SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
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शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४,महाराष्ट्र
दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी विभाग २३१–२६०९०९३/९४

Estd. 1962
"A++" Accredited by NAAC(2021)
With CGPA 3.52

SU/BOS/Science/ 18 **Date:** 01-10-2022

To,
The Principal,
All Affiliated Concerned Science Colleges/Institutions
Shivaji University, Kolhapur.

Subject :- Regarding syllabi of M.Sc. & B.Sc. (NEP-2020) degree programme under the Faculty of Science and Technology as per National Education Policy, 2020 .

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi and Nature of question paper of **M.Sc., & B. Sc.** under the Faculty of Science and Technology **as per National Education Policy 2020 .**

Sr. No.	Faculty of Science and Technology	Programme/ Course
1	Environmental Science, Engineering and Technology	M. Sc. Part- I Environmental Science, B. Sc. Part- I Environmental Science, (Entire)

This syllabi and nature of question paper shall be implemented from the Academic Year 2022-2023 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (students Online Syllabus)

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

By Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	Appointment Section
2	Director, Board of Examinations and Evaluation	8	P.G.Seminar Section
3	The Chairman, Respective Board of Studies	9	Computer Centre (I.T.)
4	B.Sc. Exam	10	Affiliation Section (U.G.)
5	Eligibility Section	11	Affiliation Section (P.G.)
6	O.E. I Section	12	P.G.Admission Section

M.Sc. Environmental Science

Programme Structure and Syllabus
(Level 8)

Choice Based Credit System (CBCS) with Multiple Exit option (NEP 2020)

ACADEMIC SESSION
(w.e.f. 2022-2023)

DEPARTMENT OF ENVIRONMENTAL SCIENCE,

SHIVAJI UNIVERSITY, KOLHAPUR

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Environmental Science Programme Structure
M.Sc. Part – I (Level-8)

SEMESTER-I (Duration- Six Month)											
	Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
CGPA	1	CC-101 Global Environmental Issues	4	4	4	80	32	3	20	8	1
	2	CC-102 Environmental Chemistry and Instrumentation Techniques	4	4	4	80	32	3	20	8	1
	3	CC-103 Environmental Ecology and Biodiversity	4	4	4	80	32	3	20	8	1
	4	CC-104 Environmental Geosciences, GIS and Remote Sensing	4	4	4	80	32	3	20	8	1
	5	CCPR-105 Environmental Chemistry, Ecology and Biodiversity	16	16	8	200	80	--	--	--	*
Total (A)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	AEC-106	2	2	2	--	--	--	50	20	2

SEMESTER-II (Duration- Six Month)

CGPA	1	CC-201 Air and Noise Pollution with its control	4	4	4	80	32	3	20	8	1
	2	CC-202 Water pollution and its control	4	4	4	80	32	3	20	8	1
	3	CC-203 Solid and Hazardous Waste Management	4	4	4	80	32	3	20	8	1
	4	CC-204 Energy studies	4	4	4	80	32	3	20	8	1
	5	CCPR-205 Environmental Sampling of Air, Water, Soil and Analysis	16	16	8	200	80	--	200	80	*
Total (B)			--	--	**24**	**520**	--	--	**80**	--	--
Non-CGPA	1	SEC-206	2	2	2	--	--	--	50	20	2
Total (A+B)					**48**	**1040**	--	--	**160**	--	--

• Student contact hours per week : **32** Hours (Min.)	• Total Marks for M.Sc.-I : **1200**
• Theory and Practical Lectures : **60** Minutes Each	• Total Credits for M.Sc.-I (Semester I & II) : **48**
• CC-Core Course • CCPR-Core Course Practical • AEC-Mandatory Non-CGPA compulsory Ability Enhancement Course • SEC- Mandatory Non-CGPA compulsory Skill Enhancement Course	• Practical Examination is annual. • Examination for CCPR-105 shall be based on Semester I Practicals. • Examination for CCPR-205 shall be based on Semester II Practicals. • *Duration of Practical Examination as per respective BOS guidelines

	• *Separate passing is mandatory for Theory, Internal and Practical Examination*
• **Requirement for Entry at Level 8:** **Completed all requirements of the relevant Bachelor's degree (Level 7) with principal / major subjects B. Sc. Degree in any subject, including B.Sc. in Agriculture, Horticulture, Forestry**	
• **Exit Option at Level 8:** Students can exit after Level 8 with **Post Graduate Diploma in Environmental Science if** he/she completes the courses equivalent to minimum of 48 credits.	

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2020)
M.Sc. Environmental Science Programme Syllabus
M.Sc. Part – I (Level-8)

- **PROGRAMME OUTCOMES (PO'S)**

The post graduates are able to

PO-1) Acquire in–depth knowledge and integrate with existing knowledge to sensitize the people about global and local environmental issues.

PO-2) Develop an ability to identify, critically analyze, formulate and solve environmental problems using basic principles of nature conservation.

PO-3) Get acquainted with environmental and social impacts of any developmental activity.

PO-4) An ability to design a system and process to meet desired needs of society within realistic limitations such as health, safety, security and environmental considerations.

PO-5) An ability to design and conduct experiments, interpret data, and provide well informed conclusions.

PO-6) Communicate effectively socio-economic problems related to environment by appropriate documentations and presentations.

PO-7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8) Apply ethical principles and commit to professional ethics and responsibilities and follow the norms of the any surrounding practice.

- **PROGRAM SPECIFIC OUTCOMES (PSO's):**

PSO-I: Professional skills

Ability to monitor the present status of environmental parameters through monitoring for design and development of new concept or technology.

PSO-II: Industrial Skills

Successfully tackle with the industrial pollution problems through appropriate technology and tools.

PSO-III: Environmental and Social values within individual

Inclusion of environmental and social values within the individual's life.

PSO-IV: Problem Solving approach:

Identify, formulate, review literature and analyze complex environmental problems and suggest suitable solutions reaching substantiated conclusions using first principles of natural science.

PSO-V: Successful development of Career and Entrepreneurship

To prepare the students with broad environmental perspective and become a successful in career and entrepreneurship.

PSO –VI: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with understanding of the limitations.

M.Sc. Part I
Sem. I (Duration Six Months)

Sr. No.	Course Code	Title of the course
1.	CC-101	Global Environmental Issues
2.	CC-102	Environmental Chemistry and Instrumentation Techniques
3.	CC-103	Environmental Ecology and Biodiversity
4.	CC-104	Environmental Geosciences, GIS and Remote Sensing
5.	CCPR-105	Environmental Chemistry, Ecology and Biodiversity
6.	AEC- 106	

M.Sc. Part I
Sem. II (Duration Six Months)

Sr. No.	Course Code	Title of the course
1.	CC-201	Air and Noise Pollution with its control
2.	CC-202	Water pollution and its control
3.	CC-203	Solid and Hazardous Waste Management
4.	CC-204	Energy studies
5.	CCPR-205	Environmental Sampling of Air, Water, Soil and Analysis
6.	SEC -206	

CC-101: Global Environmental Issues

After completion of the course, the students are able to

CO1: Get acquainted with the scope and multidisciplinary nature of environmental science.

CO2: Familiarise with the global environmental issues and Climate change.

CO3: Get acquainted with National & Global Environmental Initiatives.

CO4: Understand the basics of environmental education.

Syllabus

Unit -1

a) Introduction to Environmental Science: **(15)**

Meaning, scope and interdisciplinary nature of Environmental Science, Principles, Background and scope of Environmental Science, Applications of Environmental Science, environmental ethics, Environmental consciousness, Western and Eastern views

b) Environmental Education

Environmental Education: history, concept, goals, objectives and guiding principles, Strategies for EE development, Models for future EE System, Awareness and action through environmental education.

Unit- 2 Global Warming and Climate Change: **(15)**

a) **Global warming** : introduction, greenhouse gases, greenhouse effect, Global warming, possible impacts of global warming,
b) **Climate Change:** Climate change and Clean Development Mechanism, Carbon Sequestration, Concept of Carbon trading and Carbon credits.

Unit -3 Ozone problem and other environmental problems: **(15)**

a) Ozone in the atmosphere, Ozone depletion process, Ozone hole, Consequences of Ozone depletion.
b) Acid rain, Biodiversity loss, Desertification: causes, effects and remedies, El-Nino, La-Nina, Impacts of El-Nino.

Unit- 4 National & Global Environmental Initiatives **(15)**

International Initiatives towards Environmental Protection: Stockholm Conference, Earth Summit, World Summit on Sustainable Development, Rio+20, Ramsar Convention, Vienna Convention, Montreal Protocol, Kyoto Protocol; Sustainable Development Goals; Ecomark Scheme

References:

1. Environmental Science - Arms Karen, Holt McDougal , 1996.
2. Principles of Environmental Science-Watt, K. E. F. (1973) McGraw-Hill Book Company.
3. Environmental Science –Noble, B .J. Kormandy, E.J.(1981),The way world works, Prentice-Hall Inc., N .J.
4. Environmental Science-Turk A., Turk J. Wittes J.T. and Wittes, R.E.
5. Environmental Issues: Measuring, Analyzing, Evaluating, Abel, Daniel C. McConnell, Robert L. Abel, Daniel C. Edi. 2 Prentice Hall Publication.
6. Environmental Science, S.C. Santra, New Central agency Pvt. Ltd.

CC-102: Environmental Chemistry and Instrumentation Techniques

After completion of the course, the students are able to

CO1: Understand the basic concepts in environmental chemistry.

CO2: Identify the chemical nature of air pollutants.

CO3: Analyse the chemistry of water and soil pollutants.

CO4: Study the working of different equipment's used for environmental analysis.

Syllabus

Unit – 1 Concepts in Environmental Chemistry **(15)**

a) Environmental Chemistry

Concept and scope of environmental chemistry, Chemistry of environmental segments - lithosphere, hydrosphere, atmosphere, Stoichiometry, Gibb's energy; chemical potential; chemical equilibrium; acid - base reaction; solubility product; unsaturated and saturated hydrocarbons, radionuclide's. Organic chemicals in the environment, Inorganic chemicals in the environment, pesticides residues

b) Chemistry of soil:

Soil profile, Inorganic and organic components of soil, Classification of soil, Chemical factors affecting the soil quality, adsorption of contaminants in soil, Effect of modern agro-technology on quality of soil

Unit -2 Air & Water Chemistry **(15)**

a) Chemistry of Air:

Composition of air; particles ions and radicals in the atmosphere; chemical processes for formation of inorganic and organic particulate matter; thermo-chemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry; photochemical smog.

b) Chemistry of water:

Structure and properties of water, Water quality parameters, Physicochemical concepts of colour, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, detection of Coliforms, Solubility of gases, carbonate system, redox potential

Unit – 3 **(15)**

a) Spectrometric Analytical Techniques

UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier-transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry

b) Chromatographic Techniques

Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography); Electrophoresis

Unit -4 **(15)**

a) Microscopy Techniques and other useful instruments

Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy,(Scanning (SEM) and Transmission Electron Microscopy(TEM)

b) Instruments used in environmental monitoring:

Global Positioning System (GPS), Total Organic Carbon Analyzer (TOC), Total Kjeldas Nitrogen Analyzer (TKN), Electrophoresis, , Transmission Electronic Microscopy (TEM), GCMS, LCMS.

References:

1. Environmental Chemistry by B. K. Sharma S. H. Kaur Goel Publishing House, Meerut
2. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
3. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
4. Vogel's Textbook of quantitative Chemical analysis, 5th Edition-J. H. Basett, J. Nendham and Denny, R.C.
5. Instrumental Methods of analysis – Chatwal and Anand, Himalaya Publishing House, New Delhi.
6. Chemistry for Environmental Engineering, C. N. Sawyer and P L Mc Carty, McGraw Hill Kogakusha ltd., 1990
7. Fundamentals of Analytical Chemistry, 1982.Hobert H. Willard D.L. Merrit and J. R. J. A. Dean
8. Fundamental Concepts of Environmental Chemistry, G. S. Sodhi, Narosa Publishing House, New Delhi.

CC-103: Environmental Ecology and Biodiversity

After completion of the course, the students are able to

CO1: Demonstrate the structure and functions of Ecosystem.

CO2: Illustrate the different characteristics of population.

CO3: Enlist the characteristics of community and understand its dynamics.

CO4: Aware about the aquatic and terrestrial biomes with its importance.

CO5: Identify the role of microbes in soil, water and air environment.

Syllabus

Unit – 1 **(15)**

a) Ecosystem Dynamics:

Introduction, kinds of ecosystem, structure and function of ecosystem, food chain, food web, trophic level, ecological pyramids, energy flow models, ecosystem productivity, methods of measuring primary productivity, Ecosystem stability and regulation, biogeochemical cycles-cycling of water and nutrients.

b) Biomes: Structure of some typical ecosystems:

Bio-geographical realms, Classification of terrestrial biomes – Tundra, Taiga, Grassland, Desert, Evergreen and deciduous forests, Tropical rain forests

Classification of Aquatic Habitats: Fresh water pond, Wetlands, Rivers – their characteristics, flora and fauna;

Bio-geo-chemical Cycles: Gaseous and sedimentary cycles: Carbon cycle, Nitrogen cycle, Phosphorous cycle, Oxygen cycle.

Unit – 2 Population and Community ecology **(15)**

a) Population ecology:

Basic concepts of population ecology, population dynamics, characteristics of population: natality, mortality, fecundity, density, age distribution, relationships among organisms, population explosion, Community types and community composition.

b) Community ecology:

Characteristics of community, Composition, structure, origin and development of community, Characters used in community structure, Community dynamics, Succession: causes, types and general process of succession, Development of Hydrosere or hydrarch and Lithosere or xerosere,

Unit – 3 Biodiversity conservation

a) Biodiversity conservation **(15)**

Biodiversity as life support system for man, types of biodiversity, ecosystem, species and genetic, Values of biodiversity, Indian ethos of wildlife conservation, Hotspots of Biodiversity, Causes for loss of biodiversity, measurement of biodiversity; listing of threatened biodiversity.

b) Methods of biodiversity conservation – in situ conservation (sanctuaries, national parks and biosphere reserve); ex situ conservation (zoo, botanical gardens; gene/germ plasma banks),Convention on Biological Diversity (CBD), Biodiversity conservation efforts in the country.

Unit – 4 Environmental Microbiology **(15)**

a)Microbes in Environment:

Prokaryotes, classification of microbes, isolation of microbes, dispersal of microorganisms in extreme environments, Role of microorganisms in elemental cycles, Microbes as bio indicators in the environment.

Water microbiology:

Waterborne diseases, role of microorganism in treatment of wastewater.

b)) Air microbiology:

Aerobiology, allergies; role of microorganism in airborne diseases, Classification and enumeration of microbes in air, dust droplet and droplet nuclei.

Soil microbiology:

Important microbes for soil fertility, biodegradation of waste; soil borne diseases, Role of microbes in soil reclamation.

References :

1. Ecology - E.P. Odum, 1983, Holt-Saunders International Edition
2. Concepts of Ecology. E. J. Kormondy, 1984. Indian reprint 1991 Prentice-Hall of India.
3. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
4. Microbiology – Pelzar, Reid and Chan. Tata Mc Graw Hill Publishing Company Limited, 1996.
5. Environmental Science, S.C. Santra, New Central agency Pvt. Ltd.
6. Fundamentals of Ecology, M.C. Dash, Tata McGrow Hill Publishing Pvt. Ltd., New Delhi.
7. General Microbilogy, Stainer R.Y. , Mc Millan Press, New Delhi.
8. Microbial methods for Environmental Biotechnology, Grenar J.M., Academic Press, New Delhi.

CC-104: Environmental Geosciences, GIS and Remote Sensing

After completion of the course, the students are able to

CO1: Understand the universe, solar system Origin and evolution of biosphere

CO2: Know the basics of Atmosphere, structure, composition and dynamics

CO3: Understand the concepts in Meteorology and Climatology.

CO4: Relate the knowledge of remote sensing in understanding the basics of geography.

CO5: Apply the principles of GIS in solving various environmental problems and disaster Management.

Syllabus

Unit – 1 **(15)**

a) The universe and solar system

Brief introduction to universe, Sun - its structure and atmosphere, physical Characteristics of planets, brief description of – comets, asteroid, meteors, origin of earth.

b) Origin and evolution of biosphere

Origin and evolution of life, spontaneous generation of the life, abiogenic synthesis of low molecular weight organic compounds. Chemical evolution, prokaryotic and eukaryotic cellular evolution, Evolution of organelles and genetic basis for evolution

Unit -2 **(15)**

a) Atmosphere, structure, composition and dynamics

The vertical structure of atmosphere, composition of earth's atmosphere, thermal stratification, the ionosphere, D.E.F. and G regions, energy transfer near earth's surface, isolation, terrestrial radiation and heat balance of the earth.

b) Meteorology and Climatology

Concept of Weather, Climate, Meteorology and Climatology, Elements of Weather, Measurement of premise – Temperature, Air pressure, Turbulence, Wind, Rain, Humidity and Radiation. Wind systems of the world, El Nino, Monsoon phenomenon and its role in Indian subcontinent.

Unit -3 **(15)**

Principles of Remote Sensing, its Applications in Environmental Monitoring

Principles of remote sensing, EMR and its interaction with matter, types of sensors and platforms, IRS satellites and their sensors, aerial photography, satellite imagery, elements of aerial/satellite image interpretation, application of remote sensing in environmental studies.

Unit -4

Geographical Information System (GIS) **(15)**

Concept of GIS, Maps and GIS, cartography, digital representation of geographic data, types of geographical data, raster and vector based GIS data processing

Use of software's in Remote sensing and GIS to solve Environmental problems including Groundwater Exploration, Rainwater Harvesting, Biomass analysis and its relationship with Georesource evaluation, Sustainable Agriculture, Applications of Remote sensing and GIS in early warning of Tsunami, Earthquake, Snowfall, Global warming, Forest fire, Landslide, Land subsidence.

References:

1. Physical Geography - S. Strahler ,John Wiley and Sons,
2. Earth Science - Turbuck E. J.
3. Earths Dynamic Systems _ Hamblin W. K. and E. H. Christian
4. Planet Earth - Cesare Emiliani.
5.B.L.Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000

CC-201: Air and Noise Pollution

After completion of the course, the students are able to

CO1: Explain the classification of air pollutants with its effects on biota

CO2: Explain the sampling and monitoring of air pollutants.

CO3: Explain the working principle of air pollution controlling equipment.

CO4: Understand the control measures of noise pollution

Unit -1 Basic concepts of Air pollution **(15)**

Air pollution

a) Natural and anthropogenic sources of air pollution, Classification of air pollutants, Indoor air pollution, air pollution episodes and disasters.

b) Effects of air pollution on human health, animals, plants, material and climate, Formation of fog and smog, acid rain, National Air Quality standards, laws governing behaviour of air pollutants, Air quality index.

Unit -2 Monitoring of Air Pollution: **(15)**

a) **Air pollutants sampling:** Sedimentation, High-volume Filtration, Tape sampler, Impingement and Electrostatic precipitator; Collection of gaseous air pollutants: Grab sampling, Absorption in liquid, Adsorption on solids, Freeze out sampling; Indoor Air Monitoring.

b) **Source Sampling:** Representative sampling, isokinetic sampling, Flue gas analyser, principles for monitoring COx, NOx, SOx, Hydrocarbon.
Air Pollutants Dispersion and Modelling: Meteorological aspects of air pollutants dispersion, Plume behavior; Gaussian Plume Model, Line source model and Area source model

Unit -3 Air pollution control technologies: **(15)**

a) **Particulate pollutants Control:** Gravitational Settling Chambers, Cyclonic separator, Fabric filter System, Electrostatic precipitators, Wet scrubbers
Gaseous Pollutants Control: Absorption; spray chambers (and towers or columns), plate or tray towers, packed towers, and venturi scrubbers; Adsorption, Pressure-Swing Adsorption (PSA), Condensation: Surface and contact condensers; Combustion: Direct-flame, thermal and catalytic combustion

b) **Vehicular Pollution Control**: Air-Fuel ratio, Catalytic convertor: Selective catalytic reduction (SCR), Selective non-catalytic reduction (SCNR), Bharat Stage Emission Standards (BSES).

Unit -4 Noise Pollution and its control: **(15)**

Noise Pollution

Definition; Sources; Decibel Scale, Sound Pressure Level, Combining Decibel, Frequency Weighting Networks, Noise Indices (L10, L50, L90, Leq, LDN, TNI). Noise & vibration measurement and noise standards, Sound level meter, Noise control and abatement measures: Active and Passive methods, Impact of noise and vibrations on human health.

References:

1. Waste water engineering, Met Calf and Eddy, INC, Tata Mc Graw Hill
2. Indian Standard for Drinking Water, BSI, New Delhi.
3. Environmental Pollution Control, C.S.Rao, Wiley Eastern Ltd.,1993
4. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993.
5. Fundamentals of Air Pollution, Samuel, J.W., 1971, Addison Wesley Publishing
6. Fundamentals of Environmental Pollution, Krishnan Khannan, S. Chand and Company Ltd.,1994.
7. Noise Pollution, Vandana Pandey, Meerut Publishers,1995.

CC-202: Water Pollution and its Control

After completion of the course, the students are able to

CO1: Acquire the knowledge of basic rationale of water quality management.
CO2: Characterize the typical inorganic and organic pollutants from a variety of sources entering into water bodies.
CO3: Design and develop water purification techniques for safe drinking water and wastewater treatment technologies for abatement of water pollution.
CO4: Apply the knowledge of various methods for water resource management

Syllabus

Unit – 1

a) **Water Pollution** **(15)**

Principle forms of water pollution, sources of water pollution, Sampling of water, physicochemical and bacteriological analysis of water, water quality parameters, Eutrophication and recovery,

b) **Ocean pollution**-sources of pollution, Ballast water, Oil pollution effects, control.

Thermal pollution, **Ground water pollution** - sources of pollution, effects, control, Water quality standards, consequences of water pollution and control. Water quality index.

Unit – 2 Drinking Water Characteristics and Purification Techniques **(15)**

a) **Water Sources** – Availability and quality of Surface water and Groundwater, Water Requirements for Domestic Consumption (Population forecasting), Drinking water standards (physical, chemical & bacteriological),

b) Water Treatment process – Principal, process design and applications (Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonation), water softening

Unit -3 Wastewater Treatments **(15)**

a) **Primary treatments**-principle, flow measurement, screening, grit removal, skimming tank, equalization; sedimentation **Secondary treatments**- principle, coagulation, flocculation, filtration, chemical precipitation, membrane filtration, Activated Sludge Treatment Process, Trickling filter, rotating biological contactors (RBC), Up flow anaerobic sludge blanket (UASB),

b) **Wastewater treatment for small communities:** aerobic lagoons, oxidation ponds, septic tank, SBR **Sludge treatment** – Preliminary operation, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludge, Sludge disposal,

Tertiary treatment - Activated carbon filtration unit, disinfection of water -UV radiation, Ozonation, Chlorination, Reverse osmosis (RO).

Unit–4 Concept, Design and functioning of treatment plants **(15)**

Concept, Design and functioning of treatment plants, Design and functioning of sand filter, Sewage treatment plant (STP), Effluent treatment plant (ETP), Common Effluent treatment plant (CETP).

References:

1. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd.,1993
2. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993
3. Fundamentals of Environmental Pollution, Krishnan Khannan, S.Chand and Company Ltd., 1994.
4. Environmental Chemistry, A. K .De.,New Age Intl. pub Co, New Delhi, 1990.
5. Environmental Pollution Anlysis- Khopkar

CC-203: Solid and Hazardous Waste Management

After completion of the course, the students are able to

CO1: Understand various concepts related to solid waste management.

CO2: Apply steps in solid waste management - waste reduction at source, collection techniques, materials and resource recovery/recycling, transport, optimization of solid waste transport, treatment and disposal techniques.

CO3: Acquire the knowledge related to hazardous waste management.

CO4: Evaluate the solid waste management according to the legal framework

Syllabus

Unit –1 Municipal Solid Waste **(15)**

Solid wastes: Sources, classification, characteristics of solid waste, Waste generation rates, Collection and storage of municipal solid wastes, transfer stations, waste processing - volume and size reduction, source reduction, recycling, waste minimization.

Unit -2: Waste Treatment and Disposal **(15)**

a) Waste processing technologies, Incineration, Combustion, Stabilization, Solidification, chemical fixation, encapsulation, Composting, Vermicomposting, Energy from waste – Bio- gasification - Anaerobic digestion, pyrolysis, refuse derived fuels;
b) Landfill bioreactors, Burning, open dumping - problems, Landfill – site selection, Sanitary and secured – structure, design, construction, operation and closure. Landfill leachate and gas management, Landfill bioreactors

Unit -3 Hazardous Waste Management **(15)**

a) **Hazardous waste**: Definition, sources, classification, collection, segregation, characterization, Treatment and disposal.
Radioactive wastes: Definition, sources, classification, collection, segregation, Treatment and disposal.
b) **E waste**: Definition, sources, classification, collection, segregation, Treatment and disposal. **Biomedical wastes:** Definition, sources, classification, collection, segregation, Treatment and disposal. **Plastic Waste:** types as per chemistry, Problems in environment, Disposal mechanisms

Unit – 4 Waste Management Legislation **(15)**

Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments, Biomedical Waste (Management and Handling) Rules, 2016; Plastic Waste Management Rules, 2016; E-Waste Management Rules, 2016; Bio-Medical Waste Management Rules, 2016; Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016; Construction and Demolition Waste Management Rules, 2016.

References:

1. Ecology and Environment, P. D. Sharma, Ashish publications, 1994.
2. .Ground water Hydrology by D..K..Todd John Wiley and Sons.
3. Ground water contamination (Transport and remediation) by Philp Bedient, Hanadi.
4. S. Rifai and Charles. Publishers: Prentice Hall.
5. Environmental Hydrology by Andy. D. Ward and William J..Elliot, Lewis
6. Environmental Geography, Valdia ,K..S(1987)
7. Environmental Geography, Savindra Singh
8. Environmental Geology,Keller E.A. and Turk and Turk
9. Introduction to weather and climate-Trewartha
10. Physical Geography - S. Strahler, John Wiley and Sons,

CC-204: Energy studies

After completion of the course, the students are able to

CO1: Classify the energy resources into renewable and non-renewable resources.

CO2: Recognise the power and applications of solar energy

CO3: Get acquainted with the knowledge of biomass energy.

CO4: Make aware about the energy generation from ocean, tides and hydel power plant.

CO5: Illustrate the mechanism and types of methods for watershed management

Syllabus

Unit- 1 **(15)**

a) Introduction to energy resources

Energy use pattern in developed and developing Energy crises; Energy use pattern in India; Sources of energy and their classification; Energy forms and transformation, role of IREDA and MEDA in energy generation.

b) Fossil Fuels:

Fossil fuels – classification, composition, physiochemical characteristics; Energy content of coal, petroleum and natural gas; Formation, reserves, exploration/ mining and uses of Coal, Oil and Natural gas; Environmental problems associated with exploration/mining, processing, transportation and uses

Unit- 2 **(15)**

a) Solar Energy

Sun as source of energy: Nuclear fusion on sun, Solar spectrum, solar radiation – absorption, reflection, scattering and diffusion in the atmosphere, Albedo, Measurement of solar radiation, Harnessing of solar energy, Solar collectors and concentrators, Solar thermal energy, Solar electricity generation, Solar heaters, dryers and cookers; Photovoltaic

b) Biomass Energy

Biomass composition and types; Conversion processes – pyrolysis, charcoal production, compression, gasification and liquefaction; Energy plantation;
Biogas – production and uses, anaerobic digestion; Types of digesters, Environmental constrains; Energy from solid wastes - Sources, types, energy production

Unit- 3 **(15)**

a) Energy from water:

Principles of generation of hydroelectric power, hazard related to hydropower generation and distribution, environmental impacts, Energy from oceans- OTEC, Tidal energy, wave energy.

b) **Wind Energy:**

Wind power, Harnessing of wind energy, Power generation – wind mills, concentrators, wind characteristics and siting, environmental considerations; Wind energy potential in India.

Unit- 4 **(15)**

a) Geothermal energy:

Sources – crust, high temperature aquifers, low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect; Geothermal energy prospect in India.

b) Nuclear energy:

Fission and fusion, Nuclear fuels, – Mining and processing of Uranium –concentration, refining, enrichment, fuel fabrication and fuel cycle; Nuclear reactors and radioactive waste; Magneto Hydro Dynamic (MHD) power generation, Fuel cells.

References :

1. Remote Sensing and GIS - M. Anji Reddy.
2. Environmental Remote Sensing - F. Mark Danson.
3. Principles of GIS for Land - Burrough P.A. Resources Assessment.
4. Renewable Energy Environment and Development, Maheswar Dayal Konark Publishers pvt. Ltd.
5. Renewable Energy Programmes in India : some recent developments , Sinha P.C., Natural Resource Forum, 18 (3), 1994.
6. Renewable Energy Resources: Basic Principles And Applications Tiwari, G.N., Narosa Publishing House.
7. Conventional and Non conventional Energy sources G. D Rai.