Programme Structure

Department of Environmental Sciences

Sharda School of Basic Sciences & Research

M.Sc. (Water Resources and Environmental Management)

Programme code : SBR0701

Batch : 2023-2025

Programme Structure
Sharda School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2023-2025
TERM: I

S. No.	Subject Code	Subjects	Teaching Load			Credits	Co/Elective Pre-Requisite/Co Requisite
			L	T	P		
THEORY SUBJECTS							
1.	MWE-101	Water Resources & Management	4	-	-	4	DSE
2.	MWE-102	Environmental Chemistry	4	-	-	4	Core
3.	MWE-103	Environmental Pollution	4	-	-	4	Core
4.	MWE-110	Solid and Hazardous Management	4	-	-	4	Core
5.	MEE114/ OEM012	Earth Ecology and Environment/ Environmental Biotechnology	3	-	-	3	GE-1
6.	PCM109	Technical Presentation	2	-	-	2	SEC-1
Practical							
7.	MWE-151	Water Pollution & Monitoring Lab	0	0	2	2	Core
8.	RBL-001	Research Based Learning (RBL1)	0	0	2	0	Survey
TOTAL CREDITS						**26**	

Sharda School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2023-2025
TERM: II

S. No.	Paper ID Subject Code	Subjects	Teaching Load			Credits	Pre-Requisite/Co Requisite
			L	T	P		
THEORY SUBJECTS							
1.	MWE-111	Environmental Legislation and Audit	4	-	-	4	Core
2.	MWE-106	Climate Change & Sustainable Development	4	-	-	4	Core
3.	MWE-107	Environmental Toxicology	4	-	-	4	Core
4.	MWE-108	Glaciology & Climate Change	4	-	-	4	Core
5.	MWE-112	Remote Sensing Techniques & GIS	4	-	-	4	Core
6.	MEE112/ MWE205	Energy Sources and Global Scenario/ Water Sanitation and Health	4	-	-	4	GE-2
Practical							

7.	MWE-152	Remote Sensing & GIS	0	0	4	2	Core
8.	CCU-401	Community Connect Course	0	0	4	2	SEEC-2
9.	RBL-002	Research Based Learning 2	0	0	2	0	Survey
TOTAL CREDITS						**28**	

Programme Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2023-2025
TERM: III

S. No.	Subject Code	Subjects	Teaching Load			Credits	Pre-Requisite/Co Requisite
			L	T	P		
THEORY SUBJECTS							
1.	MWE-203	Research Methodology	4	-	-	4	Core
2.	MWE-210	Biodiversity Conservation and Management	4	-	-	4	Core
3.	MWE208	Fundamentals of Hydrology	4	-	-	4	Core
4.	MWE209	Instrumentation and Techniques	2	-	-	2	Core
5.	MTH-215/MES110	Biostatistics/Disaster Management	3	1	-	4	GE-3
6.	OPEXXX	Open Elective	2	-	-	2	SEEC-3
Practical							
7.	MWE-252	Environmental Data Analysis	0	0	4	2	Core
8.	MWE-261	Project (RBL3)	0	0	8	4	Core
TOTAL CREDITS						**26**	

Programme Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2023-2025
TERM: IV

S. No.	Course Code	Course	Teaching Load			Credits	Core/Elective
			L	T	P		
Practical							
1.	MWE-201	Environmental Impact & Risk Assessment	4	-	-	4	Core
2.	MWE-202	Water Purification & Treatment Processes	4	-	-	4	Core
3.	MWE-263	Project (RBL4)	-	-	20	10	Core
4.							
TOTAL CREDITS						**18**	

Course Modules

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: I**
1	Course Code	MWE101
2	Course Title	**Water Resource and Management**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Provide an insight into global water problems and various related laws 2 . Enable understanding of management and planning of water resources 3: Provide a thorough concept on watersheds and various projects related to watershed 4: Enable students to understand the appropriate measures to overcome flood and drought situations by adopting proper management plans 5: To impart comprehensive knowledge related to economic planning and techniques deals with water related conflict 6: Overall in-depth understanding of various available water resources, its planning and management and various associated socioeconomic components
6	Course Outcomes	CO1: Includes introduction to water problems and various constitutional provision related to deal with water related issues. CO2: Knowledge on water resources planning and development and addresses social goals CO3: The concepts on watershed, its objectives, and conservation strategies and describe role of people's participation CO4: Demonstrate causes and various issues related with flood and drought and various mitigation plans

		CO5: Detailed overview on understanding the advantage of economic planning in addressing water related issues CO6: Thorough understanding of available water resources, various water related issues and management plans to conserve the resources.	
7	Course Description	To develop thorough understanding of various water related problems and laws related to its use and distribution. Moreover it also cover various management practices that are adopted to ensure proper utilization of the resources. Further this course also focus on various water related problems like flood and drought and various management plans to be implemented during such situations.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	Global and national water problems, Quantity estimation of water –urban and rural sectors' requirement	CO1/CO6
	B	Water Laws: Constitutional provisions, National Water Policy	CO1/CO6
	C	Riparian rights / ground water owner ship, prior appropriation, permit systems, acquisition and use of rights, scope for privatization.	CO1/CO6
	Unit 2	**Water Resource Management**	
	A	Objectives: of water resource planning and management, its necessity	CO2/CO6
	B	Aspects of water resources planning, water resource development	CO2/CO6
	C	Needs and opportunities, social goals	CO2/CO6
	Unit 3	**Watershed management**	
	A	Objectives of Planning Watershed Projects, Guidelines for Project Preparation	CO3/CO6
	B	Approach in Govt. programmes, people's participation, conservation farming	CO3/CO6
	C	Watershed management planning, identification of problems, objectives and priorities, socioeconomic survey	CO3/CO6

	Unit 4	**Flood management**			
	A	causes of floods, structural and non-structural measures, mitigation plan, flood damage assessment,			CO4/CO6
	B	Drought management: types of droughts, severity index			CO4/CO6
	C	Drought forecasting, damage assessment, mitigation plan			CO4/CO6
	Unit 5	**Economic planning**			
	A	Discounting techniques, benefit cost parameters, estimation of benefits and costs			CO5/CO6
	B	Appraisal criteria, social benefit cost analysis			CO5/CO6
	C	Basin planning; inter-basin transfer of water			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Water Resources Systems Engg, D. P. Loucks, Prentice Hall 2. Chaturvedi, M.C. "Water Resources Systems Planning and Management" Tata McGraw Hill 3. James L.D and Lee R.R "Economics of Water Resources Planning", McGraw Hill 4. Water resources hand book; Larry W. Mays, McGraw International Edition			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	3	2	2	2
CO2	3	1	2	1	1	3	2	3
CO3	1	1	2	2	2	1	1	3
CO4	1	1	2	3	2	1	3	2
CO5	2	1	2	2	2	1	2	2
CO6	2	2	3	2	2	2	2	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-24**
Branch: Water Resources and Environmental Management		**Semester: I**
1	Course Code	MWE102
2	Course Title	**Environmental Chemistry**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Provide an insight into basic concept of chemistry 2 Enable to determine and investigate various water quality parameters 3: Provide a thorough concept on various chemical reactions takes place in the atmosphere 4: Enable to gain thorough knowledge on water chemistry and various related chemical reactions. 5: Detail understanding of the soil structure and various physicochemical factors influences soil formation 6: Overall in-depth understanding of various chemical reactions occurs in different segments of environments and factors affecting these reactions.
6	Course Outcomes	CO1: Basic concept of chemistry and principles governing environmental reactions CO2: Knowledge of chemical water quality parameters CO3: The concepts of various chemical reactions takes place in the atmosphere CO4: Basic water chemistry and reactions CO5: Basic chemical and biological reactions occur in soil and affecting soil formation process. CO6: Overall understanding and knowledge of basic principles of environmental chemistry

7	Course Description	To develop an understanding of basic principles that regulate and influence water, atmosphere and soil chemistry.	
8	Outline syllabus		CO Mapping
	Unit 1	**Basic Concept of Chemistry**	
	A	Stoichiometry, Gibb's energy	CO1/CO6
	B	Chemical potential, chemical equilibria, acid base reactions	CO1/CO6
	C	Solubility product, solubility of gases in water	CO1/CO6
	Unit 2	**Concept and Scope of Environmental Chemistry**	
	A	Definition, Scope & Importance of Environmental Chemistry	CO2/CO6
	B	Definition and explanation for various terms: Acid, Base, Ph	CO2/CO6
	C	Dissolved Oxygen, Biochemical oxygen demand, Chemical Oxygen Demand	CO2/CO6
	Unit 3	**Atmospheric Chemistry**	
	A	Atmospheric structure, Atmospheric composition	CO3/CO6
	B	Air pollution, Chemistry of Greenhouse gases, Acid rain	CO3/CO6
	C	Reactions, Primary and Secondary Pollutants, Photochemical Smog	CO3/CO6
	Unit 4	**Hydrospheric**	
	A	Water chemistry basics, Water Structure and Anomalous Behaviour of Water	CO4/CO6
	B	Oxidation and reduction, Dispersions, Dissolution and precipitation	CO4/CO6
	C	Chemical characteristics of water, Self-cleaning capacity	CO4/CO6
	Unit 5	**Pedospheric Chemistry**	
	A	Introduction to Soil Chemistry, Composition, Soil Profile, Formation of Soil	CO5/CO6

	B	Physico-Chemical Properties of Soil, Soil Reactions (Cation & Anion Exchange Phenomenon)			CO5/CO6
	C	Major Nutrients of Soil, Biogeochemical pathways			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Environmental Chemistry: A.K. Dey, (Wiley Eastern Ltd), 1987. 2. A Text book of Environmental Chemistry: O.D. Tyagi, M. Mehra (Anand Publications Pvt, Ltd) 1994.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	2	3	2	3	1
CO2	2	2	1	3	2	3	3	2
CO3	2	2	2	1	2	1	1	3
CO4	2	1	1	2	2	2	2	3
CO5	2	1	2	2	2	1	2	2
CO6	2	2	2	2	2	2	2	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: I**
1	Course Code	MWE103
2	Course Title	**Environmental Pollution**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of basics of pollution, types of air pollutants its sources and various impacts on human health and environment 2. Enable understanding of various physical factors influencing dispersion of air pollutants 3: Provide a thorough concept on factors affecting water quality, major water pollutants, global water crisis, and treatment of wastewater 4: Enable students to understand types of soil, impact of industrialization and urbanization on soil quality and control measures 5: To impart knowledge on solid wastes, its types, and various disposal strategies 6: Overall this course helps in-depth understanding of basics of air, water and soil pollution, and various control measures adopted for the abatement of pollution
6	Course Outcomes	CO1: Includes introduction and classification of air pollutants, its sources and its effects on local, regional and global scale. CO2: Knowledge on types on air pollutants, and analysis of various meteorological parameters responsible for dispersion of air pollutants in the atmosphere CO3: The concept of water quality and standards, various water pollution sources, effects and techniques employed for wastewater treatment CO4: Identification of soil types, and factors deteriorating the soil quality and various control measures to protect the critically degraded soil CO5: An overview on solid wastes its types, sources and various disposal strategies

		CO6: Thorough understanding of sources and factors responsible for air, water and soil pollution and various remedial measures employed in order to reduce the effect of pollution and abatement of pollutants.	
7	Course Description	To develop in-depth understanding of various aspects of air, water, and soil pollution. The course extensively covers various strategies that are being used for the control and abatement of the pollution.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	Definition, Classification of Pollution and Pollutants, Causes, Effects and Sources of Pollution	CO1/CO6
	B	Impacts of pollution on human health and biodiversity	CO1/CO6
	C	Effect of pollution in global, regional and local scale	CO1/CO6
	Unit 2	**Air Pollution**	
	A	Primary and Secondary Pollutants, Automobile Pollution, Industrial Pollution, Ambient Air Quality Standards and indices	CO2/CO6
	B	Meteorological aspects of air pollution- Wind profiles, Turbulent diffusion, Topographic effects, Temperature profiles in atmosphere, lapse Rates and Stability, Inversion, Plume behaviour	CO2/CO6
	C	Dispersion of air pollutants- solutions to the atmospheric dispersion equation - the Gaussian Dispersion Model, Instrumentation technique to control air pollution.	CO2/CO6
	Unit 3	**Water Pollution**	
	A	Point and Non-point Source of Pollution, major Pollutants of Water, Water Quality Requirement for different Uses	CO3/CO6
	B	Global water crisis Issues, Water quality standards, Coastal Pollution Due to Industrial Effluents, Effects of water pollution and its control	CO3/CO6
	C	Water and waste water treatment- primary and secondary treatment methods	CO3/CO6
	Unit 4	**Soil Pollution**	
	A	Classification of soil types, Effects of urbanization on land degradation	CO4/CO6
	B	Impact of Modern Agriculture on Soil, Effect on Environment and Life sustenance	CO4/CO6

	C	Abatement measures, Effects and Control measures.			CO4/CO6
	Unit 5	**Solid Waste Pollution**			
	A	Solid waste Classification, Different sources of Solid waste			CO5/CO6
	B	Different methods of Disposal, Effect of urban and industrial solid waste on environment			CO5/CO6
	C	Control methods, incineration, landfill			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Text book of Environmental Science and Technology by Dr. M. Anji Reddy, BS Publications, 2010. 2. Environmental Science- Towards a sustainable future by Richard T. Wright, PHI Learning, New Delhi 2008.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	2	1	1	1
CO2	2	2	1	2	2	2	3	2
CO3	3	2	2	3	3	2	2	2
CO4	2	1	1	2	2	2	2	3
CO5	2	1	3	2	2	1	1	2
CO6	2	1	2	2	2	2	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

MEE114: Earth, Ecology and Environment

School: SSBSR		**Batch : 2023-2025**
Programme: M.Sc.		**Current Academic Year: 2023-2024**
Branch: MSc Water Resource and Environmental Management		**Semester: I**
1	Course Code	MEE114
2	Course Title	**Earth, ecology and environment**
3	Credits	03
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	1. Concept of various ecosystems **2.** Detail understanding of the structure of earth and its atmospheric components 3. Understanding of energy flow concept 4. To understand various hazards in terms of natural and anthropogenic 5. To understand various environmental related issues.
6	Course Outcomes	CO1.Understand key concepts of environmental science, various components of environment and its relation. CO2.Comprehending physical structure of earth and various climatological phenomenon. CO3. Prediction and interpretation of various ecological interactions and thorough concept of energy flow and nutrient cycling. CO4. Learning and understanding of various natural and anthropogenic hazards CO5. Understanding of critical environmental issues like ozone layer depletion, global warming, de-glaciation and sea level rise. CO6. Overall in-depth understanding of various environmental components, and its interaction with each other and with its biological components.
7	Course Description	Earth, ecology and environment emphasises on various factors as 1. Importance and scope of environmental science

		2. Interaction pattern between physical and biological components of the environment. 3. Understanding and analysis of various hazards 4. Critical environmental related issues that responsible for climate change and environmental degradation.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	History, scope and importance of environmental Science	CO1/CO6
	B	Environmental priorities in India and environmental ethics	CO1/CO6
	C	General idea about forest, grassland, wetland and aquatic ecosystem	CO1/CO6
	Unit 2	**Environment**	
	A	Understanding Earth, Atmosphere and Processes, Governing Environmental Conditions; Biosphere, Atmosphere, Cryosphere	CO2/CO6
	B	Earth's Energy Budget; Climate and Climate Change-Geologic, Plate tectonics	CO2/CO6
	C	Hydrological and Biogeochemical Cycles; Melanchovich cycle	CO2/CO6
	Unit 3	**Ecology**	
	A	Biotic and Abiotic Components, Production and Consumption, Productivity and Energy Flow, Food Webs, Cycling of Elements	CO3/CO6
	B	Description and Study of Typical Natural and Artificial Ecosystems, Ecological Niche; Mortality and Survivorship; Community Interactions	CO3/CO6
	C	Changes in Ecosystems; Succession, Long Range Change; Stability; Organization and Dynamics of Ecological Communities.	CO3/CO6
	Unit 4	**Environmental Hazards**	
	A	Major Environmental Concerns; Risk assessment, Vulnerability analysis	CO4/CO6
	B	Natural hazards	CO4/CO6
	C	Man-made hazards and Processes, Dams and Environment	CO4/CO6

	Unit 5	**Environmental Issues**			
	A	Ozone Hole Depletion, Green House Effect, Global Climate Change and Hazards			CO5/CO6
	B	Effect of Population Increase on Environment			CO5/CO6
	C	Climate Change Impact on Glacier Melt and Water Availability and Sea Level Rise			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**Reference Books:** 1. Energy and Environment, 2nd ed. Ristinen and Kraushaar (Wiley, 2005). 2. The Earth System, 2nd ed. Kump, Kasting and Crane (Prentice Hall, 2003). 3. Fundamentals of ecology, 5th ed. Odum and Barret (Thomson, 2005). 4. Introduction to Environmental Engineering and Science, 3rd ed. Masters and Ela (Prentice Hall, 2007).			
	Other References				

Mapping of outcomes versus topics

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO.1	3	3	2	3	3	3	3	3
CO.2	2	2	3	3	3	3	2	3
CO.3	3	2	2	3	3	2	2	3
CO4	3	3	2	3	3	2	3	3

CO5	2	3	3	2	3	3	3	3
CO6	2	2	3	3	3	3	3	3

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

PCM109: Technical Presentation

Batch :2023-2025	
Current Academic Year: 2023-2024	
Semester: I	
Course number	**PCM109**
Course Title	**Technical Presentation**
Credits	2
Contact Hours (L-T-P)	2-0-0
Course Objective	1. To be able to implement conventions and formats for technical documents like reports, proposals. 2.To present effective oral (technical or general) presentations (power point) 3.To develop the confidence to face an interview confidently and be able to write resume and cover –letter 4. To develop clarity, poise and confidence in Public Speaking and be able to participate in Group discussions
Course Outcomes	Students would be able to : **CO1:** Prepare Technical Documents effectively **CO2:** Implement the basic guideline for Technical Presentations **CO3 :** Document research work effectively **CO4:** Express oneself confidently during Public Speaking **CO5**: Able to present a self created ppt on technical themes **CO6**: Overall it helps the students in terms of public interaction and improve presentation skills.

Outline syllabus: **Technical Presentation**

	TOPICS	**COs & POs**

Unit 1	**Technical Documentation- I**	
A	Proposals and Reports	CO1/ CO6
B	Letters and Emails	CO1/ CO6
C	Synopsis	CO1/ CO6
Unit 2	**Technical Documentation- II**	
A	Dissertation	CO2/ CO6
B	Research techniques using Library and Internet	CO2/ CO6
C	Bibliography and Technical Paper writing	CO2/CO 6
Unit 3	**Oral Presentation Skills**	
A	Public Speaking	CO3/ CO6
B	Oral Presentation of reports	CO3/ CO6
C	Defending the research topic	CO3/ CO6
Unit 4	**Technical Presentation-I**	
A	Presentation: Approaches and methods	CO4/ CO6
B	Creating Power point presentations	CO4/ CO6

C	Does and Dont's of Technical Presentation	CO4/ CO6
Unit 5	**Technical Presentation-II**	
A	Presenting Data Using graphics	CO5/ CO6
B	Guidelines for technical presentations	CO5/ CO6
C	Technical Presentations: Practical	CO5/ CO6

PCM109

Course work: 30%		
Attendance	None	
Homework	10 assignments, no weight	
Quizzes	7 best quizzes (based on assignments); 20 marks	
Lab	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 10 marks	
Presentations	None	
Any other	None	
MTE	One, 20%	
End-term Examination: One, 50%		
References		
Text book	1. Gerson, J. Sharon & Gerson, M. Steven, *Technical Writing : Process and Product*, Pearson Education, Third Impression 2009. 2. Steve Mandel. *Presentation skills by* Steve Mandel	

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	2	2	1
CO2	1	1	2	1	2	2	2	1
CO3	2	2	2	2	3	3	1	2
CO4	1	1	1	2	2	2	2	2
CO5	1	1	2	3	2	2	2	2
CO6	2	2	1	3	2	2	2	2

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

MES151: Water Pollution and Monitoring Lab

School: SSBSR		**Batch 2023-2025**
Programme: M.Sc		**Current Academic Year : 2023-24**
Branch: Environmental Science		**Semester I**
1	**Course Code**	**MES151**
2	**Course Title**	**Water Pollution and Monitoring Lab**
3	Credits	2
4	Contact hours	0-2-0
	Course Status	Compulsory
5	Course Objectives	1. Provide an insight into various water quality parameters 2. . Enable student about water sampling techniques 3. Enable student to carry out experiments and data interpretation 4. Students gets expose to certain water quality analysis based instruments 5. Helps in analysis and comparison of results 6. Overall students will develop skill in water sampling techniques and water quality analysis.
6	Course Outcome	CO1 : pH and total dissolve solid determination in water samples CO2 : Analysis of CO_2 and alkalinity of the water samples CO3 : Estimation of Hardness and chloride content in water samples CO4 : Determination of dissolved oxygen in the water sample CO5 : Biological oxygen demand analysis of water sample CO6 : Overall understanding of various physical and chemical water quality parameters.
7	Course Description	This course gives exposure to students in terms of various qualitative and quantitative analytical techniques that helps in assessing water quality.

Scheme			Scheme of Examination		
L 0	P 2	T 0	Internal Assessment 60%	Mid Term Examination 0%	End Term Examination 40%

Course outline

This course gives exposure to students in terms of various qualitative and quantitative analytical techniques that helps in assessing water quality.

Course Evaluation

Attendance	None
Any other	--
References	
Text book	Vogel's "Textbook of quantitative Analysis", Pearson
Other References	
Softwares	

Week 1-3	**Unit 1**	**Practical related to** – pH and dissolve solids determination
	a)	Determination of pH of the various industrial, tap and ground water samples
	b)	Determination of total solids, dissolved solids and suspended solids in various industrial, tap and ground water samples
Week 4-7	**Unit 2**	**Practical related to –** CO_2 and alkalinity determination
	a)	Determination of CO_2 in pond water and ground water samples
	b)	Determination of alkalinity in water samples collected from local industries, tap and ground water.
Week 8-10	**Unit 3**	**Practical related to** – hardness and chloride determination

	a)	Determination of hardness in water samples collected from local industries, tap and ground water.
	b)	Determination of chloride in water samples collected from local industries, tap and ground water.
Week 11-12	**Unit 4**	**Practical related to –** dissolve oxygen determination by Winkler's method
		Determination of dissolve oxygen content of water samples collected from local industries, tap and ground water.
Week 13-14	**Unit 5**	**Practical related to –** biological oxygen demand determination
		Determination of biochemical oxygen demand of the water samples collected from local industries, tap and ground water.

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4

CO1	2	2	3	3	3	2	2	2
CO2	2	3	2	2	2	2	2	2
CO3	2	2	3	2	3	2	2	2
CO4	3	2	2	2	2	2	2	2
CO5	3	2	3	3	3	2	2	2
CO6	3	2	3	3	3	2	2	2

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

1.1 Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: M. Sc		**Current Academic Year: 2023-2024**
Branch: Water Resource and Environmental Management		**Semester: I**
1	Course Code	MWE-110
2	Course Title	**Solid Waste Management and Treatment**
3	Credits	04
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Definition, Types, Sources of solid waste 2. Understanding about handling of solid waste 3. Understanding about processing techniques of solid waste 4. Understanding about the hazardous waste management 5. Understanding about the hazardous waste treatment.
6	Course Outcomes	CO1.Understanding about the definition, types, sources of solid waste. CO2. Understanding about solid waste handling CO3. Understanding about solid waste processing techniques CO4.Understanding about the hazardous waste management CO5.Understanding about the hazardous waste treatment. CO6. Overall in-depth understanding of Solid and hazardous waste management.
7	Course Description	Solid & Hazardous Waste Management emphasises on various factors as 1. Definition, Types, Sources of hazardous waste and its impact on environment 2. Handling and segregation of solid waste 3. Solid waste management and its processing technologies 4. Hazardous waste management processes 5. Hazardous waste treatment
8	Outline syllabus	CO Mapping

	Unit 1	**Introduction**	
	A	Definition, Types, Sources	CO1/CO6
	B	Composition of solid waste, Characteristics, and Impact on Environmental Health,	CO1/CO6
	C	Determinants of Solid waste-factors influencing Waste Generation Rates, Concepts of Waste Reduction, Recycling and Reuse	CO1/CO6
	Unit 2	**Handling of Solid Waste**	
	A	Handling and Segregation of Wastes at Source	CO2/CO6
	B	Collection of Solid waste – collection services – collection system, equipments – time and frequency of collection – labour requirement – factors affecting collection – analysis of collection system – collection routes –and Transfer and Transport: Need for transfer operation – transfer stations – types – transport means and methods – location of transport stations , Transfer stations – selection of location,	CO2/CO6
	C	Analysis of Collection Systems	CO2/CO6
	Unit 3	**Solid Waste Processing Techniques**	
	A	Solid Waste Processing Technologies, Mechanical and Thermal Volume Reduction	CO3/CO6
	B	Biological and Chemical Techniques for Energy and Other Resource Recovery	CO3/CO6
	C	Disposal in Landfills – Site Selection, Design, and Operation of Sanitary Landfills, Secure Landfills.	CO3/CO6
	Unit 4	**Hazardous Waste Management**	
	A	Need for Hazardous Waste management, Sources and Characteristics	CO4/CO6
	B	Handling, Collection, Storage and Transport	CO4/CO6

	C	Hazardous Waste Treatment Technologies.			CO4/CO6
	Unit 5	**Hazardous Waste Treatment**			
	A	Solidification, Chemical Fixation and Encapsulation			CO5/CO6
	B	Incineration. Hazardous Waste Landfills -Site Selection Design and Operation			CO5/CO6
	C	.E-Waste - Waste Categorization Generation, Collection, Transport, Treatment and Disposal			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**Reference Books:** **1**. Handbook of Solid Waste Management, F. Kreith, G. Tchobanoglous, 2009. **2.** CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000. **3.** Pollution Control, Climate Change and Industrial Disasters, Abbasi, T. and Abbasi, S.A. Discovery Publishing House, New Delhi (2010). **4.** Hazardous Waste Management, M. D. LaGrega, P. L Buckingham, J. C. Evans, 2nd edition. McGraw-Hill, 2011.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PO3	PSO4
CO1	3	2	3	2	2	2	2	3
CO2	3	2	3	2	2	2	2	3
CO3	3	2	3	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3
CO5	3	2	3	2	2	2	2	3
CO6	3	2	3	2	3	3	3	3

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1. Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: II**
1	Course Code	MWE-111
2	Course Title	**Environmental Legislation and Audit**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of various laws enacted at global level for the protection and conservation of environment. 2. Understanding of various law implemented at national level for the abatement of pollution and conservation of environment. 3: Provide a thorough concept on various environmental policies 4: Understanding of various provisions related to environment protection and important judgement and cases 5: Enable to comprehend the concept of environmental auditing 6: Overall this course helps in-depth understanding of various rules, regulation and policies related to the protection of environment
6	Course Outcomes	CO1: Understanding of role of Stockholm conference, Rio declaration and role of United Nation in protection of global environment. CO2: Knowledge various types of laws enacted for the prevention and protection of environment and abatement of pollution. CO3: It deals with various policies, rules and regulations in safeguarding our environment.

		CO4: It gives understanding of the duties and responsibilities towards environmental protection and important judgement and cases CO5: To understand the concept of environmental auditing and techniques of auditing CO6: Thorough and indepth understanding of various environmental related laws, regulations and policies that helps keeps our environment preserved and protected.	
7	Course Description	To develop in-depth understanding on various laws enacted to make use of the natural resources like air, water, and forest in a sustainable manner. The course also covers various duties and responsibilities towards environment as a citizen of India. It also introduce a concept of environmental auditing, its types and the techniques to carried out auditing.	
8	Outline syllabus		CO Mapping
	Unit 1	**International Environmental Law**	
	A	Evolution and development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration	CO1/CO6
	B	Rio+5, Rio+10 (Johannesburg Summit), Rio+20 etc. Agenda-21, Basel Convention on the control of transboundary movement etc.	CO1/CO6
	C	Global environmental issues and laws: to control Global warming, Ozone depletion, CITES. Role of UN in protection of Global Environment	CO1/CO6
	Unit 2	**Environmental law**	
	A	The Water (Prevention and Control of Pollution) Act 1974, Water cess act-1977,Prevention and Control of Air Pollution Act 1981, Forest Conservation Act 1981	CO2/CO6
	B	Environment (protection) Act 1986, Factories Act, Motor Vehicle Act , Solid waste management and hazardous rules	CO2/CO6

	C	Coastal Regulation Zones (CRZ) Rules 1991. Bio-Medical Waste (Management and Handling) Rules, 1998			CO2/CO6
	Unit 3	**Pollution abatement policies, rules and regulations**			
	A	Environmental Policy and laws. The role of courts			CO3/CO6
	B	Role of central & state Government			CO3/CO6
	C	Central & State pollution control boards for Safeguard for Environmental Protection			CO3/CO6
	Unit 4	**Environmental protection and important judgment and cases**			
	A	Duties and responsibilities of citizens in environmental protection, Public liability Insurance Act. 1991			CO4/CO6
	B	Important legislations related to environment: Provision of constitution of India regarding environment (article 48 A & 58A)			CO4/CO6
	C	Important Judgments and Cases: Discussion on landmark cases: Sriram Chemicals Oleum Leak Case, Bhopal Gas Leak case, Ganga Action Plan case etc. Green Benches.			CO4/CO6
	Unit 5	**Environmental Audit**			
	A	Guidelines for Environmental Audit,Concept of environmental audit, objectives of audit, types of audit, Matrix Method and Baetelle Method of Auditing			CO5/CO6
	B	Organisation of Auditing Programme-pre visit and collection. Audit protocol, onsite audit, data sampling- Inspections-Evaluation and presentation			CO5/CO6
	C	Exit interview, Audit report-Action plan-Management of audits.			CO5/CO6
	Mode of examination	Theory			
		CA	MTE	ETE	

	Weightage Distribution	30%	20%	50%	
	Text book/s*	1. Divan S. and Rosencranz A. (2005) Environmental Law and Policy in India, 2nd ed., Oxford, New Delhi. 2. Leelakrishnan P. (2008) Environmental Law in India, 3rd ed., Lexis Nexis, India			
	Other References				

POs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4

COs								
CO1	3	1	2	2	1	1	1	2
CO2	3	1	2	2	2	1	1	2
CO3	2	1	2	3	2	1	1	1
CO4	2	1	2	2	2	1	1	2
CO5	3	1	3	2	2	1	1	1
CO6	3	1	2	2	2	2	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Syllabus for Theory Subjects

School: SSBSR		Batch : 2023-2025
Programme: MSc		Current Academic Year: 2023-2024
Branch: Water Resources and Environmental Management		Semester: II
1	Course Code	MWE106
2	Course Title	**Climate Change and Sustainable Development**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of various components of climate and related events 2. Understanding of green house effect concept and factors responsible for and role of IPCC towards climate change 3: Provide a thorough concept on sustainable development and various elements of sustainable development 4: Understanding of sustainable development in terms of business perspective 5: Enable to comprehend the concept of climate change and various policies initiated by government for mitigation. 6: Overall this course helps in-depth understanding of climate change, elements that responsible for climate change and various governmental approach for its mitigation.
6	Course Outcomes	CO1: Understanding of climate and its components, concept of global circulation CO2: Understanding of factors responsible for green house effect and global warming and role of IPCC CO3: It deals with the concept and understanding of sustainable development CO4: To understand the concept of sustainable development and its role in various business related activities.

		CO5: It gives clear understanding of the relation between climate change mitigation and sustainable development. CO6: Thorough and indepth understanding of the causes responsible for climate change and ways of mitigating climate change by adopting governmental policies and promoting sustainable development.	
7	Course Description	To develop in-depth understanding of climate and its related components. Factors that affecting the climate and leads to climate change. Various policies, regulations and efforts taken at global level in tackling the problem of climate change. Further the course also throws light on the interrelationship between sustainable development and climate change mitigation.	
8	Outline syllabus		CO Mapping
	Unit 1	**International Environmental Law**	
	A	Weather and climate, Difference between Weather & Climate, Components of Earth's climate system	CO1/CO6
	B	Pressure, temperature, humidity, clouds, precipitation	CO1/CO6
	C	General circulation, Hadley cells, prevailing winds and weather. Ocean circulation and El Niño events	CO1/CO6
	Unit 2	**Environmental law**	
	A	Factors driving Natural and Anthropogenic sources of GHG emissions to the atmosphere	CO2/CO6
	B	Global warming potential, impact of climate change on ecosystem	CO2/CO6
	C	Kyoto Protocol, Role of IPCC in climate change impact	CO2/CO6
	Unit 3	**Sustainable Development**	
	A	Definition of Sustainable Development, Need of Sustainable Development,	CO3/CO6
	B	Environmental Sustainability, Economic Sustainability, Social Sustainability	CO3/CO6

	C	Sustainable Agriculture. Human Development and Sustainability				CO3/CO6
	Unit 4	**Sustainable Development and Business Perspective**				
	A	Sustainable Development and Business Strategy Prospective				CO4/CO6
	B	Corporate Social Responsibility, Industrial Ecology				CO4/CO6
	C	Enhancing Environment Management Systems				CO4/CO6
	Unit 5	**Environmental Audit**				
	A	Use of alternate energy resources for sustainability				CO5/CO6
	B	Govt. Policies for Mitigation – Current Status & Future Planning				CO5/CO6
	C	National & International Initiative				CO5/CO6
	Mode of examination	Theory				
	Weightage Distribution	CA	MTE	ETE		
		30%	20%	50%		
	Text book/s*	1. Sustainable Development: Economics & Environment in the Third World, David William Pearce, Edward Barbier, Anil Markandya, Earthscan, 1990. 2. Sustainable Development: Critical Issues, Organisation for Economic Co-Operation and Development, OECD Publishing, 28-Jun-2001Environmental Impact Assessment, L. W. Canter, Mc Graw Hill, New York, 2010. 3. Climate Change: Physical Science Basis. IPCC, 2013.				
	Other References					

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4

CO1	2	1	2	2	3	1	1	2
CO2	2	1	2	1	2	1	1	2
CO3	2	1	2	2	2	1	1	1
CO4	2	1	2	2	2	1	1	2
CO5	3	1	3	3	2	1	1	1
CO6	3	1	3	3	2	1	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: II**
1	Course Code	MEW107
2	Course Title	**Environmental Toxicology**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of various concepts related with toxicology, types of toxicants and toxicity as a function of dose response relationship. 2. Understanding of various mechanisms related with toxicity and detoxification process. 3: Provide a thorough concept on hepato, renal and immuno toxicology. 4: Impact of nano particles related toxicity in environment and human 5: Enable to comprehend the concept of environmental health 6: Overall this course helps in-depth understanding of various sources, effects and mechanism of toxicity.
6	Course Outcomes	CO1:Concept of toxicology and its sources CO2:Dose response relationship CO3: Mechanism of toxicity CO4:Problems caused due to toxic chemicals CO5: Nano particles and its toxicity and human exposure and diseases

		CO6: Overall understanding of various sources, effects and mechanisms of toxicity.	
7	Course Description	To develop basic understanding of sources and mechanism of toxicity	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Toxicology**	
	A	General concept of toxicology and toxic chemical in environment	CO1/CO6
	B	Sources and mechanism of toxicity	CO1/CO6
	C	Dose-response relationship	CO1/CO6
	Unit 2	**Toxicity Mechanisms**	
	A	Bioaccumulation	CO2/CO6
	B	Bio-magnification	CO2/CO6
	C	Bio-transformation	CO2/CO6
	Unit 3	**Chemical Toxicology**	
	A	Hepato and Renal Toxicology	CO3/CO6
	B	Developmental Toxicology and Immunotoxicology	CO3/CO6
	C	Organic Pollutants and Inorganic Pollutants	CO3/CO6
	Unit 4	**Environmental Nanotoxicology**	
	A	Nanoparticles in environment and its fate	CO4/CO6
	B	Toxicological and eco-toxicology	CO4/CO6
	C	Exposure and threat of nanoparticles	CO4/CO6
	Unit 5	**Environmental Health**	
	A	Global and regional perspectives of environmental health	CO5/CO6
	B	Human exposure and health impact	CO5/CO6
	C	Environmental diseases	CO5/CO6

	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Ware, George M.(Ed) (2007) Reviews of environmental contamination and toxicology. Vol. 190: Continuation of residue reviews, Springer Publishers			
	Other References	1. Tatiya, Ratan raj (2013) Elements of industrial hazards: Health, safety, environment and loss prevention Taylor and Francis. 2. Theodore, Louis (2012) Environmental health and hazard risk assessment: Principles and calculations, CRC Press 3. Wong, Ming H. (Ed.) (2013) Environmental contamination: Health risks and ecological restoration, CRC press 4. Manahan, Stanley E. (2013) Fundamentals of environmental and toxicological chemistry: Sustainable sciences, CRC press			

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	3	1	1	2
CO2	2	1	2	2	2	1	1	2
CO3	2	1	2	2	3	1	1	1
CO4	3	1	2	2	2	1	1	2
CO5	3	1	3	3	3	1	1	1
CO6	3	1	3	3	3	1	1	2

-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: II**
1	Course Code	MWE108
2	Course Title	**Glaciology and Climate Change**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of various concepts related with glaciers, characteristics features and global importance of glaciers. 2. Understanding of important glaciological features. 3: Provide a thorough concept on methods employed for glaciological measurements. 4: Understanding of glaciological hydrology through modelling 5: Enable to comprehend the concept of climate change with special reference to glacier as indicator 6: Overall this course helps in-depth understanding of various glaciological related process, features and events.
6	Course Outcomes	CO1:Concept of glaciers, its types, characteristics and importance. CO2: Knowledge of various features formed due to glaciers CO3: Concept of various techniques employed for glaciological measurements CO4: Concept related to glacier hydrology with the help of various model. CO5: Knowledge of climate change through monitoring of glacier as an indicator CO6: Overall understanding of glacier related processes and formations.

7	Course Description	To develop basic understanding of glaciological process and various technical aspects related to glaciology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	Definition of glacier and types of glaciers; Process of formation of a glaciers	CO1/CO6
	B	Snow, firn and ice; crystallization of ice; glacier distribution on the globe, importance of glacier	CO1/CO6
	C	Himalayan glaciers and their characteristic features, regional and global importance of glaciers	CO1/CO6
	Unit 2	**Glaciological features**	
	A	Different zones in a glacier; Equilibrium line, accumulation area ratio and its importance	CO2/CO6
	B	Snout, bergschrund, moulin or glacier mill, supra-glacial and sub-glacial lakes, crevasses, debris cover, glacier table	CO2/CO6
	C	Glacial deposits,; Moraines and its types; Glacier velocity; Flow of valley glaciers and concept of glacier surges	CO2/CO6
	Unit 3	**Glaciological measurements**	
	A	Definition and concept of mass balance; Methods of mass balance measurements- In-situ measurement	CO3/CO6
	B	Remote sensing methods, Hydrological methods ; Mass Balance gradients	CO3/CO6
	C	Annual mass balance cycles, Mass balance of ice sheet	CO3/CO6
	Unit 4	**Glacier Hydrology**	
	A	Glacier melt water system; Glacio-hydrological modelling- Purposes and types	CO4/CO6
	B	Glacier mass balance model, energy balance model, Temperature index models	CO4/CO6

	C	Discharge measurement method, diurnal and seasonal variation			CO4/CO6
	Unit 5	**Climate Change and Glaciers**			
	A	Glacier as indicator of climate change; Impacts of Climate Change on Cryosphere; Impacts of climate change on glacier, permafrost and glacial lake			CO5/CO6
	B	Impacts of climate change hydrology of glacierized river basin			CO5/CO6
	C	Impacts on water resources of India, Socio-economic impacts. Glacial hazards and concept of GLoF			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Ware, George M.(Ed) (2007) Reviews of environmental contamination and toxicology. Vol. 190: Continuation of residue reviews, Springer Publishers			
	Other References	1. Physics of glacier, Fourth edition, 2011, Kurt M. Cuffey, W. S. B. Paterson, Elsevier. 2. Fundamentals of Glacier Dynamics, Second edition, 2013, C.J. Van der Veen, CRC press, Taylor & Francis Group, 3. Glaciers and Glaciation, 2010, 2nd edition Douglas Benn andDavid J A Evans, Hodder Arnold Publication			

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2	3	1	1	2

CO2	2	1	1	1	2	1	1	2
CO3	2	1	2	1	2	1	1	1
CO4	2	1	2	2	3	1	1	2
CO5	2	1	2	2	3	1	1	1
CO6	2	1	2	2	3	1	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2023-2024**
Branch: Water Resources and Environmental Management		**Semester: II**
1	**Course Code**	MWE112
2	**Course Title**	**Remote Sensing Techniques & GIS**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1.Detailed understanding of principles of remote sensing 2. Understanding of concepts and various components of GIS along with its advantages and disadvantages 3: Provide a thorough concept on interpretation GIS database 4: Detailed understanding of Photogrammetry & Cartography 5: Application of remote sensing in natural hazards 6: Overall this course helps in-depth understanding of various components of remote sensing and application in the management of natural hazards.
6	Course Outcomes	CO1: Describe the concept of remote sensing and principle behind the same. CO2: Principles of GIS CO3: Use GIS and its different components for application in case studies CO4: Describe the concept of Photogrammetry & Cartography CO5: Remote Sensing Application in natural hazards CO6: Overall understanding of various components of remote sensing and application natural hazards management.

7	Course Description	To develop an understanding of geoinformatics, its principle, tools and techniques and application different fields of environmental science	
8	Outline syllabus		CO Mapping
	Unit 1	**Principles of remote Sensing**	
	A	Electromagnetic Radiation and Electromagnetic Spectrum, Interaction with the Atmosphere and radiation target	CO1/CO6
	B	Passive & Active Remote Sensing, Aerial Photographs and Satellite based Remote Sensing, Digital Image Processing and Interpretation	CO1/CO6
	C	Platforms and RS Data Acquisition Systems, Microwave Thermal Remote Sensing	CO1/CO6
	Unit 2	**Principles of GIS**	
	A	Basic Concepts: definition and component of GIS,	CO2/CO6
	B	Areas of GIS application, GIS Data and Data Structures.	CO2/CO6
	C	Advantage and Limitation of GIS	CO2/CO6
	Unit 3	**GIS Database**	
	A	Creating GIS Database-GIS Software, file organization and formats	CO3/CO6
	B	Method of spatial data capture	CO3/CO6
	C	Editing of data	CO3/CO6
	Unit 4	**Photogrammetry & Cartography**	
	A	Classification of aerial photographs. Scale of aerial photographs on uniform and variable terrain. Geometry of aerial photographs. Types of aerial mosaics and their advantages	CO4/CO6
	B	History and evolution of 2D and 3D imaging systems on Indian and foreign satellites Epi-polar registration of stereo images, Digital feature extraction and matching techniques for stereo image analysis.	CO4/CO6

	C	Use of GPS and SAR interferometry data in 3D mapping, Cartographic problems of mapping the earth with horizontal and vertical controls, Reference Surfaces, Geoid and ellipsoid definitions, Map Projections and their properties, Hardware and software components of digital mapping systems.			CO4/CO6
	Unit 5	**Application of Remote Sensing in Natural Hazards**			
	A	Natural hazards: Concept of natural hazard. Types and classification of natural hazards: Causes, effects, monitoring, management of Earthquakes, Volcanic eruptions, Tsunamis.			CO5/CO6
	B	Role of remote sensing in monitoring and damage assessment. History of natural hazards in India.			CO5/CO6
	C	Vulnerable states and regions of India. Vulnerability index of various natural hazards in India. Preventive measures. Earthquake and Tsunami warning system in India.			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Asrar Ghassem Theory and applications of optical remote sensing New York: John Wiley and Sons. 2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press. 3. Curran P.J., Principles of Remote Sensing, UK, ELBS.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	1	2
CO2	2	1	1	1	2	2	1	2
CO3	2	1	2	1	2	2	1	1
CO4	2	1	2	2	3	2	1	2
CO5	2	1	2	2	3	2	1	1
CO6	2	1	2	2	3	2	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

MEE-112: Energy Sources and Global Scenario

School: SSBSR		**Batch : 2023-2025**
Programme: M. Tech		**Current Academic Year: 2023-2024**
Branch: Energy and Environmental Engineering		**Semester: I**
1	Course Code	MEE112
2	Course Title	**Energy Sources and Global Scenario**
3	Credits	04
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	6. Concept of various energy resources 7. Detail understanding about various direct energy conversion methods 8. Understanding of national and international energy scenario 9. To understand the energy need for growing economy 10. To impart knowledge on inter-relationship between energy and economic growth
6	Course Outcomes	CO1. Knowledge about various renewable and non renewable energy sources. CO2.Deep knowledge about various direct energy conversion methods. CO3.Understanding about national and international energy scenario. CO4. Understanding about energy conservation and its importance. CO5. Understanding about the need of energy for economic growth. CO6. Overall in-depth understanding of various energy sources and its role in economy.
7	Course Description	Energy Sources and Global Scenario emphasises on various factors as 1. Various forms of energy 2. The current national and international energy scenario. 3. Energy Conservation and its importance. 4. The role of energy in growing economy.

8	Outline syllabus		CO Mapping
	Unit 1	**Different Energy Sources**	
	A	Renewable Energy Sources- Solar Energy, Wind Energy	CO1/CO6
	B	Biomass Energy, OTEC	CO1/CO6
	C	Non Renewable Energy Sources-Coal, Petroleum, Natural gas etc., Hydrogen energy, Nuclear fuels.	CO1/CO6
	Unit 2	**Direct Energy Conversion**	
	A	Magneto Hydro Dynamics (MHD) Power, Solar Photo Voltaic	CO2/CO6
	B	Fuels Cells, Energy from Biomass	CO2/CO6
	C	Thermo-chemical and Biochemical Conversion of Fuels, Biogas and its Applications.	CO2/CO6
	Unit 3	**Energy Scenario**	
	A	Global and National Energy Scenario – Current Energy Exploitation	CO3/CO6
	B	Long Term Energy Scenario	CO3/CO6
	C	Energy Pricing, Energy Security	CO3/CO6
	Unit 4	**Energy Conservation and its Importance**	
	A	Energy Conservation and its Importance	CO4/CO6
	B	Energy Strategy for the Future	CO4/CO6
	C	Energy Conservation Act-2001 and its Features	CO4/CO6
	Unit 5	**Global Concerns for Energy**	
	A	Energy Demand at present, Energy Needs for Growing Economy	CO5/CO6
	B	Energy Planning, Economic Feasibility of the New Energy Resources	CO5/CO6
	C	Impacts on Environment and Associated Problems, Energy for Sustainable Development.	CO5/CO6
	Mode of examination	Theory	

	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**Reference Books:** 1. Energy, Economics and the Environment, 3rd, Bosselman, Eisen, Rossi Spence and Weaver (Foundation Press, 2010). 2. Energy, Economics Growth, and the Environment, Schurr (Ed.), 2010. 3. Managing Our Natural Resources, William G. Camp, Thomas B. Daugherty, Cengage Learning, 01-Dec-2000. 4. Managing Natural Resources with GIS, Laura Lang, ESRI, Inc., 01-Jul-1998.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO.1	3	2	3	1	2	3	3	3
CO2	3	1	3	3	3	3	3	3
CO3	3	2	3	1	3	3	1	3
CO4	3	1	3	2	3	1	2	3
CO5	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

CCU401 : Community Connect

School: SSBSR		**Batch :2023-2025**	
Programme: M.Tech.		**Current Academic Year: 2023-2024**	
Branch: Energy and Environmental Engineering		**Semester: II**	
1	Course Code	CCU401	
2	Course Title	Community Connect	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To expose our students to different social issues faced by the people in different sections of society. 2. To connect their class-room learning with problem solving skills in real life scenario.	
6	Course Outcomes	CO1.Recognize social problems prevailing in different sections of society and finding the solution in sustainable manner. CO2.Get practical exposure of all round development which complements their class room learning. CO3. These activities will add value to students, faculty members, school and university. CO4. Students develop skill in terms of interaction, data interpretation and its analysis. CO5.In addition to Indian students international students also gets an opportunity to have an exposure with the local peoples and their culture and enable them to connect with them by discussing various social cultural and environmental related issues. CO6. Overall this course helps student to gain insight into the socio-economic structure of rural India and to understand various problems that obstruct the growth	

		and development of rural India by conducting surveys and through interactions.			
7	Course Description	In this mode, students will make survey, analyze data and will extract results out of it to correlate with their theoretical knowledge. E.g. Soil problem, water pollution problem, sanitation issues, waste management and various related issues.			
8	Outline syllabus				CO Achievement
	Unit 1	**Introduction to the Topic**			CO1,CO6
	Unit 2	**Drafting the questionnaire**			CO2,CO6
	Unit 3	**Survey**			CO3,CO6
	Unit 4	**Data collection, Discussions and result interpretation**			CO4, CO6
	Unit 5	**Report writing and Presentation**			CO5,CO6
	Mode of examination	Presentation and Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References	The entries in the list should be in alphabetical order. Journal article Hamburger, C.: Quasimonotonicity, regularity and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura Appl. 169, 321–354 (1995) Article by DOI			

		Sajti, C.L., Georgio, S., Khodorkovsky, V., Marine, W.: New nanohybrid materials for biophotonics. Appl. Phys. A (2007). doi:10.1007/s00339-007-4137-z Book Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra. Kluwer, Boston (1992) Book chapter Broy, M.: Software engineering — from auxiliary to key technologies. In: Broy, M., Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, Heidelberg (2002) Online document Cartwright, J.: Big stars have weather too. IOP Publishing PhysicsWeb. http://physicsweb.org/articles/news/11/6/16/1 (2007). Accessed 26 June 2007 Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see www.issn.org/2-22661-LTWA-online.php For authors using End Note, Springer provides an output style that supports the formatting of in-text citations and reference list. End Note style (zip, 2 kB)	

CO/PO	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	3	2	1	1	2
CO2	2	2	2	2	2	1	1	2

CO3	3	2	2	1	2	1	1	2
CO 4	2	2	3	1	2	1	1	3
CO5	2	1	1	2	2	1	1	3
CO6	2	1	1	1	2	1	1	3

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

School: SSBSR		**Batch : 2023-2025**
Programme: M. Sc		**Current Academic Year: 2023-2024s**
Branch: Water Resource and Environmental Management		**Semester: II**
1	Course Code	MWE -152
2	Course Title	**Remote Sensing & GIS Lab**
3	Credits	02
4	Contact Hours (L-T-P)	0-0-4
	Course Status	Compulsory
5	Course Objective	1. Provide an insight into various aspect of remote sensing 2. Enable students to do geo-referencing 3. Enable student to do layer staking 4. Students will get to know that how make maps of various locations 5. Enable student to do digitization 6. Overall students will develop skill in remote sensing.
6	Course Outcomes	CO1. Knowledge about earth explorer CO2. How to do geo-referencing CO3. How to do layer staking CO4. How to make map CO5. How to digitize CO6. Overall understanding of various components of remote sensing.
7	Course Description	This course gives remote sensing exposure to the students.
Week 1-3	**Unit 1**	Data downloading from earth explorer
Week 4-7	**Unit 2**	How to Geo-reference the image
Week 8-10	**Unit 3**	How to stake the layer
Week 11-12	**Unit 4**	How to make the map
Week 13-14	**Unit 5**	Image processing: Digitization

	Text book/s*	1. Asrar Ghassem Theory and applications of optical remote sensing New York: John Wiley and Sons. 2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press. 3. Curran P.J., Principles of Remote Sensing, UK, ELBS.

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	1	2
CO2	2	1	1	1	2	2	1	2
CO3	2	1	2	1	2	2	1	1
CO4	2	1	2	2	3	2	1	2
CO5	2	1	2	2	3	2	1	1
CO6	2	1	2	2	3	2	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-25**
Programme: MSc		**Current Academic Year:2024-25**
Branch: Water Resources and Environmental Management		**Semester: III**
1	**Course Code**	MWE203
2	**Course Title**	**Research Methodology**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of various elements of research. 2. Enable to understand the concept of qualitative and quantitative research. 3. Thorough understanding of statistical approach in research 4. Understanding of computer application in research 5. Impart knowledge on thesis writing and various ethical issues related to publishing.
6	Course Outcomes	CO1: Research and hypothesis CO2: Qualitative and Quantitative research CO3: Concept and levels of measurements CO4: Basics of statistics CO5: Basics of software in research CO6: Overall understanding on various aspects of research and related areas.
7	Course Description	To develop an understanding of methods and various tools applied in research

8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to research**	
	A	Foundations of Research, Concept of theory Concept of theory.	CO1/CO6
	B	Characteristics of scientific method – Understanding the language of research.	CO1/CO6
	C	Hypothesis Testing – Logic & Importance, Concept and Importance in Research, Exploratory Research Design, Experimental Design.	CO1/CO6
	Unit 2	**Qualitative and Quantitative Research**	
	A	Qualitative and Quantitative Research,	CO2/CO6
	B	Concept of measurement	CO2/CO6
	C	Levels of measurement	CO2/CO6
	Unit 3	**Statistical Research**	
	A	Sampling, Characteristics of a good sample,	CO3/CO6
	B	Probability Sample, Determining size of the sample,	CO3/CO6
	C	Data Analysis, Bivariate analysis.	CO3/CO6
	Unit 4	**Computer and Software Applications**	
	A	Spreadsheet, Presentation, web search tools, Introduction to MATLAB, and solution programming	CO4/CO6
	B	Basic concepts of SPSS, and R software , and solution programming	CO4/CO6
	C	Data Interpretation, Data optimization techniques advantages and limitation of these softwares	CO4/CO6
	Unit 5	**Writing thesis and ethics**	
	A	Interpretation of Data and Paper Writing, Layout of a Research Paper.	CO5/CO6

	B	Journals in Computer Science, Impact factor of Journals, When and where to publish?			CO5/CO6
	C	Ethical issues related to publishing, Plagiarism and Self-Plagiarism.			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	C. R. Kothari, Research Methodology: Methods and Techniques, New Age Publication.			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2	3	1	1	1
CO2	2	2	3	2	3	2	1	1
CO3	2	2	2	2	3	2	1	1
CO4	2	2	2	2	3	2	1	1
CO5	2	2	2	2	3	2	1	1
CO6	2	2	3	2	3	2	1	1

1-Slight (Low)

2-Moderate (Medium)
3-Substantial (High)

1.1. Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**	
Programme: MSc		**Current Academic Year: 2024-25**	
Branch: Water Resource and Environmental Management		**Semester: III**	
1	Course Code	**MWE207**	
2	Course Title	**Biodiversity Conservation and Management**	
3	Credits	04	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To understand the concept of biodiversity 2. To understand the concept of diversity 3. To understand the flora conservation 4. Knowledge about conservation of wild life 5. Detail knowledge about UNESCO and WHO	
6	Course Outcomes	CO1. Understanding about the concept of biodiversity, species diversity and ecosystem diversity. CO2. Understanding about the concept of diversity, community structure CO3. Understand the flora conservation and forest management CO4. Knowledge about conservation of wild life, animal Sanctuaries, national Parks CO5. Detail knowledge about UNESCO and WHO CO6. Overall in-depth understanding of Biodiversity and its conservation, forest management	
7	Course Description	Biodiversity & Conservation emphasises on various factors as 1. Concept of biodiversity 2. Concept of diversity 3. Flora conservation 4. Conservation of wild life 5. UNESCO and WHO	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	

	A	Definition, Concepts of Bio Diversity, Species Diversity	CO1/CO6
	B	Ecosystem Diversity, Genetic Diversity	CO1/CO6
	C	Distribution, Evolutionary Diversification	CO1/CO6
	Unit 2	**Variation & Diversity**	
	A	Measuring Biodiversity, Species, Abundance	CO2/CO6
	B	Adaptation, Distribution, Natural Selection	CO2/CO6
	C	Geographical Diversity - Competition and Communities Structure, Local regional Diversity relationships, Low Diversity, Extreme of High and Low Diversity	CO2/CO6
	Unit 3	**Flora Conservation**	
	A	Forest Types, Conservation of Forests	CO3/CO6
	B	Management of Forest and Forest Resources Agro Forestry Social Forestry	CO3/CO6
	C	Biomes – Forest, Grassland, Desert, Tundra, Autorotation and Deforestation	CO3/CO6
	Unit 4	**Conservation of Wild Life**	
	A	Aims, Objectives, Species Extinction	CO4/CO6
	B	Endangered Species. Animal Sanctuaries	CO4/CO6
	C	National Parks, Conservation of Wild Life	CO4/CO6
	Unit 5	**Role of various agencies in biodiversity and conservation**	
	A	UNESCO	CO5/CO6
	B	WHO	CO5/CO6
	C	Convention, In-situ- Ex-situ Conservation, Man and Biosphere Conservation Programmes	CO5/CO6

	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**Reference Books:** 1. Erach Bharucha, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India 2. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.			
	Other References				

COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO.1	2	3	3	3	2	1	2	1
CO.2	2	3	2	2	3	2	2	1
CO.3	3	3	2	3	2	2	2	1
CO4	2	2	2	3	2	2	1	1
CO5	2	2	2	2	2	1	1	2
CO6	2	2	3	2	2	1	1	2

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

1.1 Template: Syllabus for Theory Subjects

School: SSBSR		**Batch: 2023-2025**
Programme: M. Sc.		**Current Academic Year: 2024-25**
Branch: Water Resource and Environmental Management		**Semester: III**
1	Course Code.	MTH215
2	Course Title	BIO-STATISTICS
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course status	Elective
5	Course Objectives	To make students familiar with the concept of Probability and Statistics with emphasis on some standard probability distributions and sampling distributions.
6	Course Outcomes	Students will be able to: CO1: Get an overall view of Statistics and statistical inference. CO2: Find the measures of central tendency and dispersion of a data. CO3: Calculate the probability of various events in a random experiment. CO4: Use of normal distributions for computing relevant probabilities.. CO5: Test statistical hypothesis using large and small samples. CO6: Find coefficient of correlation, rank correlation and regression lines relating two variables.
7	Course Description	In this introductory statistics course we will explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations. We will cover descriptive statistics, probability, and hypothesis testing and statistical inference, correlation and regression techniques.
8	Outline syllabus:	

UNIT 1	**Introduction and descriptive statistics.**	CO Mapping
A	Some basic concepts – sampling and statistical inference	CO1
B	Frequency distribution. Measures of central tendency – mean, median, mode, mean of the combined data.	CO2
C	Dispersion – mean deviation, variance, standard deviation, quartiles.	CO2
UNIT 2	**Probability.**	
A	Objective and subjective views on probability. Random experiment, sample space, events, mutually exclusive events, independent events, axioms of probability, conditional probability.	CO3,
B	Calculation of probabilities using addition theorem and conditional probability theorems.	CO3,
C	Normal distribution: use of tables to calculate probabilities and also the mean and SD of normal distribution with given probabilities.	CO3,
UNIT 3	**Estimation.**	
A	Confidence interval of a population mean.	CO4
B	Use of the t distribution in the estimation of population mean in the small sample cases.	CO4
C	Estimation of proportions.	CO4
UNIT 4	**Testing of hypothesis.**	
A	Testing of hypothesis: single population mean and difference of two population means.	CO5
B	Testing of hypothesis: single population proportion.	CO5
C	Chi – square test – goodness of fit.	CO5
UNIT 5	**Correlation and regression.**	
A	Carl Pearson's Coefficient of correlation.	CO6
B	Rank correlation.	CO6

C	Regression lines.			CO6
	Mode of Examination	Theory		
	Weightage distribution	CA	MTE	ETE
		30%	20%	50%
	Text books	1. Gupta,S.C and Kapoor,V.K, "Fundamental of Mathematical Statistics".		
	Other references	1. Daniel,Wayne W.,"Biostatistics": Basic concept and Methodology for Health Science. 2. Grewal,B.S, "Higher Engineering Mathematics".		

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	1
CO2	2	2	3	2	3	2	2	1
CO3	2	2	2	2	3	2	2	1
CO4	2	2	3	2	3	2	2	1
CO5	2	2	3	2	3	2	2	1
CO6	2	2	3	2	3	2	2	1

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

1.1.Template: Syllabus for Theory Subjects

School: SSBSR		Batch : 2023-2025
Programme: MSc		Current Academic Year: 2024-25
Branch: Water Resources and Environmental Management		Semester: III
1	Course Code	MWE208
2	Course Title	Fundamentals of Hydrology
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of basics of concept of hydrological cycle, monsoon system 2. Enable understanding of various physical factors influencing precipitation, types of precipitation, technical analysis of precipitation data 3: Provide a thorough concept on discharge and runoff 4: Enable students to understand about flood, its frequency and techniques of estimation. 5: To impart knowledge on ground water hydrology including concept of aquifer, groundwater flow and related phenomena 6: Overall this course helps in-depth understanding of various process and phenomenon related with hydrology.
6	Course Outcomes	CO1: Understanding of role of hydrological cycle, knowledge of hydrologic budget. CO2: Knowledge on types on precipitation, its process, various technical aspects related with precipitation CO3: It deals with the discharge process runoff, and its quantitative estimation CO4: It gives understanding of flood, various technical aspects related with flood including flood frequency studies, flood routing concept etc. CO5: To understand the concept of aquifers, its types and various hydraulic phenomenon associated with aquifers CO6: Thorough understanding of various hydrological process and related hydrological events and related technical aspects.

7	Course Description	To develop in-depth understanding on monsoon system, factors regulating hydrological cycle and water budget. Also provide focus on precipitation process and ways of analysis of precipitation data. Further this course also throw light on various analytical and technical component related with flood, indepth overview on ground water hydrology that includes concept of aquifers, Darcy's law and hydraulic potential .	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	Definition, need, history of hydrology	CO1/CO6
	B	world water inventory, the Indian scenario	CO1/CO6
	C	the hydrologic cycle, hydrologic budget, the monsoon system.	CO1/CO6
	Unit 2	**Precipitation**	
	A	Precipitation: process, forms, assessment of precipitation in ungauged basins, Analysis of Precipitation data: required number of rain gauges, data consistency check and data gap fill up	CO2/CO6
	B	Presentation of rainfall data–mass curve and hyetograph, precipitation variability, , estimation of mean precipitation over an area, depth area relationship	CO2/CO6
	C	Intensity duration-frequency relationship, probable maximum precipitation, Horton's equation and phi index method	CO2/CO6
	Unit 3	**Discharge and Runoff**	
	A	Measurement of Discharge, direct and indirect estimation methods, measurement of stage Runoff: components, water yield, flow duration curve, flow mass curve	CO3/CO6
	B	Hydrograph, factors affecting flood hydrograph, Unit Hydrograph-definition, assumptions, limitation, derivation of UH from storm hydrograph, derivation of UH of longer duration from UH of shorter duration	CO3/CO6
	C	Derivation of UH of shorter duration from UH of longer duration, derivation of storm hydrograph from UH	CO3/CO6

	Unit 4	**Flood**			
	A	Estimation of flood peak-Rational method, empirical formulae, Unit Hydrograph techniques			CO4/CO6
	B	Flood frequency studies; Flood Routing concept and techniques; hydrologic reservoir routing using Modified Pulse method			CO4/CO6
	C	Hydrologic channel routing using Muskingum method			CO4/CO6
	Unit 5	**Ground water hydrology**			
	A	Concept of aquifers, flow of water to a well in confined and unconfined aquifers, infiltration			CO5/CO6
	B	Soil properties, Darcy's Law and Hydraulic Potential, The Steady-state			CO5/CO6
	C	Groundwater Flow Equation Streamlines and Flow Nets, Regional Flow and Geologic Controls on Flow			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Subramanya K. (2004) Engineering Hydrology, Tata McGraw-Hill, New Delhi. 2. Chow V.T. (1988) Applied Hydrology, Tata McGraw Hill Publishing Co. 3. Patra K.C. (2011) Hydrology and Water Resources Engineering, Narosa Publishing House			
	Other References				

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	1	1	1	1

CO2	2	2	2	2	1	1	1	1
CO3	2	2	2	2	1	1	2	1
CO4	2	1	3	2	2	2	2	1
CO5	3	1	3	2	2	1	1	2
CO6	3	1	2	2	2	2	1	2

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

MWE 209: Instrumentation and Techniques

School: SSBSR		**Batch : 2023-25**
Programme: MSc		**Current Academic Year: 2024-25**
Branch: MSc in Water Resources and Environmental Management		**Semester: III**
1	**Course Code**	**MWE209**
2	**Course Title**	**Basics of Instrumentation**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. To impart knowledge on soil analysis techniques 2. To impart knowledge on analytical principle related with water quality control. 3. Understanding of various gravimetric based principles and technique. 4. Understanding of spectrometric principles and techniques 5. Understanding of chromatographic and microscopic principles and techniques 6. Over understanding of basic instrumentation techniques for environmental analysis.
6	Course Outcomes	CO1: Collection and preservation of soil samples CO2: Different physical and chemical analysis used for soil samples CO3: Different analysis used for water samples CO4: Heavy metal analysis in water

		CO5: Various principles and technique used in environmental analysis CO6: Overall understanding of basic instrumentation techniques	
7	Course Description	To develop an understanding regarding basic concepts involved in various instruments used for the analysis.	
8	Outline syllabus		CO Mapping
	Unit 1	**Soil analysis**	
	A	Collection and preservation of soil samples	CO1/CO6
	B	Physical analysis	CO1/CO6
	C	Chemical analysis	CO1/CO6
	Unit 2	**Water analysis**	
	A	Sampling and preservation of samples	CO2/CO6
	B	Physical analysis	CO2/CO6
	C	Chemical analysis	CO2/CO6
	Unit 3	**Principle and techniques of instrumentation used in environmental analysis**	
	A	Gravimetric, and volumetric analysis	CO3/CO6
	B	Colorimetric and Potentiometric analysis	CO3/CO6
	C	X-ray diffractometry	CO3/CO6
	Unit 4	**Principle and techniques of spectrometry**	
	A	Flame photometry, Atomic absorption spectroscopy	CO4/CO6
	B	Differential spectrophotometry, ESR and NMR spectroscopy	CO4/CO6
	C	Thermogravimetric analysis, Fourier Transform Infra Red Spectroscopy	CO4/CO6
	Unit 5	**Principle and techniques of chromatography and microscopy**	
	A	Gas chromatography, Ion chromatography	CO5/CO6

	B	Thin layer chromatography, High Performance Liquid Chromatography			CO5/CO6
	C	Scanning Electron Microscopy and Transmission Electron Microscopy .			CO5/CO6
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	APHA- Standard methods for the examination of water and wastewater. 17th edn. American Public Health Association, American water works Association and Water pollution control Federation, Washington, USA.			
	Other References	Practical methods in ecology and Environmental science- Trivedy R.K, Goel P.K, Trisal C			

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	2	2	1
CO2	2	2	2	2	3	2	2	1
CO3	2	2	2	2	3	2	2	1
CO4	2	2	2	2	3	2	2	1
CO5	2	2	2	2	3	2	2	1
CO6	2	2	2	2	3	2	2	1

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 Template A1: Syllabus for Practical Subjects

School: SSBSR		**Batch 2023-2025**
Programme: M.Sc.		**Current Academic Year : 2024-25**
Branch: Water Resource and Environmental Management		**Semester I**
1	**Course Code**	**MWE151**
2	**Course Title**	Water Pollution & Monitoring Lab
3	Credits	2
4	Contact hours	0-2-0
	Course Status	Compulsory
5	Course Objectives	7. Provide an insight into various water quality parameters 8. . Enable student about water sampling techniques 9. Enable student to carry out experiments and data interpretation 10. Students gets expose to certain water quality analysis based instruments 11. Helps in analysis and comparison of results 12. Overall students will develop skill in water sampling techniques and water quality analysis.
6	Course Outcome	CO1 : pH and total dissolve solid determination in water samples CO2 : Analysis of CO_2 and alkalinity of the water samples CO3 : Estimation of Hardness and chloride content in water samples CO4 : Determination of dissolved oxygen in the water sample CO5 : Biological oxygen demand analysis of water sample CO6 : Overall understanding of various physical and chemical water quality parameters.
7	Course Description	This course gives exposure to students in terms of various qualitative and quantitative analytical techniques that helps in assessing water quality.

Scheme			Scheme of Examination		
L 0	P 2	T 0	Internal Assessment 60%	Mid Term Examination 0%	End Term Examination 40%

Course outline

This course gives exposure to students in terms of various qualitative and quantitative analytical techniques that helps in assessing water quality.

Course Evaluation

Attendance	None
Any other	--
References	
Text book	Vogel's "Textbook of quantitative Analysis", Pearson
Other References	
Softwares	

Week 1-3	**Unit 1**	**Practical related to** – pH and dissolve solids determination
	a)	Determination of pH of the various industrial, tap and ground water samples
	b)	Determination of total solids, dissolved solids and suspended solids in various industrial, tap and ground water samples
Week 4-7	**Unit 2**	**Practical related to –** CO_2 and alkalinity determination
	a)	Determination of CO_2 in pond water and ground water samples
	b)	Determination of alkalinity in water samples collected from local industries, tap and ground water.
Week 8-10	**Unit 3**	**Practical related to** – hardness and chloride determination

	a)	Determination of hardness in water samples collected from local industries, tap and ground water.
	b)	Determination of chloride in water samples collected from local industries, tap and ground water.
Week 11-12	**Unit 4**	**Practical related to –** dissolve oxygen determination by Winkler's method
		Determination of dissolve oxygen content of water samples collected from local industries, tap and ground water.
Week 13-14	**Unit 5**	**Practical related to –** biological oxygen demand determination
		Determination of biochemical oxygen demand of the water samples collected from local industries, tap and ground water.

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	3	1	2
CO2	2	1	1	1	2	2	1	2
CO3	2	3	2	1	2	2	1	1
CO4	2	3	2	2	3	3	1	2
CO5	2	2	2	2	3	3	1	1
CO6	2	2	2	2	3	2	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

PCM109: Technical Presentation

School: SSBSR		**Batch :2023-2025**	
Programme: M.Sc		**Current Academic Year: 2024-25**	
Branch: Water Resource and Environmental Management		**Semester: I**	
		PCM109	
		Technical Presentation	
		2	
		2-0-0	
		1. To be able to implement conventions and formats for technical documents like reports, proposals. 2.To present effective oral (technical or general) presentations (power point) 3.To develop the confidence to face an interview confidently and be able to write resume and cover –letter 4. To develop clarity, poise and confidence in Public Speaking and be able to participate in Group discussions	
		Students would be able to : **CO1:** Prepare Technical Documents effectively **CO2:** Implement the basic guideline for Technical Presentations **CO3 :** Document research work effectively **CO4:** Express oneself confidently during Public Speaking **CO5**: Able to present a self created ppt on technical themes **CO6**: Overall it helps the students in terms of public interaction and improve presentation skills.	
		TOPICS	**COs & POs**
	Unit 1	**Technical Documentation- I**	

	A	Proposals and Reports	CO1/CO6
	B	Letters and Emails	CO1/CO6
	C	Synopsis	CO1/CO6
	Unit 2	**Technical Documentation- II**	
	A	Dissertation	CO2/CO6
	B	Research techniques using Library and Internet	CO2/CO6
	C	Bibliography and Technical Paper writing	CO2/CO6
	Unit 3	**Oral Presentation Skills**	
	A	Public Speaking	CO3/CO6
	B	Oral Presentation of reports	CO3/CO6
	C	Defending the research topic	CO3/CO6
	Unit 4	**Technical Presentation-I**	
	A	Presentation: Approaches and methods	CO4/CO6
	B	Creating Power point presentations	CO4/CO6

	C	Does and Dont's of Technical Presentation	CO4/CO6
	Unit 5	**Technical Presentation-II**	
	A	Presenting Data Using graphics	CO5/CO6
	B	Guidelines for technical presentations	CO5/CO6
	C	Technical Presentations: Practical	CO5/CO6

	PCM109		
	Course work: 30%		
	Attendance	None	
	Homework	10 assignments, no weight	
	Quizzes	7 best quizzes (based on assignments); 20 marks	
	Lab	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 10 marks	
	Presentations	None	
	Any other	None	
	MTE	One, 20%	
	End-term Examination: One, 50%		
	References		
	Text book	3. Gerson, J. Sharon & Gerson, M. Steven, *Technical Writing : Process and Product*, Pearson Education, Third Impression 2009.	

		4. Steve Mandel. *Presentation skills by* Steve Mandel

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	2	2	1
CO2	1	1	2	1	2	2	2	1
CO3	2	2	2	2	3	3	1	2
CO4	1	1	1	2	2	2	2	2
CO5	1	1	2	3	2	2	2	2
CO6	2	2	1	3	2	2	2	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1 **Template: Syllabus for Theory Subjects**

School: SSBSR		**Batch : 2023-2025**
Programme: MSc		**Current Academic Year: 2024-25**
Branch: Water Resources and Environmental Management		**Semester: III**
1	**Course Code**	MWE201
2	**Course Title**	**Environmental Impact and Risk Assessment**
3	Credits	4
4	Contact Hours (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	1. Understanding of basic concepts, scope and purpose of EIA. 2. To provide knowledge on various methodologies employed for conducting EIA. 3. Provide a thorough concept on auditing and mitigation methods 4. Understanding of various elements of environmental risk assessment 5. Knowledge on emergency preparedness plan 6. Overall in-depth understanding of various components of EIA and risk assessment.
6	Course Outcomes	CO1: EIA origin, concept, plans and case studies CO2: Steps and methods of EIA CO3: Monitoring, Mitigation and audit CO4: Methods for risk assessment, management plans and case studies CO5: Occupational health hazards and policies and emergency preparedness

		CO6: Overall understanding of various components of EIA and risk assessment.	
7	Course Description	To develop an understanding about EIA concepts and Methodologies, risk assessment, emergency preparedness and management plan	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to EIA**	
	A	Definition , scope and development of EIA, purpose, objectives and basic principles of EIA,	CO1/CO6
	B	Types of EIA, Strategic environmental assessment(SEA); History of EIA in India - EIA Gazette Notification, 1994 & 2006	CO1/CO6
	C	Category A & Category B Projects, Prior Environment clearance(EC) requirements and stages, General EIA methodology	CO1/CO6
	Unit 2	**EIA methodology**	
	A	Screening- criteria, siting guidelines, prohibited zones; Scoping,	CO2/CO6
	B	Impact Identification -Checklists, matrices, qualitative methods, networks and overlay maps;	CO2/CO6
	C	Impact prediction- prediction models for impacts on air, water, soil and biological environment , Cost benefit analysis, Social impact assessment	CO2/CO6
	Unit 3	**Impact mitigation, monitoring & audit**	
	A	Mitigation methods and approaches, Appraisal, review, Decision making,	CO3/CO6
	B	Public consultation and participation, monitoring and auditing in EIA process, various forms of audit,	CO3/CO6
	C	Environment management plan (EMP), Environmental Impact Statement (EIS),	CO3/CO6

		Post-clearance Monitoring Protocol. Case studies: EIA of thermal power plant, mining.			
	Unit 4	**Environmental Risk assessment**			
	A	Sources of Environmental hazards, Environmental risk assessment framework			CO4/CO6
	B	Path to risk analysis; Perception of risk, risk assessment in different disciplines.			CO4/CO6
	C	Elements of Environmental Risk Assessment, Methods for Risk Assessment: HAZOP and FEMA methods,			CO4/CO6
	Unit 5	**Risk management**			
	A	Risk communication and Risk Perception, comparative risks,			CO5/CO6
	B	Risk based decision making, Risk based environmental standard setting, , Emergency Preparedness Plans,			CO5/CO6
	C	Design of risk management programs, risk based remediation.			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Environmental Management: Principles & Practices, Christopher J. Barrow, Routledge, 1999 - Business & Economics Handbook of Environmental Impact Assessment Vol. I and II, J. Petts, Blackwell Science, London, 2010.			
	Other References	Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997			

		John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.	

Pos COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	2	2	2	1	1
CO2	2	1	1	1	2	3	1	1
CO3	2	1	2	1	2	3	1	2
CO4	2	1	2	2	3	2	1	2
CO5	2	1	2	2	3	2	1	2
CO6	2	1	2	2	3	3	1	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

1.1. Template: Syllabus for Theory Subjects

School: SSBSR		**Batch : 2023-2025**	
Programme: MSc		**Current Academic Year: 2024-25**	
Branch: Water Resources and Environmental Management		**Semester: IV**	
1	**Course Code**	MWE202	
2	**Course Title**	**Water Purification and Treatment Processes**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	11. The concepts, and importance of wastewater treatment 12. Various techniques involved in wastewater treatment 13. Basics of designing of treatment plant 14. Various strategies for wastewater reuse and recovery 15. Suitable treatment plant for specific industries 16. Overall understanding of the basic concept and principles of water and wastewater treatment	
6	Course Outcomes	CO1.Objective, design and treatment of water and wastewater CO2.Types of wastewater treatment methods CO3. Biological treatment methods CO4. Advanced wastewater treatment methods CO5. Energy recovery and wastewater reuse and recovery CO6. Overall understanding of the basic concept of wastewater treatment and various techniques employed for its reclamation	
7	Course Description	To develop an understanding of the various methods of water and wastewater treatment and basics of designing a treatment plant.	
8	Outline syllabus		CO Mapping
	Unit 1	**Water treatment and Characterization of Wastewaters**	

	A	Objectives of wastewater treatment			CO1/CO6
	B	Design of waste water treatment			CO1/CO6
	C	Types of wastewater treatment plants			CO1/CO6
	Unit 2	**Waste Water Treatment**			
	A	Physical Treatment			CO2/CO6
	B	Chemical Treatment			CO2/CO6
	C	Membrane Filtration			CO2/CO6
	Unit 3	**Biological Wastewater Treatment, Recycling and Reusing**			
	A	Types of biological treatment			CO3/CO6
	B	Aerobic treatment			CO3/CO6
	C	Anaerobic treatment			CO3/CO6
	Unit 4	**Advanced Wastewater Treatment**			
	A	Nutrient removal			CO4/CO6
	B	Photocatalysis, ozonation and bioreactors			CO4/CO6
	C	Energy recovery			CO4/CO6
	Unit 5	**Wastewater Reuse and Recovery**			
	A	Treatment reuse and recovery			CO5/CO6
	B	Case studies of various industry types			CO5/CO6
	C	Zero liquid discharge			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Jain S.K. and Singh V.P. (2006). Water Resources Systems Planning and Management, Reed Elsevier India Pvt. Ltd., New Delhi.			
	Other References	Larry M. (2003). Urban Storm Water Management Tools, McGraw Hill Publication.			

POs COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3	2	2	2	2
CO2	2	2	3	2	2	3	2	2
CO3	2	2	2	3	2	3	1	2
CO4	2	2	2	3	3	2	1	2
CO5	2	2	2	3	3	2	1	2
CO6	2	2	3	3	3	3	2	2

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

Syllabus of Dissertation II

School: SSBSR		**Batch :2023- 2025**	
Programme: M.Sc.		**Current Academic Year: 2024-25**	
Branch: Water Resource and Environmental Management		**Semester: IV**	
1	Course Code	MWE-263	
2	Course Title	**Dissertation B**	
3	Credits	10	
4	Contact Hours (L-T-P)	0-0-20	
	Course Status	Compulsory/Elective	
5	Course Objective	1. To enhance the practical knowledge and result analysis skills. 2. To enable the students experience a real-life problem solving under the supervision of faculty members. 3. To prepare the students perform functions that demand higher competence in national/international organizations. 4. To train the students in scientific research. 5.Develop research/ experimentation skills as well as enhancing project writing and oral presentation skills 6. Inculcate team spirit and time management.	
6	Course Outcomes	CO1. Able to develop analytical skill. CO2. Cultivate the understanding of problem, study design, methodology/ experimentation, significance of reproducibility of results. CO3. Understanding of ethics of science and research for supporting higher studies. CO4. Learn effective project organizational skills along with discussions, result interpretation and paper writing. CO5. Able to analyse the results. CO6. Enhance the research skills.	
7	Course Description	This course will help to develop knowledge and research skills applicable to a career in environmental science.	

8	Outline syllabus				CO Achievement
	Unit 1	Introduction of subject/ literature search			CO1,CO6
	Unit 2	Concept building and study design			CO2,CO6
	Unit 3	Deep understanding about the research topic			CO3,CO6
	Unit 4	Data collection, Discussions and result interpretation			CO4, CO6
	Unit 5	Report writing			CO5, CO6
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References	Pubmed Search (NCBI) Review and research articles of Indexed Journals			

CO/PO	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	3	2	2	3
CO2	2	2	2	2	2	2	2	3
CO3	3	2	2	2	3	2	2	2
CO4	2	2	2	2	3	2	2	3
CO5	3	3	2	2	2	2	2	2
CO6	3	1	1	2	3	2	2	3

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)