

SU/BOS/Science/497

Date: 10/07/2023

To,

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.
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Subject: Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

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 revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 degree programme under the Faculty of Science and Technology.

M.Sc.Part-II (Sem. III & IV) as per NEP-2020			
1.	Microbiology (HM)	8.	Food Science & Nutrition
2.	Pharmaceutical Microbiology (HM)	9.	Food Science & Technology
3.	Microbiology	10.	Biochemistry
4.	Computer Science	11.	Biotechnology
5.	Computer Science (Online Mode)	12.	Medical Information Management
6.	Data Science	13.	Environmental Science
7.	Information Technology (Entire)	14.	Physics

This syllabus, nature of question and equivalence shall be implemented from the 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

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

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

Thanking you,



Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	8	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	9	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	10	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	11	Centre for Distance Education

M.Sc. Environmental Science

Programme Structure and Syllabus

(Level 9)

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

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



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 Syllabus (2023-24)

M.Sc. Part –II (Level-9)

Sem. III (Duration Six Months)

Sr. No.	Course Code	Title of the course	Credits
1.	CC-301	Natural Resources Management and Sustainability	4
2.	CC-302	Research Methodology and Biostatistics	4
3.	CC-303	Environmental Laws, Environmental Management System and Life Cycle Assessment	4
4.	CC-304	Environmental Toxicology	4
5.	CCPR-305	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	Industrial Safety, Disaster Management	4
3.	CC-403	Climate change, Adaptation and Mitigation	4
4.	CC-404	Environmental Biotechnology	4
5.	CCPR-405	Environmental Science Practical V and Research Project	6

**Choice Based Credit System with Multiple Entry and Multiple Exit Option
(NEP-2020)**

M.Sc. Environmental Science Programme Syllabus (2023-24)

M.Sc. Part –II (Level-9)

Sem. III (Duration Six Months)

CC-301 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

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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)

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

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-302: Research Methodology and Biostatistics

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, it's 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:
 - (i) Selection of Methodology of study various tools and their scope and limitation in application
 - (ii) 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.
- vii. Scopus, Web of Science, UGC Care journals

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: Summary statistics and graphical methods.

Unit- 3

(15)

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 -4

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.

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

CC303 - Environmental Laws, Environmental Management System and Life Cycle Assessment

Students are able to

CO1: Familiarise with the international treaties and agreements for environmental conservation.

CO2: Recognise the role of National Green Tribunal, MoEFCC CPCB, SPCB for environmental management.

CO3: Aware about the legislative provisions for environmental protection.

CO4: understand the concept of Environmental Management System

CO5: Understand the concept Life Cycle Assessment

Syllabus

Unit – 1

(15)

a) International Environmental Policies Agreements and Treaties

Stockholm Conference (1972), Rio Conference (UNCED, 1992), Agenda 21. Johannesburg treaty, CITES, Basel convention, Montreal Protocol, Kyoto Protocol, COP under UNFCCC, Ramsar Convention

b) National Policies on Environment: National Green Tribunal, MoEFCC, CPCB and SPCB and their role in environmental protection

Unit – 2

(15)

a) Environmental Legislation

Article 48(A), fundamental duties of citizen, Art. 51A (g) directive principles of state policy, 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 (Protection) Rules, 1986 (as amended to date),

The Forest (conservation) Act, 1980, The Wildlife (Protection) Act, 1972,

The Biodiversity (Protection) Act, 2002

Coastal Regulation Zone (CRZ) Notification (as amended to date),

The National Green Tribunal Act, 2010,

Unit – 3 Environmental Management System

(15)

Environmental Management Systems Definition and scope, Goals and purposes of EMS, Planning, Implementation, Review and Improvement (Plan, do, check, act model), Benefits of EMS- Environmental benefits, economic benefits, Costs associated with EMS ISO 14000 series of standards

Unit – 4 Life Cycle Assessment

Life Cycle Assessment Definition, Goals and purpose, Stages in product LCA, Procedure for LCA- defining the goal and scope, analyzing the inventory, assessing the environmental impact and evaluating the environmental profiles, LCA uses and tools, Variants of LCA- cradle to grave, cradle to gate, cradle to cradle, gate to gate, well to wheel, Benefits and limitations of conducting LCA

References:

1. Environmental Law and Policy of India, Diwan, S. and Rosencranz, A, 2001, Oxford University Press.
2. Environmental Policy in India, Shekhar Singh, IIPA, New Delhi.
3. Declaration of: The Stockholm Conference, Rio, Rio+5 and Rio +10.
4. Our Common Future, WECD, 1991.
5. Universal Environment and Pollution Law Manual, S. K. Mohanty, 1998.
6. Legal Aspects of Environmental Pollution and Management, S. M. Ali, 1992.
7. Environmental management” Capital Publishing Bala Krishnamoorthy Vijay Kulkarni and T V Ramchandra.
8. “Environmental Management: text & case studies” PIH learning
9. ISO14001 standard for EMS

CC304- Environmental Toxicology and Nanotechnology

Students are able to

CO1: Classify the sources of toxicants in the environment.

CO2: Aware the concepts in Environmental Nanotechnology.

CO3: Understand the fate of toxicants and transport of toxicants in food chain..

CO4: Know the dose response relationship of toxicants.

Syllabus

Unit – 1 (15)

a) Introduction to Environmental Toxicology

Definition, classification, Sources of toxicants in environment, Evaluation of toxicity, Bioassay, factors affecting toxicity, mutagenesis, spermatogenesis, carcinogens, hallucinogens, phyto-toxins, animal toxins.

Unit – 2 (15)

a) Ecotoxicology

Principles of toxicology, Nature of toxic effects, Acute and Chronic, Toxic substances in the environment, Industrial toxicants and hazardous materials, Routes of toxicants to human body – entry through inhalation, skin absorption, indigestion and injection; Response to toxin exposures -Dose response, Frequency response and cumulative response; Lethal and sub-lethal doses.

b) Analysis of NOEL, LD 50, LC 50 and MLD; Detoxification in human body - detoxification mechanisms, organs of detoxification, Effects of heavy metals and pesticides, Ecosystem influence on the fate and transport of toxicants by air and water; Transport through food chain - bio-transformation and bio-magnification

Unit – 3 (15)

Environmental Nanotechnology:

Overview - Definition, Historical perspectives, Scope, Environmental applications

Types, Structures of Nanomaterials:

Different types of nanomaterials: Silver, Gold, Zinc, Iron, Silica, Titanium, Carbon-based nanomaterials, metal oxide nanomaterials; nano-membranes, nano-wires, nano-needles, nano-cones, nano-rods, nano-combs, nano-walls

Synthesis and Characterization of Nanoparticles:

Basics of nanoparticle synthesis techniques (Chemical, Physical and Biological synthesis);
Functionalization of nanoparticles

Techniques for characterization: UV-Visible Spectrophotometry, Scanned electron microscope (SEM), Transmission electron microscope (TEM), X-ray diffraction (XRD)

Unit – 4

(15)

Environmental Nanoremediation:

Definition, current applications of nanotechnology for environmental clean-up such as use of non-zerovalent iron (nZVI), bimetallic nanoparticles, titanium dioxide Nano membranes, carbon nanotubes for wastewater, groundwater and soil remediation;

Implications of Environmental Nanotechnology: Risks associated with nanomaterial applications to human health and ecology; Environmental protection laws, rules and regulations to prevent hazardous impact of nanotechnology; Solutions and alternatives.

References:

1. Environmental Sanitation, Ehlers, V.M., and Steel, E.W., McGraw-Hill Book Co., Inc.
2. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
3. Basic Environmental Toxicology, Lorris G. Cockerham and Barbara S. Shane, CRC Press.
4. Introduction to Environmental Toxicology Wayne G.Landi Ming-Ho Yu.
5. Patty's Industrial Hygiene and Toxicology, Ed.by Lewis J.Cralley, Lester V. Cralley, James S. Bus.

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	Industrial Safety, Disaster Management	4
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5.	CCPR-405	Environmental Science Practical V and Research Project	6

CC-401 Environmental Impact Assessment and Environmental Audit

After completion of the course, the students are able to

CO1: Understand the concept of Environmental Impact Assessment

CO2: Bring in to light the procedure of Environmental Impact Assessment for various category projects

CO3: Aware the importance of Environmental Audit with its procedure.

Unit 1:

a) Introduction to EIA:

Concept of EIA within the frameworks of sustainable development , History of EIA , EIA – Definition, and Objective/purpose , Reasons for using EIA ,Core Values of EIA – Comprehensive study, sustainability integrity and utility, The Eight Guiding Principles of EIA

b) EIA Policy and Legislation in India

Prevailing EIA notification and important provisions under the same e.g. a) terms of reference, b) categorization of projects, c) public hearing/consultation procedure, d) validity of terms of reference, environmental monitoring, public hearing, and environmental clearance etc.

Unit 2:

a) EIA processes:

Screening Procedure (as per prevailing EIA notification) including project lists for screening , Other types of Screening , Criteria for determination of the need for, and level of EIA , Purpose of Scoping , Approaches to Scoping , Scoping Methods: Adhoc , Checklist, overlay mapping, network, simulation and modelling technique, matrix method , EIA Terms of Reference

b) Baseline Environmental data collection: methodology

a. Ambient Air Quality b. Water including ground and surface c. Soil Conservation d. Noise and Vibrations e. Hydrology, f. Geology g. Ecology and Bio-diversity h. Socio-Economic environment i. Traffic and other data

Unit 3:

a) Impact Analysis/Assessment, Mitigation and Management

i. Impact Identification **ii.** Impact Analysis/Prediction: methodology **iii.** Characteristics of Environmental Impacts - Activity – Impact Characterisation **iv.** Social Impact Assessment (SIA): introduction and methodology **v.** Evaluation of Impact Significance **vi.** Significance Criteria

Impact assessment for:

- a. Land Use b. Air Pollution Monitoring, Prevention and Control c. Meteorology, Air Quality Modelling and Prediction d. Water Pollution Monitoring, Prevention and Control e. Ecology and Bio-diversity f. Noise and Vibrations g. Socio-Economic h. Hydrology, Groundwater and Water Conservation and Geology i. Soil Conservation j. Risk Assessment and Hazard Management k. Solid and Hazardous Waste Management

Public hearing: an important step in EIA

- a. The Process b. Notice of Public Hearing c. Supervision and presiding over the hearing d. Proceedings e. Time period for completion of public hearing f. Arguments for and against public involvement

b) Final Appraisal of project

- a. Grant or Rejection of Prior Environmental Clearance b. Validity of Environmental Clearance c. Post Environmental Clearance Monitoring

Documentation of EIA

- a. EIA report / report writing - Typical Elements of an EIA Report (as per prevailing EIA notification)
- b. Case studies: for EIA report a) coal based thermal power plants, b) cement, c) infrastructure such as road/highways, construction of dam, d) sugar e) distillery

c. Impact assessment statement**d. Environmental Management Plan**

- e. Post Project monitoring-

Unit 4:**Environmental Audit**

Definition of environmental audit and its importance for industries. Environment Compliance Audit. Basic structure of audit. Elements of an audit process and its importance with respect to Form-V. Environment Audit in India – Development of environmental auditing in India, Concept of ISO 14000, requirements of Rule 14 for environmental audit under Environmental Protection Act, 1986. Definitions –signatory, consumption audit, pollution audit, hazardous audit, solid waste audit, disposal audit, cost audit, investment audit, voluntary

References:

1. EIA notification published by Ministry of Environment, Forests and Climate Change, Government of India
2. Environmental Impact Assessment, Canter R.L., McGraw Hill International Edition.

3. Environmental Impact Assessment: Practical Guide for Professional Practices by Rathi AKA, Publisher: Gujarat Akar Unlimited, 2016
4. Environmental Impact Assessment, Canter, L.W., 1977, McGraw Hills, New York.
5. Environmental Impact Assessment, Peter Wathern , Unwin Hywin, London
6. Environmental Impact Assessment, P. R. Triwedi, APH Publishing Corporation, New Delhi
7. A Handbook of EIA, V.S. Kulkarni, S.N. Kaul and R. K. Trivedi, Scientific Publication (India).

CC-402 Industrial Safety, Disaster Management

Students are able to

CO1: Familiarise the concepts of safety and health hazards in industrial and development projects

CO2: Get acquainted with the natural disasters like earthquake, volcanoes, tsunami, land Slides, etc.

CO3: Aware the different Strategies for mitigation disaster management.

Syllabus

Unit-1:

15

a) Health & Safety Management:

Occupational Health and Safety Management System,

Definition, goals, needs, Principles & Practices of industrial safety

Role of Management in Industrial Safety.

Safety Planning:

Definition, purpose, nature, scope and procedure

Strategic planning and tools of implementation. Employee Participation in Safety.

Industrial Safety Auditing & Safety Monitoring:

Concept & Importance of Safety Audit, Types of Safety Audit and standards on Safety Audit:

Health & Safety Monitoring: ISO 45001: 2018 (Occupational Health & Safety Management System)

b) OH & S Policy Formulation, Types of Accident & Accidents Prevention :

Leadership: Role, functions and attributes of a leader.

Leadership & commitment, Organizational roles, responsibilities and authorities, Concept of OH & S Policy, Policy formulation and implementation. Definition: Incident, Accident, Injury, Dangerous occurrences, Unsafe Acts, Unsafe Conditions, Hazards, Near Miss Situations, Hazard Identification and Risk Assessment (HIRA), Accident Investigation, Cost of Accident- Direct & Indirect, Accidental Reporting, Emergency Evacuation Plan. Accident Prevention: Major Theories, Principles of accident Prevention

Unit – 2: Fire Safety Management:

15

Chemistry of fire, Factors contributing towards fire, Classification of fires. Common causes of industrial fires.

Prevention of fire. Portable Fire Extinguishers (Water type, Carbon-dioxide Type, Foam Type, Dry Chemical Type Extinguishers, ABC type), Maintenance of Fire Extinguishers.

Special Industrial fire detection and alarms. Sprinkler systems.

Special safety precautionary measures for control of fire and explosion in handling/processing flammable liquids, gases, vapours, mists and dusts etc. Fixed Fire Fighting Installations (Hydrant/ Sprinklers/ Major Foam pourer/Steam Drenching/ CO2 flooding/ DCP spraying) Fire Emergency Action Plan,

Unit – 3: Environmental Disasters (15)

a) Earthquake:

Causes of occurrences, consequences, measurement, distribution of earthquake in world and India, mitigation.

Volcanoes: Origin and types of volcanic activities, Volcanic belts; causes of occurrences, consequences, distribution in world and Indian subcontinent, mitigation.

Tsunami: causes of occurrences, consequences, distribution in world, mitigation.

Landslides: Causes and types, human induced; Landslide prone areas in India distribution, rock/soil type, protective measures

b) Cyclones and Epidemics:

Cyclones – types -tropical and temperate, distribution in world and India, role in Indian subcontinent

Storms - causes of occurrences, distribution in world, consequences, mitigation.

Epidemics - types and causes and major epidemic's in India.

Unit – 4 (15)

a) Floods and Droughts

Floods – occurrences, Floodplains and Flood-Prone Areas; nature and frequency of flooding; urbanization and flooding; Flood hazard assessment - environmental effects of flooding, role of man and nature, Consequences, Mitigation.

Draught - reason of occurrences, draught prone areas in India and world, consequences, mitigation

b) Disaster management

Strategies for mitigation – warning system, forecasting, Emergency Preparedness, Education and Training Activities, planning for Rescue and Relief works, National and state level

planning for hazards mitigation, Engineered structure /structural strengthening techniques- Hazard zonation and mapping- Risk Reduction Measures.

c) Disaster management plan

Use of remote sensing in disaster management, Disaster management plan, Social and economic impacts of disasters.

References:

1. Environmental Hazards: Assessing Risk and Reducing Disaster Smith, Keith, Routledge Publication
2. Environmental Geology, K. Valdia, Tata McGraw Hill Publishing House
3. Lal D.S. Climatology, Parag Pustak Bhavan, Allahabad
4. Hillary, Sir Edmand, Ecology, 2000, The changing face of Earth, Multimedia Publication, 1984 disaster

CC-403 Climate change, Adaptation and Mitigation DSE-303

a) Climate change, Adaptation and Mitigation

Students are able to

CO1: Understand the concept of greenhouse effect, enhanced greenhouse effect and climate change

CO1: Aware about the impact of climate change at various levels such as, local, regional and global.

CO2: Understand the mitigation techniques for sustainable future.

CO3: Design for the adaptation strategy for vulnerable sectors

CO4: Understand the global scenario about climate change and its politics

Syllabus

Unit – 1 (15)

a) Introduction to climate change

The climate system, and interaction among the sub-systems, The Earth's natural greenhouse Effect, radiation balance, Climates of the past: last hundred, thousands and millions of years; natural versus anthropogenic causes of climate change, enhanced greenhouse effect, greenhouse gases, aerosols, clouds, land use etc;

b) Advancement in climate science:

Sources of greenhouse gases: role of CO₂, CH₄, water vapor etc., global warming potentials, CO₂ equivalents, CO₂ emissions and the Earth's carbon reservoirs, Emission scopes Weather and climate, Global wind systems, importance of monsoons and its circulation on Indian continent, El-Nino and Southern Oscillations, general circulation

Unit – II (15)

a) Impact of Climate change:

Climate change impacts on: fresh water resources-surface and groundwater, drought and soil moisture, wetlands, glaciers melting, terrestrial ecosystem-geographic shifts in terrestrial habitats, vegetation-climate interaction, loss of biodiversity, agriculture and food supply, marine environment- sea level rise, ocean current and circulation, ocean acidification, coastal lives, marine ecosystem.

Carbon footprints, Tipping points: ice sheet collapse, large-scale coral reef die-off, changes in Atlantic Ocean circulation, etc.

b) Mitigation strategies:

Climate change mitigation: concept and methods, Sources identification, Emission reduction, Energy efficiency, Science based targets, net zero, Carbon neutrality, Use of renewable energy, Nuclear energy Carbon pools, Carbon sequestration: vegetation, soil, ocean, Carbon Sinks

Unit – III: International scenario: (15)

a) Climate initiatives: United Nations Framework Convention on Climate Change (UNFCCC), Intergovernmental Panel on Climate change (IPCC), Conferences of Parties (COP), Kyoto Protocol, Doha agreement, Paris agreement

b) Historical emission of carbon by various countries, current emission trends, Climate Justice, Carbon space, Carbon budget

Unit – IV (15)

a) Adaptation strategies:

Adaptive capacity, adaptation to climate change, Zero carbon future, temperature stabilization, vulnerable sectors, vulnerable communities, Resilience building

b) National climate initiatives and Sustainable development goals:

MoEFCC, Nationally determined Contributions (NDCs) under Paris agreement, National Action Plan on Climate change: National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a Green India, National Mission for Sustainable Agriculture, National Mission on Strategic Knowledge for Climate Change

References:

1. The Atmosphere – Lutgens & Tarbuck
2. IPCC Reports on Climate Change
3. Fundamentals of Environmental Science: A Global Concern – Cunningham & Cunningham
4. Environmental Science – Daniel Chiras (Case Studies)

CC-404: Environmental Biotechnology

Students are able to

CO1: Introduce the role of biotechnology in Environmental Science.

CO2: Aware about the innovative practices bioleaching, bio-absorption and bioremediation.

CO3: Get aware with use of biotechnology in agro-industry and forestry.

CO4: Familiarise with use of biotechnology for industrial pollution control.

CO5: Understand the applications of genetic concept in environment management

Syllabus

Unit -1

(15)

a) Role of biotechnology in environmental science

Introduction to biotechnology, concept of environmental biotechnology, public perception of biotechnology.

b) Applications of some important technologies

Genetic engineering, Genetic concept in environment management, Concept of bio-safety, Fate of GEM'S in the environment, Role of biotechnology in conservation of species.

Unit- 2

(15)

a) Use of biotechnology in innovative practices

Concept of bio-leaching, methods of bioleaching, microorganisms involved, advantages and disadvantages of bioleaching.

Concept of bio-absorption, factors affecting bio absorption, mechanism of bacterial metal resistance, limitations of bio absorption.

Concept of bioremediation, microorganisms involved, bioremediation processes and technologies, landfill technologies Cell immobilization as a tool in waste treatment, Techniques of cell immobilization, Advantages of cell immobilization, Environmental applications of immobilized cells.

Unit -3

(15)

a) Use of different technologies

Aerobic Vs anaerobic degradation, testing of biodegradability, Bio-oxidation of phenolic compounds, Bio-degradation of specific hazardous wastes, biodegradation of hydrocarbons.

b) Biotechnology in agro-industry and forestry

Plant biotechnology, Biological control, Organic farming, Bio-fertilizers - types and production technology, Fermentation technology, Tissue culture, Animal biotechnology, Applications of biotechnology in forestry, Concept of biofuel, advantages, production. Animal Biotechnology and its application, Vermi-technology.

Unit- 4**(15)****a) Microbial degradation of chemical pesticides.**

Important micro-organisms in degradation of chemical pesticides mechanism of degradation of chemical pesticides and herbicides, concept and types of bio-pesticides and their significance.

b) Biotechnology for industrial pollution control

Application of biotechnology in wastewater treatment - Tanning industry, Distilleries, Dairies, Dye industries, Pulp and paper industry, sugar industry.

References

1. Introduction to Environmental Biotechnology, A. K. Chatterji, Prentice Hall of India Pvt. Ltd, New Delhi
2. Environmental Biotechnology-Basic Concepts and Applications Indu Shekhar Thakur, I.K. International Pvt. Ltd. New Delhi.
3. Environmental Biotechnology S.K. Agawal, APH Publishing Corp., New Delhi.
4. Elements of Biotechnology, P. K. Gupta, Rastogi Publishing House, New Delhi.
5. Environmental Biotechnology, Jogdand S.N., Himalaya Publishing House, New Delhi.
6. Biotechnology, B.D. Singh, Kalyani Publishers, New Delhi
7. Molecular Biotechnology- Principles and Applications of Recombinant DNA, Glick and Pasternak. Panima Publishing Corporation, New Delhi
8. A Text Book of Biotechnology, R.C. Dubey, S. Chand and Company Ltd., New Delhi.