Program and Course Structure

Department of Environmental Sciences

School of Basic Sciences and Research

M.Sc. (Water Resources and Environmental Management)

COURSE STRUCTURE AND SYLLABI
(As Per Guidelines of CBCS of UGC)

Programme code : SBR0701
Batch : 2018-2020

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. Transformative educational experience
2. Enrichment by educational initiatives that encourage global outlook
3. Develop research, support disruptive innovations and accelerate entrepreneurship
4. Seeking beyond boundaries

Core Values

- Integrity
- Leadership
- Diversity
- Community

1.2 Vision and Mission of the School

Vision of the School Achieving excellence in the realm of science to address the challenges of evolving society

Mission of the School

- To equip the students with knowledge and skills in basic and applied sciences
- Capacity building through advanced training and academic flexibility.
- To establish centre of excellence for ecologically and socially innovative research.
- To strengthen inter-institutional and industrial collaboration for skill development and global employability.

Core Values

- Integrity
- Leadership
- Diversity
- Community

1.3 Vision and Mission of Environmental Science Department

Vision of Environmental Science Department

The vision of the Department of Environmental Science is to produce educated community who will ensure clean, safe, secured and sustainable environment for all.

Mission of Environmental Science Department

1. Equipping students with the knowledge to environmental problem and their conservation.
2. Conducting need-based research on contemporary environmental issues and producing scholarly works in the field of environmental science.
3. Organizing national and international events (e.g. conferences/workshops/seminars/symposiums/training programs).
4. Creating public awareness on natural resources; and past, present and future environmental constraints on Earth.

Core Values

- Integrity
- Leadership
- Diversity
- Community

1.4.1 Writing Programme Educational Objectives (PEO)

PEO 1: To prepare students for advanced studies in water resources its management and conservation

PEO2: To help students to understand the concept and various advance techniques employed for wastewater treatment, reuse and recovery.

PEO 3: To expose the students to the practical aspects of physicochemical parameters of water by means of qualitative, quantitative and advance instrumentation techniques.

PEO 4: To develop the ability to communicate scientific and technical information in written and oral formats.

1.4.2 Mapping PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1:	3	2	2	2
PEO2:	3	3	2	3
PEO3:	3	2	2	2
PEO4:	2	3	3	2

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

1.4.3 Program Outcomes (PO's)

PO1: Gained knowledge, abilities and conceptual insight into various environmental processes, environmental toxicology and pollution issues its control measures and various environmental related policies and law.

PO2: Competency to work effectively and safely in a laboratory environment.

PO3: Developed communication skills, both written and oral, for specific audiences specialized in the area of hydrology, toxicology solid waste and wastewater treatment.

PO4: Acquired the skills of planning and frame strategies to deal with various types of pollution problem in general and treatment and detoxification of wastewater specifically.

PSO1 : Global level research opportunities to pursue Ph.D. programme in the related or allied area.

PSO2 : Become proficient in various advance waste water treatment techniques, toxicological studies, develop skill in drafting EIA report, and capable to understand and make use of GIS and remote sensing technology in various environmental related applications.

PSO3 : Qualitative and quantitative assessment of water and air quality through various instrumentation techniques.

PSO4 : The broad education necessary to understand and critically analyzing various pollution related problems in a global and societal context.

1.4.4 Mapping of Program Outcome Vs Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4
PO1	3	3	2	2
PO2	1	3	3	1
PO3	2	3	2	3
PO4	2	3	2	2
PSO1	2	2	2	3
PSO2	2	3	2	2
PSO3	2	3	3	2
PSO4	3	2	2	3

1. Slight (Low) **2. Moderate (Medium)** **3. Substantial (High)**

1.4.5 Program Outcome Vs Courses Mapping Table:

1.4.5.1 COURSE ARTICULATION MATRIX

Course	PO1	PO2	PO3	PO4
MWE101	3	1	2	2
MWE102	2	2	2	3
MWE103	2	1	1	2
MWE104	2	1	2	1
MWE105	2	1	2	2
MWE106	2	1	1	2
MWE107	2	1	3	2
MWE108	3	2	2	1
MWE109	3	1	2	2
MWE201	2	1	2	1
MWE202	3	2	2	3
MWE203	1	1	2	1
MWE204	2	2	2	3

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

Program Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2018-2020
TERM: I

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Co/Elective Pre-Requisite /Co Requisite	Type of Course 1) CC 2) AECC 3) SEC 4) DSE
				L	T	P			
THEORY SUBJECTS									
1.	30607	MWE-101	Water Resources & Management	4	-	-	4	Core	CC
2.	30608	MWE-102	Environmental Chemistry	4	-	-	4	Core	CC
3.	30609	MWE-103	Environmental Pollution	4	-	-	4	Core	CC
4.	30610	MWE-104	Hydrology	4	-	-	4	Core	CC
5.	15956	PCM601	Technical Presentation	2	0	0	2	AECC/SEC	AECC
Practical									
6.	30611	MWE-151	Water Pollution & Monitoring Lab	0	0	4	2	Core	CC
TOTAL CREDITS							**20**		

Program Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2018-2020
TERM: II

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Core/Elective Pre-Requisite/Co Requisite	Type of Course 1) CC 2) AECC 3) SEC 4) DSE
				L	T	P			
THEORY SUBJECTS									
1.	30557	MWE-105	Environmental Law, Policy & Audit	3	-	-	3	Core	CC
2.	30558	MWE-106	Climate Change & Sustainable Development	4	-	-	4	Core	CC
3.	30559	MWE-107	Environmental Toxicology	4	-	-	4	Core	CC
4.	30560	MWE-108	Glaciology & Climate Change	4	-	-	4	Core	CC
5.	30561	MWE-109	Remote Sensing & GIS	3	0	0	3	Core	CC
Practical									
6.	30611	MWE-152	Remote Sensing & GIS	0	0	4	2	Core	CC
7.	30804	CCU-401	Community Connect Course	0	0	4	2	SEEC	SEC
TOTAL CREDITS							**22**		

Program Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2018-2020
TERM: III

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Pre-Requisite/ Co Requisite	Type of Course 1) CC 2) AECC 3) SEC 4) DSE
				L	T	P			
THEORY SUBJECTS									
1.	30688	MWE-201	Environmental Impact & Risk Assessment	4	-	-	4	Core	CC
2.	30689	MWE-202	Water Purification & Treatment Processes	4	-	-	4	Core	CC
3.	30690	MWE-203	Research Methodology	4	-	-	4	Core	CC
4.	30691	MWE-204	Basics of Instrumentation	2	-	-	2	Core	CC
Practical									
5.	30692	MWE-261	Dissertation -1	0	0	8	4	Core	CC
6.	30693	MWE-252	Environmental Data Analysis	0	0	4	2	Core	CC
TOTAL CREDITS							**25**		

Program Structure
School of Basic Sciences & Research
M. Sc. Water Resource and Environmental Management
Batch: 2018-2020
TERM: IV

S. No.	Paper ID	Course Code	Course	Teaching Load			Credits	Core/Elective	Type of Course 1) CC 2) AECC 3) SEC 4) DSE
				L	T	P			
Practical									
1.		MWE-262	Dissertation-2		-	32	16	Core	CC
TOTAL CREDITS							**16**		

MWE101: **Water Resource and Management**

School: SBSR		**Batch : 2018-20**
Program: MSc		**Current Academic Year: 2018-19**
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)

MWE102 : Environmental Chemistry

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
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,	CO2/CO6

		Base, pH			
	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)

MWE 103: Environmental Pollution

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
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				

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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)

MWE 104: Hydrology

School: SBSR		**Batch : 2018-20**
Program: MSc		**Current Academic Year: 2018-19**
Branch: Water Resources and Environmental Management		**Semester: I**
1	Course Code	MWE104
2	Course Title	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 105 : Environmental Law, Policy and Audit

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
Branch: Water Resources and Environmental Management		**Semester: II**	
1	Course Code	MWE105	
2	Course Title	**Environmental Law, Policy 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 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. 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, 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 Mechanism**	
	A	Duties and responsibilities of citizens in environmental protection	CO4/CO6
	B	Important legislations related to environment: Provision of constitution of India regarding environment (article 48 A & 58A)	CO4/CO6
	C	Public liability Insurance Act. 1991	CO4/CO6
	Unit 5	**Environmental Audit**	
	A	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	
	Weightage Distribution	CA: 30% / MTE: 20% / ETE: 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 COs	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4
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)

MWE 106 : Climate Change and Sustainable Development

School: SBSR		**Batch : 2018-20**
Program: MSc		**Current Academic Year: 2018-19**
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 throw 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)

MWE 107: Environmental Toxicology

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
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 nanoparticles 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: Nanoparticles 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*	Ware, George M.(Ed) (2007) Reviews of environmental contamination and toxicology. Vol. 190: Continuation of residue reviews, Springer Publishers			
	Other References	Tatiya, Ratan raj (2013) Elements of industrial hazards: Health, safety, environment and loss prevention Taylor and Francis. Theodore, Louis (2012) Environmental health and hazard risk assessment: Principles and calculations, CRC Press Wong, Ming H. (Ed.) (2013) Environmental contamination: Health risks and ecological restoration, CRC press 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

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

MWE 108 : Glaciology and Climate Change

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
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,	CO2/CO6

		glacier table			
	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*	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 and David 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)

MWE 109 : Remote Sensing

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
Branch: Water Resources and Environmental Management		**Semester: II**	
1	**Course Code**	**MWE109**	
2	**Course Title**	**Remote Sensing**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1.Detailed understanding of various elements 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: Enable to validate the data using remote sensing tool 5: Application of remote sensing in environmental management 6: Overall this course helps in-depth understanding of various components of remote sensing and application in the management of environment.	
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: Validate the remote sensing data by field measurements CO5: Remote Sensing Application in Land Use, Human Settlement and environmental analysis CO6: Overall understanding of various components of remote sensing and application environmental 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	**Definition, types and concept 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	**Validation of Data**			
	A	Introduction to conventional field survey techniques			CO4/CO6
	B	Surveying Instruments			CO4/CO6
	C	Geopositioning-Basic Concepts,Positioning Types.			CO4/CO6
	Unit 5	**Remote Sensing Application in Environmental Science**			
	A	Agriculture, Soil, Forestry, Geosciences, Geology and Water Resources			CO5/CO6
	B	Environmental Analysis and Managements, Marine Science			CO5/CO6
	C	Land Use Application and Human Settlement Analysis			CO5/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Asrar Ghassem Theory and applications of optical remote sensing New York: John Wiley and Sons. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press. 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)

MWE 201: Environmental Impact Assessment

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
Branch: Water Resources and Environmental Management		**Semester: III**	
1	**Course Code**	**MWE201**	
2	**Course Title**	**Environmental Impact 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), Post-clearance Monitoring Protocol. Case studies: EIA of thermal power plant, mining.			CO3/CO6
	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)

MWE 202: Water Purification and Treatment Processes

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
Branch: Water Resources and Environmental Management		**Semester: III**	
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	1. The concepts, and importance of wastewater treatment 2. Various techniques involved in wastewater treatment 3. Basics of designing of treatment plant 4. Various strategies for wastewater reuse and recovery 5. Suitable treatment plant for specific industries 6. 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)

MWE 203: Research Methodology

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
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 Applications**			
	A	Spreadsheet tools			CO4/CO6
	B	Presentation tools			CO4/CO6
	C	Web search tools			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)

MWE 204: Basics of Instrumentation

School: SBSR		**Batch : 2018-20**	
Program: MSc		**Current Academic Year: 2018-19**	
Branch: MSc in Water Resources and Environmental Management		**Semester: III**	
1	**Course Code**	**MWE204**	
2	**Course Title**	**Basics of Instrumentation**	
3	Credits	2	
4	Contact Hours (L-T-P)	2-0-0	
	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	Physical analysis	CO2/CO6
	B	Chemical analysis	CO2/CO6
	C	Heavy metal quantification	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, NMR spectroscopy			CO4/CO6
	C	Mass spectroscopy, 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)