b>	<ul style="list-style-type: none"><li>• <b>To understand the practical concepts of Environmental Science</b></li></ul>				
<b>Course Content</b>	<ol style="list-style-type: none"><li>1. Determination of NPK in water, soil and sediment.</li><li>2. Determination of Al in water, soil and sediment.</li><li>3. Determination of Mg and Ca in water, soil and sediment.</li><li>4. Detection and determination of micronutrients in water, soil and sediment.</li><li>5. Determination of Clin water, soil and sediment.</li><li>6. Determination of <math>\text{SO}_4^{2-}</math> in water, soil and sediment.</li><li>7. Determination of <math>\text{NO}_3^-</math> in water, soil and sediment.</li><li>8. Determination of <math>\text{NH}_4^+</math> in water, soil and sediment.</li><li>9. Other advanced practical.</li></ol>				
<b>Course Outcome</b>	<ul style="list-style-type: none"><li>• On the completion of this course successfully student will be able to understand practical Environmental Science.</li></ul>				
<b>Text Books</b>	<ol style="list-style-type: none"><li>1. Vogel's Textbook of Quantitative Analysis, rev. Mendham, ELBS.</li><li>2. Synthesis and Characterization of Inorganic Compounds, W.L. Jolly, Prentice Hall.</li><li>3. Practical Organic chemistry by A. I. Vogel.</li><li>4. Practical Organic chemistry by Mann and Saunders.</li><li>5. Practical Organic chemistry by Garg and Salija.</li></ol>				
<b>Reference Books</b>	<ol style="list-style-type: none"><li>1. The Systematic Identification of Organic compounds, R. L. Shriner and D. Y. Curtin.</li><li>2. Semimicro Qualitative Organic Analysis, N.D. Cheronis, J. B. Entrikin and E. M. Hodnett.</li><li>3. Practical Physical chemistry by Alexander Findlay.</li><li>4. Experimental Physical chemistry, D. P. Shoemaker, G. W. Garland and J. W. Niber, McGraw Hill Interscience.</li></ol> <p style="text-align: center;">Findlay's Practical Physical chemistry, revised B</p>				



**Two year Master of Science in Environmental Science programme**  
**M.Sc. Environmental Science Semester-III**  
**2022-2023**

<b>Course Title</b>	<b>EVS LAB COURSE: IV</b>				
<b>Course Code</b>	<b>SMS05282P</b>				
<b>Course Credit</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>TC</b>	
	-	-	2	2	
<b>Prerequisite</b>	<b>EVS Lab Course: II</b>				
<b>Objective</b>	<ul style="list-style-type: none"><li><b>To understand the practical concepts of spectroscopy and physical chemistry</b></li></ul>				
<b>Course Content</b>	<ol style="list-style-type: none"><li>Flame photometric determinations<ol style="list-style-type: none"><li>Sodium and potassium when present together.</li><li>Sodium/potassium in solid samples.</li><li>Solid Sodium and Potassium in Liquid Samples.</li><li>Lithium/calcium/barium/strontium.</li><li>Cadmium and magnesium in tap water.</li></ol></li><li>Nephelometric determinations<ol style="list-style-type: none"><li>Sulphate</li><li>Phosphate</li><li>Silver</li></ol></li><li>Spectroscopy<ol style="list-style-type: none"><li>Verification of Beer's Lambert Law.</li><li>Determination of stoichiometry and stability constant of inorganic (e.g. ferric-salicylic acid) and organic (e.g. amine-iodine) complexes, thiocyanam.</li><li>Characterization of the complexes by electronic and IR, UV spectral data.  Determination of Indicator constant (pKa) of methyl red in (i) aqueous and (ii) micellar media.</li></ol></li></ol>				
<b>Course Outcome</b>	<ul style="list-style-type: none"><li>On the completion of this course successfully student will be able to understand practical knowledge of physical chemistry, spectroscopy and analytical chemistry practical laboratory work.</li></ul>				
<b>Text Books</b>	<ol style="list-style-type: none"><li>Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, Prentice Hall.</li><li>Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.</li><li>Systematic Qualitative Organic Analysis, H. Middleton, Adward</li></ol>				



**Two year Master of Science in Environmental Science programme**  
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**2022-2023**

	<p>Arnold. Handbook of Organic Analysis –Qualitative and Quantitative, H. Clark, Adward Arnold.</p> <p>4. Vogel’s Textbook of Practical Organic Chemistry,</p> <p>5. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.</p>
<b>Reference Books</b>	<p>1. Findley’s Practical Physical Chemistry, B.P. Levi</p> <p>2. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.</p> <p>3. Computer and Common Sense, R. Hunt and J. Shelley, Prentice Hall.</p> <p>4. Computational Chemistry, A.C. Norris.</p> <p>5. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.</p> <p>6. Computer Programming in FORTRAN IV, V. Rajaraman, Prentice Hall.</p> <p>7. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.</p> <p>8. Experiments in Chemistry, D.V. Jahagirgar.</p>