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शिवाजी विद्यापीठ, कोल्हापूर
४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग: ०२३१- २६०९०९४. २६०९४८७
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Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Science/153 **Date: 07/ 03/2024**

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

Subject: Minor Change in Syllabi of M. Sc. Part –I (Sem.I&II) Environmental Science, (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 **Minor Change in syllabi** of M.Sc. Part –I (Sem.I&II) Environmental Science, under the Faculty of Science and Technology.

This Cousre Syllabi shall be implemented from the Second term of Academic Year 2023-2024 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

(Dr. S. M. Kubal)
Dy Registrar

Encl : As above

Copy to: **For Information and necessary action.**

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

M.Sc. Environmental Science

Programme Structure and Syllabus (Level 6.0) (Part-I)

Multiple Exit option (NEP 2020)

ACADEMIC SESSION
(w. e. f. 2023-2024)

DEPARTMENT OF ENVIRONMENTAL SCIENCE,

SHIVAJI UNIVERSITY, KOLHAPUR

- ## 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 analyse, 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

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2023)
M.Sc. Environmental Science Programme
M.Sc. Part – I (Post Graduate Diploma in Environmental Science)
(Level-6.0)
Sem. I (Duration Six Months)

Sr. No	Course Code	Title of the course	Credits
1.	CC-101	Introduction to Environment and Ecology	4
2.	CC-102	Natural Resources Management and Sustainability	4
3.	CC-103	Research Methodology	4
4.	DSE-101	1. Environmental Chemistry, Microbiology and Instrumentation Techniques 2. Biodiversity Conservation and Wildlife Management	4
5.	CCPR-101	Environmental Science Practical I	4
6.	CCPR-102	Environmental Science II	2

Sem. II (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-201	Air, Noise, Soil and Radiation Pollution: monitoring and its control	4
2.	CC-202	Water and wastewater management	4
3.	CC-203	(OJT/RP) Students are expected to spend a minimum of 30 days during their semester break under the guidance of a competent professional / scientist at a research institute or research centre with the aim of learning techniques and their applications OR internship in industry /consultancy/ NGO. The assessments should be based on supervisor's feedback, submission of a training report and a open presentation and Viva voce.	4
4.	DSE-201	1. Solid and Hazardous Waste Management 2. Environmental Geoscience and Climatology	4
5.	CCPR-201	Environmental Science Practical III	4
6.	CCPR-202	Environmental Science Practical IV	2

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2023)

M.Sc. Environmental Science Programme

M.Sc. Part – II

(Level-6.5)

Sem. III (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-301	Energy Studies	4
2.	CC-302	Environmental Toxicology and Nanotechnology	4
3.	DSC-303	1. Climate change, Adaptation and Mitigation 2. Global Environmental Issues	4
4.	CC-301	Research Project (Phase I)	4
5.	CCPR-301	Environmental Science Practical V and VI	6

M.Sc. Part II

Sem. IV (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-401	Environmental Impact Assessment and Environmental Audit	4
2.	CC-402	Environmental Laws, Environmental Management System and Life Cycle Assessment	4
3.	CC-403	Industrial Safety, Disaster Management	4
4.	DSC-401	1. Environmental Biotechnology 2. Restoration Ecology and Watershed Management	4
5.	CC-405	Research Project (Phase II)	6

Choice Based Credit System with Multiple Entry and Multiple Exit Option (NEP-2023)
M.Sc. Environmental Science Programme
M.Sc. Part – I (Post Graduate Diploma in Environmental Science)
(Level-6.0)
Sem. I (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-101	Introduction to Environment and Ecology	4
2.	CC-102	Natural Resources Management and Sustainability	4
3.	CC-103	Research Methodology	4
4.	DSC-101	1. Environmental Chemistry and Instrumentation Techniques 2. Biodiversity Conservation and wildlife management	4
5.	CCPR-101	Environmental Science Practical I and II	6

CC-101 Introduction to Environment and Ecology

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 Environmental Education, People's participation, Sustainable Development.

CO3: Get acquainted with Fundamental Concepts of Ecology.

CO4: Understand the basics of Biodiversity conservation.

Syllabus

Unit -1

a) Introduction and Scope of 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, Environmental segments - lithosphere, hydrosphere, and atmosphere.

b) Environmental Education, People's participation, Sustainable Development

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

Environmental movements, People's participation and role of NGOs in environmental protection, Involvement of social, organizations, women groups, youths nature**,** etc. in environmental protection action, Concept, Definition of sustainable development integrating economic and Ecological principles, Sustainable development goals

Unit – 2 **(15)**

a) Fundamental Concepts of Ecology

Definition of ecology and sub divisions, Relation to other sciences, Relevance to civilization, levels of organization hierarchy, Cake and other ecological models, Concept of ecosystem, its structure and function, cybernetic nature and stability of Ecosystem, Energy in ecological systems, concept of productivity, food chains, food web and trophic levels, ecological pyramids, Concept of habitat, niche and guild, concept of ecotone and edge effect, Carrying capacity

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 – 3 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 – 4 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

CC-102: Natural Resources Management and Sustainability

Students are able to

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

CO2: Understand the role of abiotic natural resources like Soil, Mineral, and Energy resources.

CO3: Introduce the concept of wetlands, ground water, Watershed Management.

CO4: Understand the concept of Forest resources and its monitoring.

Syllabus

Unit – 1 **(15)**

a) Introduction to natural resources and Soil, Mineral, and Energy resources

Definition and concept of resources, types of resources, values of a resources, Abiotic resources- minerals, fossil fuels, water, soil, Biodiversity as a resource

Soil as resource, Soil classification, genesis, causes of soil degradation and their effects, Soil conservation practices, wasteland reclamation.

Mineral resource: important minerals; mineral exploitation; use of minerals**;**

Environmental problems due to mining; reclamation of mining areas;

Energy resources: conventional energy resources (fossil fuels, biomass), nonconventional energy resources (wind energy, solar energy) energy use patter;

Environmental problems due to energy use.

Unit – 2 **(15)**

a) Conservation of wetlands, ground water

Wetlands: Definition and classification of wetlands, values of wetland, present status of wetlands in India, RAMSAR convention, Wetland International, conservation of wetlands, Environmental Importance of Mangroves

Ground water: Definition – soil moisture, Water table, Aquifers, Geology of aquifers; Ground water flow; Environmental influences on ground water overuse, Ground water recharging and rain water harvesting.

Unit – 3 **(15)**

Watershed Management:

Concept, objectives, planning and measures; Water shed morphology and characterization (with respect to size, elevation & slope, aspects & orientation, watershed shape, drainage network), Socioeconomic aspects of watershed management

Water harvesting methods: traditional water harvesting structures such as nadis, Khadin, Rapats, Lakes, etc. contour bunding, graded bunds /field bunds, land leveling or terracing, farm ponds

Water harvesting in streams: Biological measures, check dam, gully plug, Gabion structure, Overflow weir, earthen dam, Underground *bandhara*. Soil and water conservation aspects: Contour trenches, continuous contour benches, live hedges, infiltration pit, *in situ* conservation through appropriate cultivation practices

Rainwater harvesting techniques, Ground water recharge techniques

Unit – 4 **(15)**

a) Forest resources

Energy plantation, social forestry, Joint Forest management programme (JFM), Agro forestry Systems

Forest resource monitoring:

Definition and scope. Measurement of individual trees: a) Measurement of diameter and girth of trees b) Measurement of heights of trees c) Measurement of form of trees d) Measurement of volume of felled trees e) Measurement of volume of standing trees f) determination of age of trees g)) determination of increment of trees, increment percent, Sample plot, forest inventory, kinds of Sampling, sampling units, sampling intensity.

Wild life monitoring: scope, methods/ techniques a) census for invertebrates, fish, amphibian, reptiles, birds and mammals

b) Natural resource conservation and Natural Resource Accounting

Concept of resource conservation and its importance, economic aspects of resource conservation, planning for the conservation of resources, NRA for soil, water, air and biodiversity resource, Environmental Action Plan (EAP).

References:

1. Environmental Conservation: R. F. Dasman (1968) John Wiley and Sons New York .
2. Environmental Science, Miller T. G. Jr., Wadsworth Publishing Company.
3. Environmental Biology and Toxicology, P.D. Sharma, Rastogi Publications Meerut 1985
4. Global Biodiversity Assessment, V. H. Heywood and Watson, R.T.,
5. Essentials of Ecology and Environmental Science, Rana S.V.S, Prentice Hill Publications, New Delhi

CC-103: Research Methodology

Students are able to,

CO1: Know the basics of scientific writing

CO2: Analyse the facts with the help of Biostatistics

CO3: Use of Computer Applications for data management and presentation.

CO4: Understand the Principles of Remote Sensing, its Applications in Environmental Monitoring

Unit -1 **(15)**

a) Research Methodology:

i. Principles of scientific research experimentation in natural sciences. Postulation of hypothesis

ii. Design, execution, analysis and evaluation of experiments.

iii. Methodology:

1. Selection of Methodology of study various tools and their scope and limitation in application,
2. Selection of research topic, Library consultation, compilation of working, bibliography preparation.

b) Scientific writing:

i. Technique and knowledge of preparation of abstracts, Manuscripts, Dissertation thesis and report writing.

ii. Preparation of articles for scientific journal, typing / printing -manuscripts, margins, spacing, heading and title page numbers, tables and illustrations, corrections and insertion, preparation of contents.

iii. Preparation of list of work cited: General guidelines, placement, arrangement, citation of books, and other references, citation technique in report writing, information storage and retrieval sample entries, maintenance of field note book.

iv. Abbreviations and reference words, standard abbreviations, scientific connotations, SI Units, geographical names, common scholarly abbreviations and reference/key works, publishers names, symbols and abbreviations used in printing technology and proof reading.

v. Plagiarism.

vi. Copy Right Laws and their protection.

Unit- 2 **(15)**

Biostatistics

Nature of environmental data: Survey based (empirical) and experimental data. Concepts of population and sample – Random variable and parameters of interest. Concepts of statistical inference, Simple random sampling for selection of sampling units for making observations.

Univariate data –

Frequency distribution and their properties (including Skewness and Kurtosis), Histogram, Frequency Curve and Ogive Curves. Measure of central tendency: Mean, Median and Mode. Measure of Dispersion: Range, Variance, standard deviation and co-efficient of variation. Presentation of data: Summery statistics and graphical methods.

Bivariate data -

Obtaining bivariate data by measuring two variables on a single sampling unit. Summary statistics for bivariate data: Mean, standard deviation and covariance, correlation coefficient. Scatter plot and its interpretation.

Multivariate data –

Multivariate analysis, Regression Multivariate Analysis, PCA, Q-mode and R-Mode Factor analysis, Time-series data analysis, Moving averages, Wavelet analysis / Spectral analysis; Introduction to MATLAB

Tests of Significance-

Chi- squared test: goodness of fit. Independence of attributes, T and F tests for significance

Unit -3

Computer Applications:

a. **Microsoft Excel**: Introduction to spreadsheet application, features and functions, using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool.

b. **Microsoft PowerPoint**: Introduction to presentation tool, features and functions, creating presentation, customizing presentation, showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool.

c. **Web Search**: Using advanced search techniques, Google earth, Using GPS.

Unit -4 **(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. Barnett Vic (2004) Environmental Statistics: methods and applications.
2. Ott, Wayne R. (1995) Environmental Statistics and data analysis.
3. Zar, Jerrold H. (1997) Biostatistical Analysis. Prentice Hall (India)
4. Nychka, Douglas and Piegorsch Walter W (1998) Case studies in environmental Statistics.
5. Manly Bryan F.J. (2001) Statistics for Environmental Science and Management.
6. Walpole R. and Myem R. (1993) Statistics for engineers and scientists

DSE-101: 1. Environmental Chemistry, Microbiology and Instrumentation Techniques

After completion of the course,

the students are able to

CO1: Understand the basic concepts in environmental chemistry

CO2: Identify the role of microorganisms in environment

CO3: Analyse the chemistry of water and soil pollutants

CO4: know different instrumentation Techniques for environmental analysis.

Syllabus

Unit – 1

a) Chemistry of Atmosphere: (15)

Composition of earth's atmosphere, The vertical structure of atmosphere, thermal Stratification, the ionosphere, D.E.F. and G regions 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 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

Monitoring of Soil

Objectives of soil monitoring/testing, sampling and sample units; sample number, frequency and timing; Sampling methodology; a. Site selection b) Infield sampling technique c) Describing the soil profile d) Site description e) Setting a transect instruments / Equipment's used,

Quality Parameters (testing contaminants/polluting elements), important soil quality indicators - soil acidity (pH); EC; carbon (C); total nitrogen (N) and carbon to nitrogen ratio; extractable phosphorous (P); extractable potassium (K) and magnesium (Mg); micro nutrients

Unit –2 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:

Role of microorganisms, Kinds of Microorganisms, Pathogenic microbes, indicator microbes, enumeration of microbes, Coliform bacteria as indicator organisms, Tests for the coliform group (MPN

Method), Types of waterborne diseases (Protozoan, Algal, Fungal, Bacterial, and Viral diseases), prophylactic measures, 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.

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.

DSE-101 2.Biodiversity Conservation and Wildlife Management

Unit -1

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.

Unit -2 (15)

Wildlife as a Resource, threats to wildlife, wildlife environment, methods of study, Wildlife wealth of India, Endangered fauna of India, Wild-life conservation and management strategy, Application of tissue culture in conservation of plant and animal species, wildlife censes methods, censes analysis & interpretation. Objectives and functions of IUCN and WWF

Unit -3 (15)

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 (15)

Measures of Conversation of wildlife: Biosphere reserve, Sacred groove and other protective areas. Project Tiger, Tiger Reserves in India, Crocodile Breeding, Project Elephant, Save Barasingha, Investigation and identification of potential and prospective threats.

Improvement and development of wildlife environment, Wildlife diseases, Concept & Criteria of Ecological Sensitive Zone, National Parks, Sanctuaries and facilities, National and international organizations, eco sensitive zones- concepts & criteria's.

References:

1. Environmental Conservation: R. F. Dasman (1968) John Wiley and Sons, New York.
2. Environmental Science, Miller T. G. Jr., Wadsworth Publishing Company.
3. Environmental Biology and Toxicology, P.D. Sharma, Rastogi Publications, Meerut 1985
4. Global Biodiversity Assessment, V. H. Heywood and Watson R.T.
5. Essentials of Ecology and Environmental Science, Rana S.V.S, Prentice Hill Publications, New Delhi
6. Corporate Environmental Strategy: The Avalanche of Change Since Bhopal Bruce Piasecki Wiley
7. Environmental Management, N K Uberoi, Published by Excel Books

8. Forest Management and Planning Peter Bettinger, Pete Bettinger, Kevin Boston, Jacek. Siry, Donald L. Grebner, Academic Press, 2010
9. Forest Management in India, S.S. Negi, Published by Bishen Singh Mahendra Pal Singh, 2011
10. Wildlife Management and Conservation: Contemporary Principles

Sem. II (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-201	Air, Noise and Radiation Pollution: monitoring and its control	4
2.	CC-202	Water and wastewater management	4
3.	CC-203	(OJT/RP) Students are expected to spend a minimum of 30 days during their semester break under the guidance of a competent professional / scientist at a research institute or research centre with the aim of learning techniques and their applications OR internship in industry /consultancy/ NGO. The assessments should be based on supervisor's feedback, submission of a training report and a open presentation and Viva voce.	4
4.	DSC-201	1. Solid and Hazardous Waste Management 2. Environmental Geoscience ,GIS and Remote Sensing	4
5.	CCPR-201	Environmental Science Practical III and IV	6

CC-201 Air, Noise, and Radiation Pollution: monitoring and its control

After completion of the course, the students are able to

CO1: Explain the 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 sources, effects and control measures for noise and radiation pollution

Unit -1 **(15)**

a) Air pollution

Natural and anthropogenic sources of air pollution, Classification of air pollutants, air pollution episodes and disasters, Effects of air pollution on human health, animals, plants, material and climate, acid rain, National Air Quality Standards, laws governing behaviour of air pollutants, Air quality index.

b) Air pollutants sampling:

Particulate Matter sampling: PM_{10}, $PM_{2.5}$**,** Sedimentation, High-volume Filtration, Tape sampler, Impingement and Electrostatic precipitator;

Collection of gaseous air pollutants, monitoring of COx, NOx, SOx, Hydrocarbon, O_3, C_6H_6, Pb,

Indoor air pollution: Sources, Effects Monitoring and Control

Stack Sampling: Representative sampling, isokinetic sampling, Flue gas analyser,

Air Pollutants Dispersion and Modelling: Meteorological aspects of air pollutants dispersion, Plume behaviour; Gaussian Plume Model, Line source model and Area source model

Unit -2 **(15)**

Air pollution control technologies:

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

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

Unit -3 **(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, Noise Standards, Sound level meter, Noise control and abatement measures: Active and Passive methods, Impact of noise and vibrations on human health.

Unit -4 Radiation Pollution **(15)**

Types, sources and measurement, Detection of nuclear radiations – G. M. counter, scintillation counter, semi-conductor detector. Internal and external radiation hazards, Biological effects and health hazards associated with radiation. Interaction of radiations with biological cells, somatic and genetic effects. Classification of radio-active wastes – gas, solid, liquid.

Control measures – treatment and disposal of radio-active waste, generation of waste from various sources, Chernobyl accidents

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.
8. Guidelines for the Measurement of Ambient Air Pollutants - Volume-I - Guidelines for Manual Sampling & Analyses by Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India), Delhi - May, 2011
8· Guide Manual: Water and Wastewater Analysis By Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India), Delhi - May, 2011
9· Guidelines for Water Quality Monitoring by Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India), Delhi - MINARS/27/2007-08
10· Guidelines for Water Quality Management - by Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India), Delhi

CC-202 Water and Wastewater Management

After completion of the course, the students are able to

CO1: Acquire the knowledge of water pollution

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: know the selection of appropriate unit operations for industrial wastewater

Unit – 1

a) Water Pollution (15)

Principle forms of water pollution, sources and effects of water pollution, Eutrophication, **Ocean pollution**-sources of pollution, Ballast water, Oil pollution effects, control.

Thermal pollution, **Ground water pollution -** sources of pollution, effects, control, Sampling of water, physicochemical and bacteriological analysis of water, water quality parameters, Specifications for drinking water (physical, chemical & bacteriological) by Bureauof Indian Standards & World Health Organization. Packaged drinking water, Water Quality Index

b) Quantity of water - Water Requirements for domestic consumption. Population forecasting by the methods, Demographic method, Arithmetical progression method, Geometrical progression method, Logistic methods, Graphical projection method, Final prediction. Variation in quantity of water and waste water, Factors affecting rate of demand.

Quality of water required for – Domestic, Institutional (Schools, Hostels, Hospitals), Fire fighting, Commercial (Shopping complex, Hotels, Restaurant), Industrial (Dairy, Sugar, Pulp and Paper, etc.). Specific requirement at pilgrimage place and recreation activities

Unit – 2

Water Treatment – Principle, Application & Designing of following Unit Operation in water treatment.

a. Collection & pumping; b. Aeration; c. Flocculation; d. Sedimentation; e. Filtration;

f. Disinfection; g. water softening

Advanced treatment methods:

a. Demineralization; b. Ultra filtration; c. Reverse osmosis; d. Colour & odour removal by activated carbon; e. Iron removal; f. Nitrification and denitrification

Unit – 3

Wastewater engineering –

Primary, secondary and Tertiary treatment process (STP, ETP, CETP) Principle and designing of following Unit Operations in waste water treatment:

Collection system - Methods of collection, conservancy systems, collection system, water carriage system, sewerage system.

Screen chamber, Grit chamber, Oil & grease removal, Aeration and sedimentation, Stabilization pond, Aerated lagoon, Activated sludge process, Trickling filter, Rotating biological contactors

Anaerobic digestion processes, fluidized bed reactor, UASB

Treatment and Disposal of sludge (composting, sludge cakes, sludge digestion, energy recovery) Special treatments like septic tanks, soak pits

Unit – 4

Specifications of treated wastewater for disposal into surface water, on land & in marine waters after treatment.

Industrial Wastewater-Selection of appropriate unit operations for the treatment and flow chart of wastewater treatment plant for

a. Dairy; b. Pulp & Paper; c. Sugar, d. Textile e.Distillary etc.

Common Effluent treatment plant (CETP).

Reference:

1. Waste water engineering – Metcalf & Eddy
2. Elements of Environmental Engineering –K.N. Duggal
3. Water Supply and Sanitary Engineering –G.S.Birdie and J.S.Birdie
4. Water Supply Engineering –Dr. P.N.Modi
5. Water Supply and Wastewater Engineering –Dr. B.S.N.Raju
6. Water Supply Engineering –B.C. Punmia
7. Water Supply Engineering –Hussain
8. Water Supply Engineering –Chatterjee
9. Environmental Biotechnology-T Srinivas (New Age Publications)
10. Environmental Engineering - Peavy, Rowe, Tchenobolus
11. Water supply and sanitary engineering - Rangwala

CC-203: Internship/FP

OJT/FP) Students are expected to spend a minimum of 30 days during their semester break under the guidance of a competent professional / scientist at a research institute or research centre with the aim of learning techniques and their applications OR internship in industry /consultancy/ NGO. The assessments should be based on supervisor's feedback, submission of a training report and a open presentation and Viva voce.

DSC-201: a) 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)

Sources and generation of solid waste, their classification and chemical composition; **Municipal Solid Waste management in India:** Generation, Collection, segregation, Transportation, Transfer stations, processing and disposal. Assessment of existing situation & possible areas for improvement

Unit -2: Waste management technique (15)

a) Waste processing, Recovery of biological and chemical conversion products composting, biomethanation, RDF system, hydrolysis, Pyrolysis, plasma gasification, incineration, sanitary landfills. Resource conservation and recycling

b) **Industrial solid waste management:** Pulp and paper, Sugar, thermal power station, textile, food processing, mining, agriculture, etc.

Unit -3 Hazardous Waste Management (15)

Hazardous waste: Definition, sources, classification, collection, segregation, characterization, Treatment and disposal.

Radioactive wastes: Definition, sources, classification, collection, segregation, Treatment and disposal.

a) E waste: Definition, sources, classification, collection, segregation, Treatment and disposal.

b) Biomedical wastes: Definition, sources, classification, collection, segregation, Treatment and disposal.

c) Plastic Waste: types as per chemistry, Problems in environment, Disposal mechanisms

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

a) Solid Waste (Management and Handling) Rules, 2000, 2016 and amendments, Biomedical Waste (Management and Handling) Rules, 2016 and amendments; Plastic Waste Management (Amendment) Rules, 2016 and 2022.

b) E-Waste Management Rules, 2016; Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 and 2022; Construction and Demolition Waste Management Rules, 2016, The batteries (Management and Handling) Rule,2001

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,

DSC-202: b) 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