KOLHAN UNIVERSITY
CHAIBASA

SYLLABUS FOR FYUGP, NEP – 2020
(B. Sc. ENVIRONMENT AND WATER MANAGEMENT)

Designed By

Mala Mandhyan
NAAC & IQAC Coordinator
Mrs. KMPM Vocational College,
Jamshedpur

Anish Rani
Assistant Professor, B.Sc. EWM
Mrs. KMPM Vocational College,
Jamshedpur

Course Structure for Environment and Water Management

Under Four Year Under- Graduate Programme (FYUGP)

Prepared and Proposed By;

Ms. Mala Mandhyan, Department of EWM

Ms. Anish Rani, Department of EWM

SEMESTER	COURSE CODE	TITLE OF THE PAPER	CREDITS Theory + Practical
I	MJ - 1	Environmental pollution	3
	MJ - 1	Practical	1
	MN – 1A	Disaster Management and Industrial Safety	3
	MN-1A	Practical	1
	MDC – 1/2/3	Environmental Economics	3
II	MJ - 2	Ecology and Ecotourism	3
	MJ - 3	Environment & Society	3
	MJ - 2	Practical	2
	MN – 2A	Water Resource Management - I	3
	MN-2A	Practical	1
III	MJ - 4	Fluid Mechanics	3
	MJ - 5	Waste Management	3
	MJ-3	Practical	2
	MN – 1B	Sustainable Development	3
	MN-1B	Practical	1
IV	MJ - 6	Hydrology I	3
	MJ - 7	Air Pollution & Meteorology	3
	MJ - 8	Green Technologies	3
	MJ-4	Practical	3
	MN – 2B	Water Resource Management II	3
	MN-2B	Practical	1

V	MJ - 9	Hydrology II	3
	MJ - 10	Environmental Issues	3
	MJ - 11	Environmental Geosciences	3
	MJ-5	Practical	3
	MN – 1C	Environmental Conventions & Actions	3
	MN-1C	Practical	1
	IAP	Summer Internship	4
VI	MJ-12	Environment & Agriculture	3
	MJ-13	Environmental Legislation	3
	MJ-14	Environment & Energy Resource	3
	MJ-15	Environment Impact Assessment & Auditing	3
	MJ-6	Practical	4
	MN-2C	Water Resource Management III	3
	MN-2C	Practical	1
VII	MJ-16	Remote Sensing & GIS	3
	MJ-17	Environmental Economics	3
	MJ-18	Climate Change	3
	MJ-19	Agroforestry	3
	MJ-7	Practical	4
	MN-1D	Environmental Organizations	3
	MN-1D	Practical	1
VIII	MJ -20	Research Methodology & IPR	3
	MJ-8	Practical	1
	MN – 2D	Water Resource Management IV	3
	MN-2D	Practical	1
	RC /	Research Internship/ Field Work/ Dissertation	12
	AMJ 1	Green Marketing	3
	AMJ 2	Environmental Statistics	3
	AMJ 3	Entrepreneurship	3
	AMJ 1	Practical	3

SEMESTER I

Subject: B. Sc. Environment & Water Management
Course Code: MJ-01
Course: Environmental pollution

Learning Outcomes

1. Learner will be able to understand the effects of water and air pollution on the environment.
2. Learners will develop scientific attitude to abate environmental Pollution.
3. Learn will experience the real-world problem of thermal pollution and will acquire a set of values for environmental protection.
4. Learner will develop improved understanding of fresh water and marine pollution and will be able to develop scientific thinking about the measures to control water pollution.
5. Learner will be able to evaluate the relations among environment, human, and health.
6. Learners will enhance their knowledge about soil erosion and conservation.

Unit	Topics	Details	Credit hours
1	**Environmental Pollution**	Definition of Pollution, Pollutants, classification of pollutants	5
2	**Air Pollution**	Ambient Air quality: Sources and types of pollutants (Primary and Secondary) sources, National ambient air Quality standards, Urban air Quality.	5
3	**Noise Pollution**	Sources, frequency, intensity and permissible ambient noise Standards, noise measurements, Impact on life forms and humans: control measures.	10
4	**Freshwater and**	Sources of surface and groundwater Pollution; Sources & effects of inorganic pollutants, organic pollutants, sewage & domestic waste, detergents, biological pollutants. Water Quality parameters and standards.	10
5	**Marine Pollution**	Sources of marine pollution, oil spill, its effects and control.	5
6	**Thermal pollution**:	Introduction, sources, effects and control	3
7	**Soil pollution**	Definition, causes of soil pollution and land degradation; effects of soil pollution on environment, vegetation and other life forms, control strategies.	7
			45

References:

1. Environmental Chemistry, H. Kaur (Pragati Prakashan)
2. Environmental Chemistry, A. K. Dey (New Age International Publication)
3. A Basic Course in Environmental Studies, S.Deswal /A.Deswal (Educational and Technical Publication)
5. Solid Waste Management, K, Shashi Kumar (P.H.I Learning Private Limited)
6. Purohit, S.S. & R. Ranjan, R. 2007. Ecology ,Environment & Pollution [Agrobios (India), 2003]

Subject: B.Sc. Environment & Water Management
Course Code: MJ 1 - Practical

Practical / Field work	**Credit hours**
1. Determination of Physical Parameters of Freshwater Source (pH, Turbidity, Temperature) 2. Measurement of Noise level 3. Estimation of Soil pH. 4. Estimation of Soil moisture. 5. Determination of oil & grease 6. Plant a sapling & take care of it.	
	60

References:

1. Environmental Chemistry, H. Kaur (Pragati Prakashan)
2. Environmental Chemistry, A. K. Dey (New Age International Publication)

Subject: B. Sc. Environment & Water Management
Course Code: MN - 01
Course: Disaster Management and Industrial Safety.

Learning outcomes

1. Learners will be able to understand the basic concept of disaster(s) and disaster management, their significance and types.
2. Learners will develop the analytical skills to study relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. Learners will gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR).
4. Learners will be empowered with the awareness of institutional processes in the country for Disaster Management.

Unit	**Topic**	**Details**	**Credit hours**
1	**Disaster Management**	Introduction to Disaster, Types of Disaster, Risk and Vulnerability, Concept and scope of disaster management emergency management. Phases and professional activities – Mitigation, preparedness, response, recovery.	**10**
2	**Tools of Disaster management**	Emergency Management Information Systems (EIMS) organizations related to disaster management. International organizations – International Association of Emergency Managers, Red cross/Red crescent, United Nations, World Bank. National Organizations – National Institute of Disaster Management (NIDM), Emergency management and research institute (EMRI), National remote sensing institute (NIRS).	**14**
3	**Introduction to Industrial Safety**	Introduction to Industrial safety**,** Need for safety , the role of safety professional/officer, safety organizations, accidents, OSHA , Fire prevention, Chemical exposure & Industrial Hygiene, Industrial Noise, HAZOP analysis and Risk Assessment.	**12**
4	**Safety management and legislation**	Industrial safety management, safety audit, Safety education and training, Personal Protective Equipment's, Indian safety legislation.	**9**
			45
	Practical	1. Training on disaster management 2. Training on fire safety.	**30**

References:

1. Environment: Problems and Solutions, D.K. Asthana and Meera Asthana, S. Chand & Co., New Delhi
2. Environmental Hazards, Smith, K.Routledge, London.
3. Deshmukh. L.M., Industrial Safety Management, 3rd Edition, Tata McGraw Hill, New Delhi, 2008.
4. Jain.R.K and Sunil Rao, Industrial Safety, Health and Environmental Management Systems, 1st Edition, Khanna Delhi 2006.
5. Dr.KU.Mistry - Fundamentals of Industrial Safety and Health, Sidharth Prakashan, Ahmedabad.
6. Grimaldi and Simonds, Safety Management, AITES Publishers, New Delhi (2001)

SEMESTER II

Subject: B.Sc. Environment & Water Management
Course Code: MJ-02
Course: Ecology and Ecotourism
Learning Outcomes:

1. Learners will be able to develop the basic understanding of ecosystem and its structural and functional aspects.
2. Learners will be able to explore the interconnectedness among all the biotic and abiotic components of environment and the dynamic nature of the ecological processes in maintaining equilibrium in nature.
3. Learners will be able to contextualize tourism within broader cultural, environmental, political and economic dimensions of society.
4. Learners will be able to apply principles of sustainability to the practice of tourism in the local and global context.

Unit	Topic	Details	Credit hours
1	**Environment And its components**	Atmosphere Introduction, composition and structure of Atmosphere. **Hydrosphere**: Introduction, Water resources, Hydrological cycle. **Lithosphere**: Introduction, Landforms, Rocks (types and cycle), Soil profile. Biosphere: Introduction, Animal Association interactions.	15
2	**Ecology**	**Ecology is an interdisciplinary science.** **Ecology: Definitions, Organizational Levels of Ecology Systems.** . **Ecosystem:** Ecosystem structure, Ecological pyramids, Ecosystem function, Productivity of the ecosystem, food chains, food web, energy flow in ecosystems. Ecological succession: cases of succession, stages of succession, types of succession, Process of succession. Biogeochemical cycles (carbon cycle, nitrogen cycle, phosphorous cycle, oxygen cycle, Sulphur cycle). **Ecosystem**: Forest ecosystem, grassland ecosystem, aquatic ecosystem, Cropland ecosystem.	15
3	**Ecotourism**	History of Ecotourism, Definition, concept and objective, Types of ecotourism, Characteristics and functions of Ecotourism Economic and environmental effects of ecotourism, Ecotourism and sustainability, Ecotourism organizations, Ecotourism in India.	15
			45

References:

1. Ecology and Environment, P.D. Sharma (Rastogi Publication).
2. Fundamentals of Ecology, E. P. Odum, (Cengage Learning India Private Ltd.).
3. Concepts of Ecology, Edward J. Kormondy (Pearlson Prentice Hall).
4. Fundamental of Ecology, M.C. Das (Tata McGraee Hill).
5. Essentials of Ecology and Environmental Science, S.V.S Rana (PHI Learning Private Ltd.).
6. Ecotourism and Sustainable Tourism, Meenakshi Thakur (Omega Publications).
7. Ecotourism, Jagbir Singh (I.K. International Private Ltd.).

Subject: B.Sc. Environment & Water Management
Course Code: MJ-03
Course: Environment & Society
Learning Outcomes:

1. The learners will be able to examine the relationship between the environment and society and enabling them to understand and appreciate the role played by environment, society, and, their interface in shaping environmental decisions.
2. The learners will be enabled to think critically on environmental issues.
3. Learners will be able to differentiate possible future implications of societal approaches to the environment.

UNIT	Topics	Details	Credit hours
1	Introduction	Social and cultural construction of 'environment'; environmental thought from historical and contemporary perspective in light of the concepts of Gross Net Happiness and Aldo Leopold's Land Ethic.	8
2	Development-environment conflict	Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: Discussion on Project Affected People (PAPs).	8
3	Urbanization and environment	Production and consumption-oriented approaches to environmental issues in Indian as well as global context; impact of industry and technology on environment; urban sprawl, traffic congestion and social-economic problems; conflict between economic and environmental interests.	10
4	Environment and social inequalities	Inequalities of race, class, gender, region, and nation-state in access to healthy and safe environments; history and politics surrounding environmental, ecological and social justice; environmental ethics, issues and possible solutions.	11
5	Community participation	Case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan); corporate responsibility movement; appropriate technology movement; Role played by NGOs; environmental education and awareness.	8
			45

References:

1. Chokkan, K.B., Pandya, H. &Raghunathan, H. (eds). 2004. *Understanding Environment*. Sagar Publication India Pvt. Ltd., New Delhi.
2. Elliot, D. 2003. *Energy, Society and Environment, Technology for a Sustainable Future*. Routledge Press.
3. Guha, R. 1989. *Ecological change and peasant resistance in the Himalaya*. Unquiet Woods, Oxford University Press, Delhi.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 2 - Practical

Practical / Field work	**Credit hours**
1. Determination of frequency, density and abundance of different plant community by quadrat method. 2. Study of Effect of tourism on bats in bat island in Jayanti Sarovar, Jamshedpur. 3. Study of Effect of tourism on elephants of Dalma Wildlife Sanctuary. 4. Analysis of Ecotourism in India. 5. Report & presentation on role of Indian Culture & Society on Environment Protection. 6. Create awareness in your community on any relevant environmental issue. 7. Study of role of urbanisation on various components of Environment. 8. Plant a tree & take care of it.	
	60

References:

1. Ecology and Environment, P.D. Sharma (Rastogi Publication).
2. Ecotourism and Sustainable Tourism, Meenakshi Thakur (Omega Publications).
3. Ecotourism, Jagbir Singh (I.K. International Private Ltd.).
4. Chokkan, K.B., Pandya, H. &Raghunathan, H. (eds). 2004. *Understanding Environment*.

Course Code: MN 2A
Course: Water Resource Management - I
Learning Outcomes:

1. Learner will be able to gain working knowledge of laboratory Procedures and sampling strategies required to ensure adequate water quality to ensure public health.
2. Learner will be able to learn Sample collection procedures & Lab Practices.
3. Learner will be able to gain knowledge water quality standards.
4. Learner will be able to understand the principles and the practical approaches and techniques required to effectively monitor the chemical elements of water quality.
5. Learner will be able to build understanding of water quality parameters and their relation to environment.

Unit	Topics	Details	Credit hours
1	**Introduction**	Water resources and planning, Status of water quality in India, rural water, urban water. Self-purification of natural rivers, zones of pollution in a river stream. Role of soil in water purification.	8
2	**Water quality Parameters**	Physical: turbidity, colour, pH. Chemical: Total solids, conductivity, alkalinity, acidity, hardness, chlorides, fluorides, carbonates in water, Total nitrogen by Kjeldahl method, nitrates, nitrites, phosphates, DO, BOD and COD.	16
3	**Analytical Methods**	Titrimetry, Chromatography, Spectrophotometery, Flame photometry.	13
4	**Water Quality Standard**	Drinking water standard**,** Industrial standards**,** Irrigation standard**,** Stream standard**,** Effluent standard.	8
			45
	Practical	➢ Determination of chemical parameters of water-total solids, conductivity, alkalinity, acidity, chlorides, fluorides, hardness, carbonates in water, Total nitrogen by Kjeldahl method, nitrates and phosphates.	
			30

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers)
2. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House) Environmental Chemistry, H. Kaur (PragatiPrakashan)
3. Environmental Chemistry, A.K.Dey (New Age International Publication)
4. Chemical and Biological Methods for Water Pollution Studies**,** R.K. Trivedy, P.K. Goel (Environmental Publications)

SEMESTER III

Subject: B.Sc. Environment & Water Management
Course Code: MJ-04
Course: Fluid Mechanics
Learning Outcomes:

1. Learner will be able to understand the properties of fluids
2. Learner will be able to concepts of continuity equation, Bernoulli's equation and turbulence.
3. Learner will be able to analyze laminar and turbulent flows.
4. Learner will be able to understand measurement of discharge in open & closed channels.

Unit	Topic	Details	Credit hours
1	**Introduction to Fluid Mechanics**	Properties of Fluid: Density, Specific Weight, Specific volume, Specific Gravity, Viscosity, Surface tension and Capillarity, fluid pressure, measurement of pressure, manometers.	**10**
2	**Kinematics of Flow**	Types of Fluid Flow: Steady and Unsteady flow, Uniform and non-uniform flow, Laminar and turbulent flow, Compressible and Incompressible flow, Rotational and irrotational flow, One, two and three dimensional flow. Rate of flow of Discharge, Continuity Equation.	**8**
3	**Open Channel Flow**	**C**lassification of flow in open channel**,** Discharge through open channel by Chezy's formula, flow through notches and weirs, Economical sections.	**10**
4	**Pipes Flow**	Introduction, Bernoulli's Equation, Limitation of Bernoulli's Equation, Application of Bernoulli's Equation (Venturimeter, Orifice meter, Pitot tube)Loss of Head in Pipes, Darcy's Formula for loss of Head in Pipes, Chezy's Formula for loss of Head in Pipes.	**12**
5	**Pumps**	Introduction**,** Centrifugal pump**,** Reciprocating Pump, Maintenance of pumps.	**5**
			45

References:

1. A text of Fluid Mechanics and Hydraulic Machines, R. K. Bansal (Laxmi Publication)
2. Fluid Mechanics and Hydraulic Machines, Dr. R. K. Mandal (Laxmi Publication)
3. Water Supply Engineering, S. K. Garg (Khanna Publishers)

Subject: B.Sc. Environment & Water Management
Course Code: MJ 05
Course Core: Waste Management
Learning outcomes:

1. Learners will be able to understand the effects of different types of plastics and can play an important role in reducing plastic pollution and increasing recycling rates for a healthier environment.
2. Learners will be able to learn basic concepts of solid waste and hazardous waste management, beginning from source generation to waste disposal in a system of municipality organizational structure.
3. Learners will be able to 'coordinate and monitor issues relating to the handling and disposal of fly ash and associated issues.
4. Learners will be able to Know about the environmental impacts of e-waste, construction waste, and also learn different measures proposed for their disposal and management.

Unit	Topics	Details	Credit hours
1	**Solid Waste**	Definition, Types Sources, Solid waste characteristics, solid, solid waste collection and transportation; effects and control. Solid waste processing and recovery- Recycling, Recovery and reuse, Disposal and its management.	10
2	**Hazardous Wastes**	Introduction, types, characteristics and health impacts. Hazardous waste management. Treatment methods	6
3	**E waste**	Definition, types, sources, environmental impacts and management.	6
4	**Fly Ash**	Sources, composition and utilization	5
5	**Plastic pollution**	Introduction, its decomposition and persistence, environmental impacts and management.	10
6	**Construction Waste**	Definition, causes of waste, management strategies.	8
			45

References:

1. Solid waste management- Present and future challenges, Jagbir Singh, Ramanathan, Al., (2019). I.K. International Publishing House Pvt. Ltd., India.
2. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA
3. E-Waste Management: Challenges and Opportunities in India, Varsha Bhagat Gangly, Routledge Publication India; First Edition (30 September 2021); Taylor & Francis Books India Pvt. Ltd.
4. Environmental Pollution and Management 1/E by Chauhan Avnish, I K International, IK International Publication.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 3 - Practical

Practical / Field work	**Credit hours**
1. Determination of surface tension by capillary rise method. 2. Determination of Viscosity of water by capillary flow method. 3. Measurement of discharge in an open laboratory channel by area-velocity method with rectangular notch using a pitot tube. 4. Measurement of discharge in an open laboratory channel by area velocity method with v- notch using a current meter. 5. One week training in e waste/ plastic waste management. 6. Visit to solid waste management plant. 7. Plant a sapling & take care of it.	
	60

References:

1. A text of Fluid Mechanics and Hydraulic Machines, R. K. Bansal (Laxmi Publication)
2. Fluid Mechanics and Hydraulic Machines, Dr. R. K. Mandal (Laxmi Publication)
3. Solid waste management- Present and future challenges, Jagbir Singh, Ramanathan, Al., (2019). I.K. International Publishing House Pvt. Ltd., India.
4. Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA
5. E-Waste Management: Challenges and Opportunities in India, Varsha Bhagat Gangly, Routledge Publication India; First Edition (30 September 2021); Taylor & Francis Books India Pvt. Ltd.

Subject: B.Sc. Environment & Water Management
Course Code: MN 1B
Course: Sustainable Development
Learning outcomes:
1. Learners will be able to have a grounded understanding of sustainability and how systems are interrelated.
2. Learners will develop a capacity to address 21st century environmental as well as cultural challenges.
4. Learners will be able to develop the means to indicate how sustainability issues are impacting their immediate social, economic, and political environment.
5. Learners will be able to recognize and advocate for civic engagement and inclusive practices for applying sustainability principles to local issues.
6. Learners will be able to learn ethical principles of sustainability and how they are connected to practical issues of social justice, and environmental-economic equity.

Unit	Topics	Details	Credit hours
1	**Introduction to Sustainable Development**	Introduction, United Nations and a World in Order, Model of Growth and Development, Need for Change, Definition of Sustainability, Transition from MDGs to SDGs. The Role of UN and the Need for SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs.	12
2	**Various aspects of SDG**	Distinction between Development and Sustainable Development, Circular economy, Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification. Identifying probable interventions for SD	12
3	**Sustainable Development Goals**	Framework and Structuring of Seventeen SDGs, SDG 1: No Poverty, SDG 2: Zero Hunger, SDG 3: Good Health and Well-being, SDG 4: Quality Education, SDG 5: Gender Equality, SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 8: Decent Work and Economic Growth, SDG 9: Industry, Innovation and Infrastructure, SDG 10: Reduced Inequality, SDG 11: Sustainable Cities and Communities, SDG 12: Responsible Consumption and Production, SDG 13: Climate Action, SDG 14: Life Below Water, SDG 15: Life on Land, SDG 16: Peace and Justice Strong Institutions, SDG 17: Partnerships to achieve the Goal.	21
			45
	Practicals	➢ Make a report on Sustainable Entrepreneurship. ➢ Study of role of NGOs in achieving sustainable development goals. ➢ Make a report on current challenges in sustainable development. ➢ Practice community engagement through writing, speaking, and other forms of public discourse. ➢ Exemplify effective agents of change in individual, local, and global contexts.	30

References:

1. Sustainable development goals: An Indian Perspective, Somnath Hazra & Anadya Bhukta.
2. Introduction to Sustainable Development, Martin J. Ossewaarde, Sage Publications.
3. Issues and trends in Education for Sustainable Development: UNESCO Publication
4. Digital Pedagogy for Building Peaceful & Sustainable Societies: Blue Dot Publication
5. OECD (2019), Sustainable Results in Development: Using the SDGs for Shared Results and Impact, OECD Publishing, Paris, https://doi.org/10.1787/368cf8b4-en.
6. https://www.un.org/sustainabledevelopment/

SEMESTER IV

Subject: B.Sc. Environment & Water Management
Course Code: MJ-06
Course: Hydrology I
Learning Outcomes:
1. Learners will be able to understand the fundamentals of hydrology, hydrological cycle and water runoff.
2. Learners will be able to acquire knowledge on the basic terms and measurements about precipitation, evaporation and evapotranspiration.
3. Learners will be able to demonstrate the ability to apply the scientific method and critical thinking in measuring and analysing the losses and know the water abstraction from the rainfall.
4. Learners will be able to explain measurement and prediction methods.

Module	Topic	Details	Credit hours
1.	**Hydrology**	Introduction, hydrological cycle, Hydrological budget.	**5**
2.	**Precipitation**	Types, forms, characteristics of precipitation falling in India, measurement of precipitation- non recording and recording type gauge (tipping bucket, weighing type and float recording gauges).	**8**
3.	**Infiltration**	Infiltration, Infiltration rate, process of infiltration, Factors affecting infiltration, Measurement of infiltration	**8**
4.	**Water Runoff**	Introduction, Rainfall Runoff Process, Surface runoff and runoff	**7**
5	**Abstraction from rainfall**	**Evaporation Losses** Interception Losses, Evaporation Losses from water surfaces, Dalton's Law, factors effecting evaporation losses, measurement of evaporation by pan measurement, **Transpiration Losses**: Transpiration and its measurement by Phytometer method, evapotranspiration and its measurement by Lysimeter. **Land Evaporation losses** : Evaporation Opportunity	**8** **7** **2**
			45

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers).
2. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House).
3. Hydrology, H.M. Raghunath (New Age International Publication).
4. Engineering Hydrology, K. Subramanya (McGraee Hill Company).

Subject: B.Sc. Environment & Water Management
Course Code: MJ-07
Course: Air Pollution & Meteorology
Learning Outcomes:

1. Learners will be able to gain knowledge of transfer & dispersion of air pollutants.
2. Learners will develop ability to analyze the effects on a global scale, such as ozone hole & global warming.
3. Learners will be able to identify the essential components of the air pollution phenomenon, types, correlated effects, transformation processes and integrated approaches in controlling.
4. Learners know examples of industrial gaseous emission control devices, technologies and system schematic design.

UNIT	Topics	Details	Credit hours
1	**Air Pollution**	Introduction, definition, pollution and contamination, Air quality standards, emission standards. Sources of air pollution, Classification of air pollution.	5
2	**Air Pollutants**	Sources, sinks, effects and control of Carbon dioxide, Carbon monoxides, NOx, SOx, particulate matter, hydrocarbons.	10
3	**Global environment problems**	Smog, Global warming, climate change, Ozone layer depletion, Acid rain, Indoor Air Pollution.	15
4	**Meteorology**	**Meteorological parameters**, atmospheric stability, mixing height, Temperature inversion. Lapse rate **Methods of measurement**: Wind direction and speed, wind rose diagram, temperature, solar radiation. Plume behaviour, Dispersion of pollutants. Human activity and meteorology.	15
			45

References:

1. Environmental Chemistry, H. Kaur (PragatiPrakashan)
2. Environmental Chemistry, A.K.Dey (New Age International Publication)
3. A Basic Course in Environmental Studies, S.Deswal/ A.Deswal (Educational and Technical Publication)
4. Air Pollution, M. N. Rao (Tata McGraw Hill)

Subject: B.Sc. Environment & Water Management
Course Code: MJ-08
Course: Green Technologies
Learning Outcomes:
1. Learners will be able to introduce themselves to the concept of green technology, its goals and advantages.
2. Learners will be able to highlight potential role of green technologies in realizing the goal of sustainable development and focuses on community participation to tap the economic benefits associated with switching to green technologies.

UNIT	Topics	Details	Credit hours
1	**Introduction**	Definition and concepts: green technology, green energy, Principles of green chemistry. 3 R's of green technology: Cleaner development mechanism, carbon credits, carbon trading, carbon sequestration.	15
2.	**Green infrastructure, planning and economy**	Green buildings; LEED certified building; Eco-mark certification, Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities, public transportation for sustainable development, green belts; Introduction to UNEP's green economy initiative.	15
3	**Green future**	Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies; green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.) Role of advancement in science in developing environmentally friendly technologies.	15
			45

References:

1. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford University Press.
2. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw Hill Publications.
3. Baker, S. 2006. Sustainable Development. Routledge Press.
4. Thangavel, P. & Sridevi, G. 2015. Environmental Sustainability: Role of Green Technologies. Springer Publications.
5. Woolley, T. & Kimmins, S. 2002. Green Building Handbook (Volume 1 and 2). Spon Press.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 4 - Practical

Practical / Field work	**Credit hours**
1. Report on global environmental problems (any one) 2. Determination of meteorological parameters (Temperature, wind speed and direction) 3. Make a working model on rain gauge. 4. Power point presentation on green technologies & its implications. 5. Plant a sapling & take care of it.	
	90

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers).
2. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House).
3. Environmental Chemistry, H. Kaur (PragatiPrakashan)
4. Environmental Chemistry, A.K.Dey (New Age International Publication)
5. Anastas, P.T. & Warner, J.C. 1998. Green Chemistry: Theory & Practice. Oxford University Press.
6. Arceivala, S.L. 2014. Green Technologies: For a Better Future. Mc-Graw Hill Publications.

Subject: B.Sc. Environment & Water Management
Course Code: MN 2B
Course: Water Resource Management II (Water Treatment)

Learning Outcomes:

1. Learners will be able to understand the characteristics of water and its measurement.
2. Learners will get the detailed information on water treatment processes.
3. Learners will be able to witness the actual water treatment process in water treatment plant to gain practical understanding of the course.

Unit	Topic	Details	Credit hours
1	**Water Treatment**	Sources of water, necessity of treatment.	2
2	**Screening**	Course and fine screen.	3
3	**Plain Sedimentation**	Theory of Sedimentation, Sedimentation Tanks.	4
4	**Sedimentation aided with Coagulation**	Chemicals used for Coagulation**,** Constituents of coagulation Sedimentation plant.	6
5	**Filtration**	Theory of filtration**,** Types of filters and their Classification.	10
6	**Disinfection**	Methods of Disinfection (minor & major)	10
7	**Water Softening**	Methods of removing Temporary Hardness**,** Methods of removing Permanent Hardness.	10
			45
	Practicals	1. Determination of DO. 2. Determination of Ca and Mg hardness. 3. Determination of optimum coagulation dose through jar testing. 4. Determination of Chlorine demand for disinfection of water. 5. Visit to water treatment plant and make a report.	
			30

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers).
2. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House).

SEMESTER V

Subject: B.Sc. Environment & Water Management
Course Code: MJ-09
Course: Hydrology II

Learning outcomes:
1. Learners will be able to understand basic terminology about groundwater.
2. Learners will be able to know different methods and importance of rain water harvesting.
3. Learners will be able to know the basic fundamentals of Groundwater distribution, flow, storage and yield.
4. The learners will be equipped with the concepts of Groundwater which would help them to take better decisions in groundwater uses and management.

Unit	Topic	Details	credit hours
1	**Surface water Hydrology**	Sources of water, Intakes for collecting surface water and its types, Types of Conduits for transporting water	**10**
2	**Distribution system**	Introduction, layouts, methods, reservoirs- function and types, storage capacity, leakage detection, its prevention and rectification.	**10**
3	**Ground water hydrology**	Introduction, occurrence, zones, velocity and movement, Aquifers and its types, concept of groundwater yield, specific yield and specific retention. **Forms of underground sources:** infiltration galleries, infiltration wells, springs, Wells- Open and tube wells. **Tubewells-** Introduction, types, boring of tubewells, its failure and maintenance.	**15**
4	**Water resource management**	Inter basin transfer of water, waste water reuse, desalination, Rain water harvesting.	**10**
			45

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers)
2. Water Supply Engineering. S.K. Garg (Khanna Publishers)
3. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House)
4. Engineering Hydrology, K. Subramanya (McGraee Hill Company)
5. Water Supply, Water Disposal and Environment Engineering, A.K.Chatterjee (Khanna Publishers)

Subject: B.Sc. Environment & Water Management
Course Code: MJ-10
Course: Environmental issues
Learning Outcomes:

1. Learners will be able to outline the important local and regional environmental issues.
2. Learners will be able to compare the practices followed for solution of environmental issues in different societies and relate them with national practices.
3. Learners will be able to discuss reasons, practices behind important environmental issues at the global, national and local level.

Unit	Topics	Details	Credit hours
1.	**Global Environmental Issues.**	Ozone Layer Depletion, Acid Rain and Its Spread, Desertification and Expansion, Greenhouse Effect and Global Warming, Climate Change and Current Issues, Energy Crisis and Issues, Species Loss and Human Impacts, Food Crisis and Population, Biological Warfare and Future Threats, Eco-Terrorism and Issue.	15
.	**Environmental Issues in India**	Municipal Solid Wastes and Conflicts, Issues with Slums and Environmental Health, Droughts and Floods in India, Eutrophication Issues of Major Aquatic Ecosystems.	10
2.	**National Efforts to Curb Issues**	Citizen Participation in Environmental Decisions, Environmental Information System Network, Right to Information and Environment Protection, Ganga Action Plan and Recent Programmes, Interlinking of Rivers: Plan and Implementation, Strategies under Disaster Management Plan, Wasteland Development Programme	10
3	**Environmental Issues and Genesis of Movements**	Genesis of Environmental Movements in India, Narmada Bachao Andolan and Outcome, Developments in Save Silent Valley Movement, Dam Conflict and Current Situation, Indian Case Studies to Solve Issues, Environmental Movements in Developed Countries.	10
			45

Reference Books

1. Environmental Science by Santra S. C., New Central Book Agency (P) Limited (2001).
2. Environmental Chemistry by Sharma B. K., Goel Publishing House, Meerut (1997).
3. Environmental Chemistry by De A. K, New Age International (P) Limited (2017).
4. Environmental Issues in India: A Reader by Rangarajan, Pearson Education India .
5. Climate Change and Environmental Issues by Singh N. and Thakur A. K., The EnergyResource Institute (TERI).
6. Development, Ecology and Climate Change: Issues and Challenges: Volume 1 by Mohinder Kumar Slariya Createspace Independent Publication.
7. Environmental Studies and Ethics by Gouri Suresh, U. S. Hampannavar I K International Publishing House Pvt. Ltd.
8. Environmental Issues in India: A Reader, by Rangarajan, Pearson Education India.
9. Climate Change and Environmental Science by S. C. Bhatia Agrotech Press.

Subject: B.Sc. Environment & Water Management
Course Code: MJ-11
Course: **Environmental Geosciences**

Learning Outcomes:

1. Learners will be able to understand major geological processes occurring in the near surface of the Earth.
2. Learners will develop knowledge on how environmental geological processes impact humans and society.
3. Learners will be able to know how the anthropogenic activities modify natural environmental processes.

Unit	Topic	Details	Credit hours
1.	**Introduction**	Origin of earth. Layers of earth, landforms.	10
2.	**Geoscience**	Earth's thermal environment and seasons. Coriolis force, pressure gradient force, frictional force, geo-strophic wind field, gradient wind. Climates of India, western disturbances, Indian monsoon, droughts, El Nino, La Nina. Concept of residence time and rates of natural cycles. Geophysical fields. Weathering including weathering reactions, erosion, transportation and deposition of sediments, Soil Profile Rock cycle	15
3.	**Geological Hazards**	**Floods:** Causes nature and frequency of flood, flood hazards, urbanization and flooding, Flood mitigation. **Earthquakes:** Causes intensity and magnitude of earthquakes, geographical distribution of earth zones and seismic waves, nature of destruction, protection from earthquake hazards. **Volcanism:** Nature, extend ad causes of volcanism, volcanic materials and pollution, geographical distribution of volcanoes, adverse effects, mitigation measures. Environmental impacts of mining, surface blasting etc.	20
			45

References:

1. Keller, E.A. Environmental Geology, Upper Saddle River, N.J, Prentice- Hall
2. Valdiya, K.S.: -Environmental Geology- Indian Context (Tata McGraw-Hill,1987)
3. Smith, K.: -Environmental Hazard: Assessing risk and reducing disaster. London: Routledge.
4. Savindra Singh, Physical geography (Prayag Pustak Bhawan, Allahabad)
5. Savindra Singh, Environmental Geography, (Prayag Pustak Bhawan, Allahabad)

Subject: B.Sc. Environment & Water Management
Course Code: MJ 5 - Practical

	Practical /Field Work	**Credit hours**
1	Demonstration of layout of distribution system.	
2	Detection of leakage in pipeline by pressure meter/ flow meter.	
3	Study of flood prone area in India;	
4	Study of major Dams of India and their impact on river systems	
5	Case studies of Urban flood.	
6	Make a report on mining areas of Jharkhand.	
7	Prepare a report on the environmental issues of a specific city.	
8	Presentation showcasing approaches in Human Development Success Stories of Mitigating Environmental Issues.	
9	Plant a sapling and take care of it.	
		90

References:

1. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers)
2. Water Supply Engineering. S.K. Garg (Khanna Publishers)
3. Keller, E.A. Environmental Geology, Upper Saddle River, N.J, Prentice- Hall
4. Valdiya, K.S.: -Environmental Geology- Indian Context (Tata McGraw-Hill,1987)
5. Environmental Science by Santra S. C., New Central Book Agency (P) Limited (2001).
6. Environmental Chemistry by Sharma B. K., Goel Publishing House, Meerut (1997).

Subject: B.Sc. Environment & Water Management
Course Code: MN-1C
Course: Environmental Conventions & Actions
Learning Outcomes:

1. Learners will understand environmental conventions and ethical reflection regarding environmental problems in local, regional, national, and global communities
2. Learners will be prepared for careers and environmental stewardship.
3. Learners will be equipped with actions taken for the environmental protection in India.
4. Learners will develop sense to serve environment as a resource, through service, outreach and engagement.

Unit	Topics	Details	Credit hours
1	**Important Conventions / Conference**	Stockholm Conference Rio summit Montreal protocol & Kigali Agreement Basel Convention Kyoto protocol Ramsar convention Stockholm Conference The Three Rio Conventions Cartagena Convention Rotterdam Convention Convention on International Trade in Endangered Species	23
2	**Environmental protection in India**	National Solar Mission National Afforestation Program Namami Gange Programme National Water Mission National Clean Air Program (NCAP) National Mission for Enhanced Energy Efficiency (NMEEE) National Mission on Sustainable Habitat National Mission for Sustaining the Himalayan Ecosystem (NMSHE) National Bio-Energy Mission	22
	Practical	Review on the book Silent Spring by Rachel Carson.	30

References:

1. The Ecology & Environment Compendium, Disha Publications.
2. International Organizations and Environmental Protection, Wolfram Kaiser & Jan-Henrik Meyer, Kindle Edition.
3. Ecology & Environment, P. D. Sharma, Rastogi Publications.

SEMESTER VI

Subject: B. Sc. Environment & Water Management
Course Code: MJ 12
Course: Environment & Agriculture

Learning Outcomes

1. Learners will know the role of environment in the current practice of agriculture and concerns of sustainability, especially in the context of climate change and emerging global issues.
2. Learners will develop know how of ecological context of agriculture and its concerns.

Unit	Topics	Details	Credit hours
1	Environmental Concerns	Environmental basis for agriculture and food, Land use and landscape changes, Water quality issues, Changing social structure and economic focus, Globalization and its impacts, Agro ecosystems.	8
2	Environmental Impacts	Irrigation development and watersheds, mechanized agriculture and soil cover impacts, Erosion and problems of deposition in irrigation systems, Agricultural drainage and downstream impacts, Agriculture versus urban impacts.	9
3	Climate Change	Global warming and changing environment, Ecosystem changes, Changing blue-green-grey water cycles, Water scarcity and water shortages, Desertification.	8
4	Ecological diversity & Agriculture	Ecological diversity, wild life and agriculture. GM crops and their impacts on the environment. Insets and agriculture – Pollination crisis. Ecological farming principles, Forest fragmentation and agriculture. Agricultural biotechnology concerns.	10
5	Emerging Issues	Global environmental governance, alternate culture systems. Mega farms and vertical farms. Virtual water trade and its impacts on local environment. Agricultural environment policies and its impacts. Sustainable agriculture.	10
			45

References:

1. M. Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House.
2. Dr. S. Anand Kumar Varma, Environment and Agriculture, Sri Krishna Hitech Publishing Company.
3. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service.
4. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development.
5. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 13
Course: Environmental Legislation
Learning Outcomes:

1. Learners will be able to develop understanding regarding various legislation on environmental law
2. Learners will be able to develop fundamental understanding of environmental law and its policy.
3. Learners will be able to review the Environmental ethics and justify challenges associated with it.

Unit	Topics	Details	Credit hours
1.	**Environmental Law and Policy**	Introduction to Law, Policy: Meaning, Basic difference and Importance. 48A, 51A (g) and 58A · Precautionary and Polluter pay principles.	10
2.	**Environmental Acts**	**Environmental Laws in India: Anti-Pollution Acts** The Water (Prevention and Control of Pollution) Act,1974, The Air (Prevention and Control of Pollution) Act,1981, The Environment (Protection) Act,1986, The Environmental Tribunal Act, 1995 **Environmental Laws in India: Conservation Acts** Indian Forests Act (Revised),1982, The Indian Wildlife (Protection) Act,1972, National Green Tribunal Act, 2010, Public Interest Litigation (PIL)	20
3.	**Environmental regulations**	**Rules and Regulations** Hazardous waste management and handling rules, Solid waste management and handling rules, Plastic waste management regulations, Noise pollution rules, E-Waste management rules.	15
			45

References:

1. Gupta, K.R., Environmental Legislation in India. Atlantic Publishers and Distributors Private Limited.
2. Leela Krishnan, P., Environmental Law in India (3rd edition). LexisNexis.
3. Naseem, M., Environmental Law in India Mohammad. Kluwer Law International.
4. Venkat, A., Environmental Law and Policy. PHI Learning Private Ltd.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 14
Course: Environment and Energy Resource
Learning Outcomes:

- Learners will be able to learn key terms related to energy and will be able to List out the benefits and disadvantages to using renewable resources.
- Learners will be able to develop more efficient ways to use generate electricity and understand the importance of energy in everyday life.
- Learners will develop ability to identify and differentiate between renewable and non-renewable resources.

Unit	Topics	Details	credit hours
1.	**Energy resource**	Energy resources, sun as source of energy, solar radiation and its spectral characteristics.	5
2.	**Non-renewable energy resources**	Fossil fuel: composition, physico chemical characteristics and energy context of coal, petroleum and natural gas classifications and their impact on environment.	10
3.	**Renewable energy resources**	Introduction, working principle, working, applications, advantage and disadvantages of hydel energy solar energy, wind energy, bio energy, geothermal energy, ocean energy, tidal energy, nuclear energy. Advantages of renewable energy sources over non -renewable energy resources.	15
4.	**Environmental implications of energy use**	Energy use pattern in India and the world, emissions of CO2 in developed and developing countries including India, Impacts of large-scale exploitation of solar, wind, hydro and nuclear energy sources.	10
5.	**Energy efficiency and sustainability**	Need of energy efficiency, energy conservation and sustainability.	5
			45

References:

1. G.D. Rai, Non-conventional Energy Sources, Khanna Publishers, New Delhi .
2. Tiwari, G.N., and Goshal,M.K. Renewable Energy Resources – Basic Principles and applications ,Narosa Publishing House.
3. Dan Charis, Mick Sagrillo, Nonoffender," Power from the Wind", New SocietyPub.,2009.
4. Dr. R.K. Singal, Non-Conventional Energy Resources , S.K. Kataria Publishers.

Subject: B.Sc. Environment & Water Management

Course Code: MJ 15

Course: Environmental Impact Assessment and Auditing

Learning Outcomes:

1. Learners will be able to familiarise with a variety of professional tools used in predicting environmental impacts.
2. Learners will develop knowledge and professional skills necessary to enable them to undertake environmental impact assessment.
3. Learners will be able to outline and articulate differences in types of audits as well as how auditing can support broader environmental management.

Unit	Topics	Details	Credit hours
1.	**Sustainable Development**	Concept of sustainable development, need for sustainable development**,** objective**s,** strategies of sustainable development.	10
2.	**Environmental Impact Assessment**	Concept**,** objective and role of EIA**,** various components of EIA**, EIA Procedure,** methodology of EIA Study. Environment Impact Statement (EIS) Environment Management Plan (EMP)	12
3	**Environmental auditing**	Definition, scope, concept of environmental auditing**,** objective**,** audit procedure.	8
4.	**Environmental Management Standards**	**ISO 14001:2015** Introduction to ISO, ISO 14000 family of standards, ISO 14001:2015: guidelines for implementation of standard **Life cycle assessment, concept** of LCA, phases: goal and scope, definition, inventory analysis, impact assessment, interpretation, applications of LCA, benefits and value of LCA evaluation.	15
			45

References:

1. Barathwal,R.R., Environmental Impact Assessment, New Age International Publishers, New Delhi.2002.
2. N.S. Raman, A.R. Gajbhiye,S.R. Khandeshwar., Environmental Impact Assessment ,IK International Publishing House.
3. Paliwal U.L.,Environment Audit Indus Valley Publication, Jaipur.,2002.
4. Shrivastava A.K., Environmental Auditing, APH Publisher,2003.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 7 - Practical

Practical / Field work	**Credit hours**
1. Study the GOI notifications on environmental audit -benefits to Industry. 2. An EIA study of Industrial/ water resource development project. 3. Study on any one important case law in protection of Environmental pollution. 4. Presentation on how negligence and violations led to a deadly disaster. 5. Develop a working model on the use of renewable energy. 6. One week training in organic farm. 7. Plant a sapling & take care of it.	
	120

References:

1. M. Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House.
2. Dr. S. Anand Kumar Varma, Environment and Agriculture, Sri Krishna Hitech Publishing Company.
3. Gupta, K.R., Environmental Legislation in India. Atlantic Publishers and Distributors Private Limited.
4. Leela Krishnan, P., Environmental Law in India (3rd edition). LexisNexis.
5. G.D. Rai, Non-conventional Energy Sources, Khanna Publishers, New Delhi .
6. Tiwari, G.N., and Goshal,M.K. Renewable Energy Resources – Basic Principles and applications ,Narosa Publishing House.
7. Barathwal,R.R., Environmental Impact Assessment, New Age International Publishers, New Delhi.2002.
8. N.S. Raman, A.R. Gajbhiye,S.R. Khandeshwar., Environmental Impact Assessment ,IK International Publishing House.

Subject: B.Sc. Environment & Water Management
Course Code: MN 2C
Course: Water Resource Management III (Waste Water Treatment)
Learning Outcomes:

1. Learners will be able to understand the basic characteristics of wastewater.
2. Learners will understand basic principles, concepts and theories of wastewater treatment processes.
3. Learners will gain knowledge of wastewater & sludge treatment technologies to recycle these resources for the benefit of society.
4. Learners will be able to witness the actual water treatment process in water treatment plant to gain practical understanding of the course.

Unit	Topics	Details	Credit hours
1	**Waste water/ Sewage Quality and characteristics of Sewage**	Introduction, Physical characteristics of sewage**,** Chemical characteristics of Sewage**,** Bacteriological characteristics of sewage. Classification of treatment processes.	10
2	**Treatment of Sewage**	**Preliminary Treatment:** Screening**,** Grit removal**,** Oil and grease removal. **Primary Treatment**- Sedimentation, its importance and tanks**.** Sedimentation aided with Coagulation- Chemical precipitation and coagulation, Merits and demerits of coagulation.	10
3	**Secondary Treatment**	**Sewage Filtration**-Contact beds**,** Intermittent sand filters**,** Trickling filter, Construction and Operation**,** Merits and demerits **Activated Sludge Process:** Definition**,** Construction, Operation of Activated sludge process**,** Merits and demerits. **Oxidation ponds and Aerated Lagoons:** Oxidation ponds**,** Oxidation ditches. **Anaerobic Stabilisation Units:** Anaerobic stabilisation ponds, Septic Tank, Imhoff Tank.	25
4	**Tertiary Treatment**	Disinfection, Nitrogen & phosphorus removal, Suspended & dissolved solid removal.	10
5	**Disposal of Sludge**	Introduction, treatment and disposal of sludge.	
6	**Disposal of Waste water**	Methods of disposal of waste water.	5
			60
	Practical	➢ Determination of nitrite in waste water. ➢ Determination of phosphate in waste water. ➢ Determination of ammonia in waste water. ➢ Determination of BOD and COD. ➢ Visit to waste water/ sewage treatment plant and make report.	
			30

References:

1. Sewage Disposal and Air Pollution Engineering ,S.K.Garg (Khanna Publishers)
2. Hydrology and Water Resource Engineering, K.C. Patra (Narosa Publishing House)
3. Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc, Tata McGraw Hill Publishing Co. Ltd.
4. Wastewater Treatment Concepts and Design Approach, Karia G.L., and Christian R.A., Prentice Hall of India Pvt. Ltd.

SEMESTER VII

Subject: B.Sc. Environment & Water Management
Course Code: MJ 16
Course: Remote Sensing & GIS
Learning Outcomes:

1. Learners will be able to understand the basic characteristics of wastewater.
2. Learners will understand basic principles, concepts and theories of wastewater treatment processes.
3. Learners will gain knowledge of wastewater & sludge treatment technologies to recycle these resources for the benefit of society.

Unit	Topics	Details	Credit hours
1	**Basics of Remote Sensing**	Overview, History, Definition and Evolution of Remote Sensing, Remote Sensing Process, Sensors, Orbits and Platforms. Electromagnetic Radiation (EMR, Terms & Definitions, Electromagnetic Spectrum, Sources of EMR, EMR Radiation Interaction, Matter, Reflection, Absorption, Transmission, Scattering). Atmospheric Windows, Spectral Reflectance, Spectral Signatures, Spectral response pattern – Vegetation, Rocks, Soil, Water bodies – Spectral properties and characteristics. Aerial photography – characteristics of aerial photographs, Thermal Remote Sensing, Image Interpretation.	20 15
2	**Geographic information system (GIS)**	Definition, Characteristics, Components & types of GIS. Sources of Input Data, Spatial data models, data types & values.	10
3	**Applications**	Remote sensing & GIS in water resource management, disaster management, Agriculture, Forest management, Air Quality monitoring.	
			45

References:

1. Fundamental of remote sensing & GIS, Dr. Debarata Panda, Kunal Books.
2. Remote Sensing & GIS, Basudev Bhatta, Oxford University Press.
3. Remote Sensing & image interpretation, Lillesand Kiefer Chipman, Wiley Publication.
4. M. Anji Reddy, Textbook of Remote Sensing and Geographical Information systems, BS Publications
5. A.M.Chandra and S.K.Gosh. Remote Sensing and GIS, Narosa Publishing Home.
6. Kali Charan Sahu, Textbook of Remote Sensing and Geographical Information Systems, Atlantic Publishers.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 17
Course: Environmental Economics
Learning Outcomes:

1. Learners will understand the environmental issues in relation to the theory of externalities, public goods, and welfare.
2. Learners will be able to illustrate and examine economic principles concerning the choice of instruments for controlling pollution and the relative strength and weaknesses of environmental policies based on command-and-control vis-à-vis market-based instruments.
3. Learners will understand various approaches and methods developed for valuing environmental goods and services.
4. Learners will be able to examine issues in the contemporary environmental discourse from an economists' point of view.

Unit	Topics	Details	Credit hours
1	**Basics of Economics of Environment**	Fundamental concepts in Environmental economics, Economy-environment interaction: Resource Economics, Circular flow model and Material Balance Model, Brief introduction to major components of economy: producer and consumer surplus, market equilibrium, law of demand and supply, tangible and non-tangible goods.	10
2	**Environmental economics**	Main characteristics of environmental goods; cost benefit analysis, Environmental Kuznet Curve.	8
3	**Resource economics**	Optimal use of exhaustible and renewable resources, Optimal provision of public goods-Lindahl's equilibrium; Energy and Environment – Resource Scarcity. The Coase theorem.	10
4	**Environmental valuation**	Integrated environmental and Economic accounting and the measurement of environmentally corrected GDP, Use values, option values and non-use values -total economic value, Valuation techniques; production based, contingent valuation, hedonic-pricing, travel cost method. Expressed preference method (Trade off game method, costless choice method, Delphi method), Revealed preference method (travel cost method, hedonic price method, preventive expenditure method, surrogate markets, property value method), Cost based method (relocation cost method, replacement cost method)	17
			45

References:

1. Ramprasad Sengupta, 2013, Ecological Limits and Economic Development, Oxford University Press, New Delhi
2. Ahmed Hussen, 2013, Principles of Environmental Economics and Sustainability: An integrated economic and ecological approach, Routledge, UK.
3. Sankar U. Environmental Economics, Oxford University Press, UK.
4. Basic concept of Environmental Economics, Dr. Y M Chudasma, Dr. S. Jhala
5. World commission on Environment and Development "Our common future". Oxford University Press publications.
6. The Economics of Pollution, Victor P.A ,Mathau, London Publication.
7. Principles of Environmental management, Rogene and Buchoiz, Prentice Hall Publications.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 18
Course: Climate Change
Learning Outcomes:

1. Learners will be able to understand the fundamentals and basic concepts of Climate change science.
2. Learners will be able to identify the anthropogenic drivers of climate change .
3. Learners will be able to analyse different climate change scenarios and their implications.
4. Learners will be able to explain the observed and projected trends and impacts in the climate

Unit	Topics	Details	Credit hours
1.	**Climatic System and Variations**	Global Climate System , Causes for Modern Climate Change , External Climate Forces: Greenhouse Gases, Orbital Variations, Solar Fluctuations, Evidence and Measurement of Climate changes	10
2.	**Consequences and Challenges**	Economics of Climate Change, Climate Change and Water Scarcity, Coastal Ecosystem and Vulnerability, Threats to Forest and Biodiversity, Agriculture and Food Security, Energy Generation and Climate Change Mitigation	10
3.	**Confronting Climate Change: Policies and Efforts**	India: National Action Plan on Climate Change (NAPCC) ,State Action Plan on Climate Change (SAPCC), National Adaptation Fund on Climate Change (NAFCC), India's Post-2020 Climate Goals , Climate Change Action Programme (CCAP), National Carbonaceous Aerosols Programme (NCAP) , Long Term Ecological Observatories (LTEO) Programme, Clean Development Mechanism (CDM), Extreme Events and Disasters	15
4	**Mitigation Approaches in Climate Change**	Carbon Emissions Reduction Technologies, Climate Change Research, Climatology Journals and Top Institutions, Governance for Climate Change, Technology Options Fuel Switching and Carbon Sequestration.	10
			45

References:

1. The Climate Solution: India's Climate Change Crisis and What We Can Do About It by Mridula Ramesh, Hachette India .
2. What Is Climate Change? (What Was?) by Gail Herman (Author), Illustrated by John Hinderliter, Penguin Workshop .
3. Climate Change Biodiversity and Green Economy by H.S. Sharma S. Padmaja and Ganesh Sharma, Concept Publishing Company Pvt. Ltd.
4. Climate Change by Joseph Romm, OUP US (2018).

Subject: B.Sc. Environment & Water Management
Course Code: MJ 19
Course: **Agroforestry**

Learning Outcomes

1. To understand the need of agroforestry and the involved biophysical processes
2. To study the role of agroforestry systems in soil fertility and nutrient cycling
3. To examine the positive and negative tree-crops-soil interactions (for light, water and nutrients)
4. To be aware of opportunities for employment and cash income through agroforestry systems
5. To appreciate how agroforestry innovations can make positive impact on economy and environment

Unit	Topic	Details	Credit hours
1.	Importance of Agriculture	Principles of crop ecology and crop adaptation, Argo-ecological regions in India. Geographical distribution of crop plants, Climatic factors and their effect on plant processes and crop productivity, Role of GIS and GPS in agriculture. Major pests and diseases of rice, wheat, cotton, chickpea, sugarcane and their management.	12
2.	Sustainable land use systems:	Sustainable agriculture, parameters and indicators, Conservation agriculture, safe disposal of Agri-industrial waste for crop production, Argo-forestry.	10
3.	Forest	Importance, types, classification, nursery and planting technique, social forestry, farm forestry, urban forestry, community forestry, forest management, natural regeneration, man-made plantations, shifting cultivation, hardwoods, softwoods, pulp woods, fuel woods, multipurpose tree species	10
4.	Agroforestry	Importance and land use systems, forest soils, watershed management, wildlife - importance, abuse, depletion, management, major and minor forest products including medicinal and aromatic plants, aerial photo interpretation and remote sensing, role of forests and trees in climate mitigation, tree diseases, wood decay and discoloration, integrated pest and disease management, biological and chemical wood preservation, forest conservation	13
			45

References:

1. Dwivedi AP. 1992. Agroforestry: Principles and Practices. Oxford and IBH.
2. Mehta T. 1981. A Handbook of Forest Utilization. Periodical Expert Book Agency.
3. Nautiyal JC. 1988. Forest Economics – Principles and Applications. Natraj Publications, Dehradun. Sharma LC.

Subject: B.Sc. Environment & Water Management
Course Code: MJ 7 - Practical

Practical / Field work	**Credit hours**
1. Organize & participate in quiz competition on remote sensing & GIS. 2. Introduction to GIS software. 3. Report on policy for the control of pollution externalities. 4. Case study on Environmental Kuznet Curve. 5. Presentation on environmental valuation techniques. 6. Prepare a presentation on the key points relevant for a post 2020 climate change regime. 7. Impacts of extreme events in selected areas: A case study 8. Collect medicinal plants and identify there medicinal properties. 9. Visit a nursery and learn some plantation techniques. 10. Plant a sapling & take care of it.	
	120

References:

1. Fundamental of remote sensing & GIS, Dr. Debarata Panda, Kunal Books.
2. Remote Sensing & GIS, Basudev Bhatta, Oxford University Press.
3. Ramprasad Sengupta, 2013, Ecological Limits and Economic Development, Oxford University Press, New Delhi
4. Ahmed Hussen, 2013, Principles of Environmental Economics and Sustainability: An integrated economic and ecological approach, Routledge, UK.
5. The Climate Solution: India's Climate Change Crisis and What We Can Do About It by Mridula Ramesh, Hachette India .
6. What Is Climate Change? (What Was?) by Gail Herman (Author), Illustrated by John Hinderliter, Penguin Workshop .
7. Dwivedi AP. 1992. Agroforestry: Principles and Practices. Oxford and IBH.

Subject: B.Sc. Environment & Water Management
Course Code: MN-1C
Course: Environmental Organizations
Learning Outcomes:

1. Learners will have knowledge of organizations working towards environmental problems in local, regional, national, and global communities.
2. Learners will be prepared for careers and environmental stewardship.
3. Learners will be equipped with actions taken for the environmental protection in India and worldwide.
4. Learners will develop sense to serve environment as a resource, through service, outreach and engagement.

Unit	Topics	Details	Credit hours
1	**National organizations**	Ministry of Environment, Forest & Climate Change, Central and State Pollution Control Boards, National Green Tribunal, Forest Survey of India, Animal Welfare Board Of India, National Ganga River Basin Authority. Wildlife Crime Control Bureau, Central Zoo Authority, National Biodiversity Authority, National Board of Wildlife, Genetic Engineering Appraisal Committee.	21
2	**International organizations**	International Agencies -IUCN, UNEP, WCED, WWF for Nature, Intergovernmental Panel on Climate Change (IPCC), United Nations Forum on Forest (UNFF), Earth System Governance Project (ESGP), International Geosphere-Biosphere Programme (IGBP), The Partnership for Action on Green Economy (PAGE), Climate Action Network (CAN), Global Climate Change Alliance Plus (GCCA+), Global Green Growth Institute (GGGI), International Whaling Commission (IWC), Arctic Council, Scientific Committee on Antarctic Research (SCAR), Global Tiger Forum (GTF), World Nature Organisation (WNO), International Solar Alliance (ISA), Global Environment Facility (GEF).	24
			45
	Practical	➢ Visit MoEFCC website and make a report on current schemes & plans. ➢ Visit CPCB website and make a report on the highlights of last two annual reports. ➢ Visit UNEP website and make a report on the strategies for this session. ➢ Visit NGT website and make a report on its initiatives & updates.	30

References:

1. The Ecology & Environment Compendium, Disha Publications.
2. International Organizations and Environmental Protection, Wolfram Kaiser & Jan-Henrik Meyer, Kindle Edition.
3. Ecology & Environment, P. D. Sharma, Rastogi Publications.

SEMESTER VIII

Subject: B.Sc. Environment & Water Management
Course Code: MJ 20
Course: Research Methodology & IPR

Learning Outcomes:

1. Learners will develop the ability to choose methods appropriate to research aims and objectives
2. Learners will understand the limitations of particular research methods
3. Learners will develop skills of data analysis and presentation.
4. Learners will develop advanced critical thinking skills.
5. Learners will develop enhanced writing skills.

Unit	Topics	Details	Credit hours
1	Foundations of Research	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	10
2	Problem Identification & Formulation	Effective literature studies approaches, analysis, Plagiarism, Research ethics.	5
3	Research Design	Effective technical writing, how to write review, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	10
4	Nature of Intellectual Property	Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.	10
5	Patent Rights	Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	10
			45
	Practical	➢ Use of tools/ techniques for Research: methods to search required information effectively. ➢ Reference Management Software like Zotero/ Mendeley. ➢ Software for paper formatting like LaTeX/ MS Office. ➢ Software for detection of Plagiarism. ➢ Plant a sapling & take care of it.	30

References:

1. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand
3. Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions.
4. Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
5. Research Methodology- C. R. Kothari, New Age International Publications Limited.

Subject: B.Sc. Environment & Water Management
Course Code: MN 2D
Course: Water Resource Management IV (Advanced Water Treatment)
Learning Outcomes:

1. Learners will get to know the advanced technologies in Wastewater treatment.
2. Learners will get knowledge to select the most appropriate types of membrane processes for tertiary treatment of wastewater.
3. Learners will be able to apply tertiary treatment processes for optimum removal of pollutants.

Unit	Topics	Details	Credit hours
1	**Introduction**	Overview of Advanced Waste Water Treatment, Introduction, Need of Advanced Waste Water Treatment, Purpose of Advanced Waste Water Treatment	5
2	**Nitrogen & Phosphorus Removal**	Nitrification, Denitrification, Phosphorus Removal: Introduction, Phosphorus removal by Chemical Precipitation. Phosphorus removal by Biological Precipitation	10
3	**Membrane Filtration Membrane Process**	Terminology, Membrane Process, Classification and operation: Microfiltration, Ultrafiltration, Nano filtration, Reverse Osmosis, Application of membrane processes:	13
4	**Water Softening**	Methods of removing Temporary Hardness**,** Methods of removing Permanent Hardness.	9
5	**Specific Water Treatment**	Removal of Colour, Odour and Taste from water**,** Removal of Iron and Manganese Defluoridation of water**,** Desalination of Brackish Water**:** Necessity of Desalination**,** Methods of Desalination.	8
			45
	Practical	➢ Determination of nitrite in waste water. ➢ Determination of phosphate in waste water. ➢ Training in waste water/ sewage treatment plant and make report.	
			30

References:

1. Sewage Disposal and Air Pollution Engineering ,S.K.Garg (Khanna Publishers)
2. Hydrology and Water Resource Engineering, S.K. Garg (Khanna Publishers)
3. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy Inc, (McGraw-Hill Education)
4. Environmental Engineering- Peavy, Rowe & Tchobanoglous, (McGraw-Hill Education)

Subject: B. Sc. Environment & Water Management
Course Code: AMJ - 1
Course: Green Marketing

Learning Outcomes

1. To make the student understand the concept and increase the consciousness about Green Marketing and Green Products.
2. To learn the factors that affect purchase decision of consumers
3. Broader understating of Green Marketing and its significance.

Unit	Topics	Details	Credit hours
1	**Introduction**	Meaning of Green Marketing, Definition of Green Marketing Evolution of Green Marketing, Objectives of Green Marketing, Importance of Green Marketing, Strategies of Green Marketing, Green Product, Benefits of Green Marketing, Green Marketing Mix , Strategies to Green Marketing.	15
2	**Green Marketing Concepts**	-Green Spinning, Green Selling, Green Harvesting, Enviropreneur Marketing, Compliance Marketing, Green Washing, Climate Performance Leadership Index	10
3	**Purchase Decision**	-Meaning of Purchase decision, Factors affecting Purchase decision, Steps in the decision-making process, five stages of consumer buying decision process, Models of buyer decision-making	10
4	**Environmental Consciousness**	-Introduction of Environment, Importance of environmentalism, Extended Producer Responsibility Plan, Green Marketing Initiatives (Green Firms, HCL's Green Management Policy, IndusInd Bank's Solar Powered ATMs, ITCs Paperkraft, Maruti's Green Supply Chain, Reva's Electric Car).	10
			45

References:

1. Esakki and Thangasamy, Green Marketing and Environmental Responsibility in Modern Corporations, IGI Global, 2017
2. Robert Dahlstrom, Green Marketing Management, Cengage Learning, 2010.
3. Jacquelyn A. Ottman , Green Marketing: Challenges and Opportunities for the New Marketing Age, , NTC Business Books, 1993
4. Jacquelyn A. Ottman, The New Rules of Green Marketing, Berrett-Koehler Publishers, 2011.

Subject: B.Sc. Environment & Water Management
Course Code: AMJ - 2
Course: **Environmental Statistics**

Learning Outcomes
1.Enable the studentsin having deep knowledge on Environmental statistics
2.Ddevelop knowledge on basic concepts useful for data analysis .
3. Student will become aware of wide range of applications of statistics in environmental management and decision making.
4.Develop technical skills to use statistical tools and software in environmental data analysis.

Unit	Topic	Details	Credit hours
1.	**Introduction**	Environmental models-deterministic and stochastic; generation of environmental data; types and objectives of environmental studies, stochastic processes in environment; the nature environmental data; concept of random variable and its relevance with respect to the environmental data; relevance of statistics in environmental management; populations and samples – parameters and statistic.	10
2.	**Describing environmental data**	Measurement scales; statistical descriptors of environmental data – numerical and graphical; measurement uncertainty – accuracy, precision and bias estimation of environmental data; variability and errors in environmental pollution data.	10
3.	**Probability models and their use**	Probability concepts; probability distribution functions and their applications-discrete and continuous distributions. Probability distribution applications-interpreting environmental standards, flood frequency analysis and air quality data.	10
4.	**Environmental data sampling**	Need and purpose of sampling; methods for selecting sampling locations and times for different environmental matrices – monitoring of water bodies for hydrological and water quality data; air quality monitoring; soil sampling-statistical considerations; types of sampling designs.	8
5	**Tests of hypothesis**	Hypothesis testing-parametric and non-parametric tests: assessment of violation of environmental standards, comparing environmental parameters (differences of means, proportions, difference of proportions, multiple proportions, variances, ratio of variances and analysis of variance).	7
			45

References:

1.Ayyub, B.M. and McCuen, R.H. (2011) *Probability, Statistics and Reliability for Engineers and Scientists*, CRC Press, Boca Raton, FL.
2.Gilbert R.O. (1987) *Statistical Methods for Environmental Pollution Monitoring*, New York, Van Nostrand Reinhold.
3.Helsel D.R. and Hirsch R.M. (1997) *Statistical Methods in Water Resources*, Elsevier Science Ltd., UK.
4. Kottegoda N.T. and Rosso R. (2008) *Applied Statistics for Civil and Environmental Engineers*, McGraw-Hill, International Edition.

Subject: B.Sc. Environment & Water Management
Course Code: AMJ - 3
Course: **Entrepreneurship**

Learning Outcomes

1.Student will be able to assess or identify their readiness/ability/aptitude for entrepreneurship.

2.Student will be able to verbally articulate the value proposition of an Entrepreneurial venture.

3. Student will have an understanding of how Entrepreneurship can impact their lives and society.

Unit	Topic	Details	Credit hours
1.	**Introduction to Entrepreneurship**	Definition and concept of Entrepreneurship, classification and type of entrepreneurs, Nature and importance of Entrepreneurs. Entrepreneurship & small Business problems of entrepreneurship	
2.	**Entrepreneurship Developments**	Entrepreneurial environment, Institutions in and of entrepreneur, Role of EDI's, NIESBUD, NSIC, DIC'S in promoting entrepreneurs.	
3.	**Project Identification**	Over view of project identification, search of a business idea, identification of project, identification of business opportunities	
4.	**Project Formulation**	Project formulation, preparation of Project Report, Project appraisal	
5.	**Source of Finance**	Sources of finance for small Business, Management of working capital	
6.	**Small Scale Industry**	Setting up of a small industry-an overview of steps involved. Sickness in small scale industries - Reason & remedies	
			45

References:

1. B. K. Mehta: Entrepreneurship, SBPD, Agra.
2. Tandon B.C.: Environment and Entrepreneur; Chugh Publications, Allahabad.
3. Sin era David: Entrepreneurial Megabucks; John Wiley and Song, New York.
4. SrivastavS.B. A Practical Guide to Industrial Entrepreneurs; Sultan Chand and Songs, New Delhi.
5. Prasanna Chandra: Project Preparation, Appraisal & Implementation, Tata McGraw Hill, New Delhi.

Subject: B.Sc. Environment & Water Management
Course Code: AMJ 1 - Practical

	Practical	1.Analysis of trend in the environmental data 2. Introduction to time-series analysis; characteristics of hydrological, water and air quality time series; 3. Trend and seasonality; detecting and estimating trends-applications to hydrological, meteorological, water and air quality data. 4. Submit a profile summary of a successful entrepreneur indicating milestone achievements. 5. Undertake SWOT analysis of any Start – up. 6. Presentation on ideas for setting up green business. 7. Describe any green supply chain initiative. 8. Plant a sapling & take care of it.	
			75

References:

1. Esakki and Thangasamy, Green Marketing and Environmental Responsibility in Modern Corporations, IGI Global, 2017

2. Robert Dahlstrom, Green Marketing Management, Cengage Learning, 2010.

3.Ayyub, B.M. and McCuen, R.H. (2011) *Probability, Statistics and Reliability for Engineers and Scientists*, CRC Press, Boca Raton, FL.

4.Gilbert R.O. (1987) *Statistical Methods for Environmental Pollution Monitoring*, New York, Van Nostrand Reinhold.

5. B. K. Mehta: Entrepreneurship, SBPD, Agra.

6. Tandon B.C.: Environment and Entrepreneur; Chugh Publications, Allahabad.

AEC-IV Language Through Literature - II

SEMESTER- IV (2 Credits 50 Marks)

Course Objective

- To use literature as a medium to teach/learn grammar, reading, spelling, vocabulary, writing mechanics, creative writing and thinking skills
- To strengthen contextual understanding of the language through textsrelevant to specific disciplines and offer scope for imaginative involvement and self-expression
- To stimulate interest in acquiring twenty first century skills
- To engage in self-assessment activities for self- development
- To help absorb the values, ethics and attitudes of life and culture expressed in literature

Course Content

UNIT- I Poetry (1 Credit – 25 marks)

Leisure	*W. H. Davies*
The Secret of theMachines	*Rudyard Kipling*
Water	*Ralph Waldo Emerson*
Casey at the Bat	*Earnest LawrenceThayer*
Very Indian Poem inIndian English	*Nissim Ezekiel*

UNIT- II Short Stories (1 Credit – 25 marks)

Witches' Loaves	*O. Henry*
The Country of the Blind	*H. G. Wells*
The Boy Who Broke theBank	*Ruskin Bond*
The Squirrel	*Ambai*

Source Books:

Confluence, Edited by KN Sobha, Cambridge University Press

Semester Examination and distribution of marks:-

End Semester Examination (ESE): 50 Marks

Group A

1. ***Ten*** Objective Type Questions (**1 x 10 = 10**) [MCQs not to be set]

2. ***Two*** Short Answer Type Questions (**5 x 2 = 10**)
   (Two questions to be answered out of a choice of Four)

Group B

Three Long Answer Type Questions (**10 x 3 = 30**)
(Three questions to be answered out of a choice of Six)

Semester-IV

VAC-2(Value Added Course-2)

Paper Name-GLOBAL CITIZENSHIP EDUCATION FOR SUSTAINABLE DEVELOPMENT

Credits-2 **Full Marks-50**

End Semester University Examination-50 **Pass Marks-20**

No Internal Examination

Objectives

That the undergraduate students embibe the true qualities of a global citizen. Every student must be aware of the local and global problems and be able to solve them applying their competencies and true knowledge. Moreover, the course is designed to make students aware of multifarious problems, understand them and that they learn to adopt corrective measures to mitigate the problems. The objective of the course lies in inculcating broad perspectives of problem- solving ethos so that they become part of the epistemic community to mitigate local and global ills. As such the thrust is upon digital engagement with community participation of the young learners as 'future-proofing' tool. Hence, sensitized students should be able to grasp the true meaning of environmental- consciousness and sustainable development, within the broader perspective of transdisciplinary approach.

Learning Outcomes

1.Understanding and acquiring comprehensive knowledge of the global issues within the broader multidisciplinary approaches.

2. To develop wide-ranging practical skills and acquire the capacity to extrapolate from what one has learned to apply those competencies in the varied contexts to solve specific problems.

3. That the students acquire problem solving skills, critical thinking, creativity and enhance their communication skills to cooperate and coordinate as a team for common good.

4. Students pursue learning activities throughout their life that include learning out to learn skills.

5. That every student acquires multicultural competence that entail global perspective and honour diversity yet accomplish common group tasks and goals.

6. That students embrace universal human values, promote sustainable development and take effective measures to mitigate the effects of environmental degradation and is aware of climate change and its impact.

7. That every student promotes universal respect for and observance of human rights, promotes peace and non-violence and fosters community participation.

Unit-I: Introduction (i) The concept of Citizenship (ii) Citizenship Education in India. (iii) The Concept of Global Citizenship & Global Citizenship Education (iv)The notion of Global Citizenship embedded in Indian ethos. **(10 Hrs)**

Unit-II: (i) Attributes and Aims of Global Citizenship Education (ii) Importance of Problem solving skills, critical thinking and creativity to generate solutions (iii) Knowledge and multi-culturalism (iv) Value inculcation and accountability of knowledge **(10 Hrs)**

Unit-III: (i) Global governance systems and Human Rights education (ii)Equality and Non-discrimination, Dignity and Justice, Inclusion and Participation (iii) The importance of peace and non-violence in mediating and resolving conflicts (iv) Environmental awareness and sustainability. UN's Sustainable Development Goals for heralding peace and prosperity by the year 2030. **(10 Hrs)**

Readings:

1. Bakshi ,G.D, Constitution of India , Part 2, Articles 5-11 and part 4-A
2. Guha ,Ramchandra , Environmentalism : A global history.
3. Carlsen , Rachel , silent spring

4. www.undp.org
5. Hrdin, G. Living within limits: Ecology, Economics and population.
6. Hardin , G"Essays on Science and Society :Extensions of "The Tragedy of the Commons " " Science 280 (5364): 682-683.
7. Journal of Education for sustainable development, CEE, Centre for environment education, www.journals.sagepub.com/home/jsd
8. Das, Sujata. K Global Climate and sustainable development, Disha Books (Orient Longmen)
9. Ossewaarde , Martin J, Introduction to Sustainable Development ,sage
10. Devaki , N , Education for Sustainable Development , Shanlax
11. Chalkley,Brian, Martin Haigh,David Higgitt,Education for Sustainable Development, Routledge