ASSAM UNIVERSITY, SILCHAR

SYLLABUS
FOR

UG / B.Sc Programme in Ecology and Environmental Science

17/7/2023

10/7/23

ASSAM UNIVERSITY, SILCHAR

SYLLABUS

FOR

ECOLOGY AND ENVIRONMENTAL SCIENCE

SEMESTER I			
Course No.	**Papers Name**	**Total Marks**	**Total Credits**
Discipline Specific Core (DSC-101)	ECOLOGY AND ECOSYSTEMS	Total Marks = 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Discipline Specific Core (DSC-102)	EARTH AND EARTH SURFACE PROCESSES	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Discipline Specific Minor (DSM-101)	FUNDAMENTALS OF ECOLOGY	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Interdisciplinary Course (IDC101)	Basic Concepts of Ecology and Environmental Science	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Skill Enhancement Courses (SEC-101)	BAMBOO CULTIVATION, UTILIZATION AND MANAGEMENT	Total Marks= 100 End Semester Examination = 50 Practical Examination = 30 Internal Test = 20	Total Credits=3

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SEMESTER II			
Course No.	**Papers Name**	**Total Marks**	**Total Credits**
Discipline Specific Core (DSC-151)	PHYSICS AND CHEMISTRY OF ENVIRONMENT	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Discipline Specific Core (DSC-152)	PRACTICAL	Total Marks= 100	Total Credits=3
Discipline Specific Minor (DSM-151)	BASIC CONCEPTS OF ECOLOGY	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Interdisciplinary Course (IDC151)	Natural Resources,Biodiversity Conservation and Environmental Pollution	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3
Skill Enhancement Courses (SEC-151)	ENVIRONMENTAL IMPACT AND RISK ASSESSMENT	Total Marks= 100 End Semester Examination = 50 Practical Examination = 30 Internal Test = 20	Total Credits=3
Common Value Added Courses (VAC-151)	ENVIRONMENTAL STUDIES	Total Marks= 100 End Semester Examination = 70 Internal Examination = 30	Total Credits=3

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SEMESTER I

Discipline Specific Core (DSC-101)

ECOLOGY AND ECOSYSTEMS

Total Marks = 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives:

- To understand basic concepts of ecology & the factors affecting ecosystem.
- To provide knowledge of bio-geochemical and sedimentary cycles and its' importance.
- To develop knowledge of major Ecosystems of the world.

Expected Course Outcomes :

- The course will enable the students to gather in-depth knowledge on the basic concepts of ecology.
- The student will learn the abiotic and biotic factors that influence ecosystem structure.
- It will help understand the concepts of the basic laws in ecology.
- The student will understand the important biogeochemical cycles.
- The students will learn about various community concepts.

SEMESTER I

Discipline Specific Core (DSC-101)

ECOLOGY AND ECOSYSTEMS

Total Marks = 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Unit 1: Basic concepts of ecology: **(10 lectures)**

Definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes; ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity; ecotypes; ecoclines; ecological niche.

Unit 2: Ecology of populations: **(10 lectures)**

Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent; limits to population growth.

Unit 3: Ecology of communities : **(10 lectures)**

Community structure and organization; keystone species; ecotone and edge effect; species diversity; species interactions (positive and negative) ; ecological succession and climax community.

Unit 4: Ecosystem ecology: **(10 lectures)**

Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands; ecosystem structure and function; abiotic and biotic components of ecosystem; food chain, foodweb; ecological efficiencies; ecological pyramids.

Unit 5: Biogeochemical cycles and nutrient cycling: **(10 lectures)**

Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; nutrient cycling; input of nutrients in ecosystem; biotic accumulation; nutrient supply and uptake.

Suggested Readings

1. Groom. B. & Jenkins. M. (2000). Global Biodiversity: Earth's Living Resources in the 21st Century. World Conservation Press, Cambridge, UK.
2. Gurevitch, J., Scheiner, S. M., & Fox, G. A. (2002). The Ecology of Plants. Sinauer associates incorporated.
3. Loreau, M. & Inchausti, P. (2002). Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
4. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Sounders.
5. Pimentel, D. (Ed.) 2011. Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species. CRC Press.
6. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications.
7. Wilson, E. O. (1985). The Biological Diversity Crisis. Bio Science 35: 700-706.

SEMESTER I

Discipline Specific Core (DSC-102)

EARTH AND EARTH SURFACE PROCESSES

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives :

- The paper will introduce students to the basic structure and composition of the Earth Surface and its processes.
- This paper will help in enhancing knowledge of Geological timescale and evolution of Earth.
- It will also deal with the interactive processes in the inner as well as outer Earth's surface.

Expected Course Outcomes:

- Students will be able to analyze formation of Earth, Atmosphere, Hydrosphere.
- Students will be able to Analyze role of Plate Tectonics in Various Earth Surface Processes.
- Students will be able to Evaluate the role of different types of Rocks in Rock Cycle and significance of Weathering and Erosion over Earth Surface.
- Students will Evaluate the role of Atmosphere - Ocean, Atmosphere- Land & Ocean-Land Interface in Earth Surface processes.

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SEMESTER I

Discipline Specific Core (DSC-102)

EARTH AND EARTH SURFACE PROCESSES

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Unit 1: History of Earth: **(10 lectures)**

Formation of the Earth: formation and composition of core, mantle, crust, atmosphere and hydrosphere; chemical composition of Earth; geological time scale and major changes on the Earth's surface; Holocene and the emergence of humans.

Unit 2: Earth system processes: **(10 lectures)**

Movement of lithosphere plates; mantle convection and plate tectonics, major plates and geological hot spots, plate boundaries; sea floor spread; earthquakes; volcanic activities; orogeny; isostasy; gravitational and magnetic fields of the earth; origin of the main geomagnetic field; continental drift, Pangaea and present-day continents.

Unit 3: Minerals and rocks: **(10 lectures)**

Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks; weathering: physical, biogeochemical processes; erosion: physical processes of erosion, factors affecting erosion.

Unit 4: Earth surface processes: **(10 lectures)**

Atmosphere: Composition of atmosphere, physical and optical properties, circulation; interfaces: atmosphere–ocean interface, atmosphere–land interface, ocean–land interface, rivers and geomorphology; types of glaciers, glacier dynamics.

Unit 5: Importance of being a mountain: **(10 lectures)**

Formation of Peninsular Indian mountain systems - Western and Eastern Ghats, Vindhyas, Aravallis, etc. Formation of the Himalaya; development of glaciers, perennial river systems, formation of Indo-Gangetic Plains.

Suggested Readings

1. Bridge, J., & Demicco, R. (2008). Earth Surface Processes, Landforms and Sediment deposits.Cambridge University Press.
2. Duff, P. M. D., & Duff, D. (Eds.). 1993. Holmes' Principles of Physical Geology. Taylor & Francis.
3. Gupta, A. K., Anderson, D. M., & Overpeck, J. T. (2003). Abrupt changes in the Asian southwest monsoon during the Holocene and their links to the North Atlantic Ocean. Nature 421:354-357.
4. Gupta, A. K., Anderson, D. M., Pandey, D. N., & Singhvi, A. K. (2006). Adaptation and human migration, and evidence of agriculture coincident with changes in the Indian summer monsoon during the Holocene. Current Science 90: 1082-1090.
5. Keller, E.A. (2011). Introduction to Environmental Geology (5th edition). Pearson Prentice Hall.
6. Krishnan, M. S. (1982). Geology of India and Burma. CBS Publishers & Distributors.
7. Leeder, M., Arlucea, M.P. (2005). Physical Processes in Earth and Environmental Sciences.Blackwell Publishing.
8. Pelletier, J. D. (2008). Quantitative Modeling of Earth Surface Processes (Vol. 304). Cambridge: Cambridge University Press. Chicag.

SEMESTER I

Discipline Specific Minor (DSM-101)

FUNDAMENTALS OF ECOLOGY

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives :

- To understand basic concepts of ecology.
- To understand the factors affecting ecosystem.
- To provide knowledge of bio-geochemical and sedimentary cycles and its importance.
- To understand about population and community ecology.

Expected Course Outcomes :

- The course will enable the students to gather in-depth knowledge on the basic concepts of ecology.
- The student will learn the abiotic and biotic factors that influence ecosystem structure.
- It will help understand the concepts of the basic laws in ecology.
- The student will understand the important biogeochemical cycles.
- The students will learn about the various ecological aspects of population & community.

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SEMESTER I

Discipline Specific Minor (DSM-101)

FUNDAMENTALS OF ECOLOGY

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Unit 1: Concepts of ecology: **(10 lectures)**

Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes; Liebig's Law of the Minimum; Shelford's Law of Tolerance; ecological niche.

Unit 2: Population ecology: **(10 lectures)**

Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent.

Unit 3: Community ecology: **(10 lectures)**

Community structure and organization: keystone species, ecotone and edge effect; species interactions: positive and negative; ecological succession and climax community.

Unit 4: Ecosystem ecology: **(10 lectures)**

Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands; ecosystem structure and function; abiotic and biotic components of ecosystem; food chain, food web; ecological pyramids.

Unit 5: Biogeochemical cycles: **(10 lectures)**

Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; ecosystem input of nutrients; nutrient supply and uptake.

Suggested Readings

1. Groom. B. & Jenkins. M. (2000). Global Biodiversity: Earth's Living Resources in the21stCentury. World Conservation Press, Cambridge, UK.
2. Gurevitch, J., Scheiner, S. M., & Fox, G. A. (2002). The Ecology of Plants. Sinauer associates incorporated.
3. Loreau, M. & Inchausti, P. (2002). Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
4. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Sounders.
5. Pandit, M.K., White, S.M.& Pocock, M.J.O. (2014). The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis. New Phytologist 203: 697-703.
6. Pimentel, D. (Ed.). 2011. Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species. CRC Press.
7. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications.
8. Wilson, E. O. (1985). The Biological Diversity Crisis. Bio Science 35: 700-706.

SEMESTER –I

Interdisciplinary Course (IDC-101)

Name of the paper: Basic Concepts of Ecology and Environmental Science

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives:

- To understand basic concepts and need of Ecology and Environmental Science .
- To understand the factors affecting ecosystem .
- To understand energy flow and biogeochemical cycles in an ecosystem.
- To develop an in-depth understanding about the chemistry and importance of the atmosphere, hydrosphere and lithosphere.

Expected Course Outcomes:

After completing this course, students will be able to:

- Understand the basic concept and need of Ecology and Environmental Science.
- Understand the concept of structure and function of different components of the Environment and appreciate the interactions of different components of ecosystems.
- Understand the transfer of energy from one trophic level to another and biogeochemical cycles in an ecosystem.
- Learn about the composition of the atmosphere, hydrosphere and lithosphere.

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SEMESTER –I

Interdisciplinary Course (IDC - 101)

Name of the paper: Basic Concepts of Ecology and Environmental Science

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

UNIT1: Introduction to Ecology and Environmental Science : (10 lectures)

Definition, aim, Objectives, scope and importance of Ecology and Environmental Science; history of ecology ; various approaches of studying Ecology and Environmental Science; multidisciplinary nature of Ecology and Environmental Science; Need for environmental awareness.

UNIT 2: Ecosystem and its components : (12 lectures)

Concept and definition of ecosystem; components of ecosystem; types of ecosystem: terrestrial ecosystem, aquatic ecosystem; concept of species, population and community; energy flow in an ecosystem; food chain and food web; biogeochemical cycle: patterns and types; biosphere.

UNIT 3: Atmosphere: (8 lectures)

Definition, composition and importance of atmosphere; layers of atmosphere; stratospheric ozone; differences between weather and climate; climate of North East India; tropical monsoon climate.

UNIT 4: Hydrosphere: (10 lectures)

Definition and importance of hydrosphere; hydrologic cycle; fresh water ecosystem (lotic and lentic); marine ecosystem; estuarine ecosystem. Concept Surface and ground water.

UNIT 5: Lithosphere : (10 lectures)

Definition, composition and importance of lithosphere; formation and composition of core , mantle and crust. Composition and formation of soil; physical properties of soil; soil profile; soil water holding capacity; soil humus.

Suggested readings:

1. Asthana, D. K. (2006). Text Book of Environmental Studies. S. Chand Publishing.
2. Basu, M., Xavier, S. (2016). Fundamentals of Environmental Studies, Cambridge University Press, India .
3. Bharucha, E. (2013). Textbook of Environmental Studies for Undergraduate Courses. Universities Press.
4. De, A.K., (2006). Environmental Chemistry, 6th Edition, New Age International, New Delhi.
5. Odum, E. P., Odum, H. T., & Andrews, J. (1971). Fundamentals of ecology. Philadelphia: Saunders.
6. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment. Rastogi Publications.
7. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment. Rastogi Publications.
8. Odum, E.P., Odum, H.T. & Andrews, J. (1971). Fundamentals of Ecology. Philadelphia: Saunders.
9. Killham, K. (1994). Soil Ecology. Cambridge University Press.

SEMESTER I

Skill Enhancement Courses (SEC-101)

BAMBOO CULTIVATION, UTILIZATION AND MANAGEMENT

Total Marks= 100

End Semester Examination = 50

Practical Examination = 30

Internal Test = 20

Total Credits=3

Course Objectives:

- To develop interest among students in bamboo cultivation.
- To impart skill-based knowledge on nursery management and silvicultural management of bamboo.
- To develop technical knowledge about bamboo cultivation, utilization and management.
- To develop an understanding about the prospect of bamboo cultivation as a livelihood opportunity and entrepreneurship development.

Expected Course Outcomes:

After completion of this course students will be able to:

- Gather knowledge of diversity, distribution and growth behaviour of bamboo.
- Develop an understanding of nursery management and silvicultural management.
- Develop an understanding of processing and preservation technology for storage of fresh bamboo shoots.
- Gather knowledge of traditional and commercial utilization of bamboos.
- Take up nursery management; silvicultural management; various bamboo products for entrepreneurship development.

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SEMESTER I

Skill Enhancement Courses (SEC-101)

BAMBOO CULTIVATION, UTILIZATION AND MANAGEMENT

Total Marks= 100

End Semester Examination = 50

Practical Examination = 30

Internal Test = 20

Total Credits=3

Unit 1: Diversity, Distribution and Growth behaviour: (10 lectures)

Origin, diversity and distribution of bamboo in global scenario with special reference to Northeast India, Rhizome types, Clump and culm character, Culm sheath, Culm emergence, Culm elongation, Shoot mortality, Branching habit, Culm production.

Unit 2: Silvicultural management: (10 lectures)

Plantation raising and silvicultural management, harvesting strategies of forest and village bamboos, Nutrient and fertilizer management in bamboos; Insect pests and diseases of bamboo and their control.

Unit 3: Propagation and Nursery Management: (10 lectures)

Rhizome, culm and branch cutting, culm cutting and layering. Concept of tissue culture, Infrastructure facilities, Concept of green house, net house, polyhouse and their utility. Nursery bed preparation, techniques of nursery management, seedling nursing and management, Vegetative Propagation Centre.

Unit 4: Bamboo as food: (10 lectures)

Bamboo shoots and human health, Indigenous and oriental recepies, Nutritional properties of bamboo shoot, Processing technology for storage of fresh bamboo shoots, Preservation techniques, Traditional and laboratory fermentation techniques of bamboo shoots.

Unit 5: Bamboo products and value addition: (10 lectures)

Traditional and commercial utilization of bamboos, utilization of bamboo resources for: traditional and value added craft, incense stick and paper industry.

Practicals:

1. Studying rhizome behaviour in bamboos – sympodial, amphipodial and monopodial.
2. Studying culm ages in a bamboo.
3. Documenting traditional uses of bamboo products.
4. Bamboo propagation through offset, culm cutting and branch cutting.
5. Tutorial works are to be given to students based on theory paper.

Suggested readings:

1. Banik, R.L. (1995. A Manual for Vegetative Propagation of Bamboos. INBAR.

2. Banik, R.L. (2000). Silviculture and Field-Guide to Priority Bamboos of Bangladesh and South Asia. Government of the people's republic of Bangladesh, Bangladesh Forest research Institute, Chittagong.
3. Banik, R.L. (2010). Biology and silviculture of Muli Bamboo (*Melocanna baccifera*).National Mission on Bamboo Applications, New Delhi.
4. Barooah, C. and Bortakur, S.K. (2003). Diversity and Distribution of Bamboos in Assam.Bishen Singh Mahendra Pal Singh.
5. Bedell, P.E. (1997). Taxonomy of Bamboos. APC Publications Pvt. Ltd.
6. FAO (2010). Global Forest Resources Assessment, 2010. Food and Agricultural Organisation.
7. FSI (2011). India State of Forest Report. Forest Survey of India, Dehradun.
8. Liese, W. And Kohl, M. (2015). Bamboo: The Plant and its Uses (Tropical Forestry). Springer International Publishing.
9. NMBA (2004). The Bamboo Book. National Mission on Bamboo Applications. Department of Science and Technology, New Delhi.
10. Negi, S.S. (2009). Bamboos of India. Bishen Singh Mahendra Pal Singh.
11. Seethalakshmi, K.K. and Muktesh Kumar, M.S. (1998). Bamboos of India: A compendium. Kerala Forest Research Institute &INBAR.
12. Tewari, D.N. (1992). A Monograph on Bamboo. International Book Distributors.

SEMESTER II

Discipline Specific Core (DSC-151)

PHYSICS AND CHEMISTRY OF ENVIRONMENT

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives :

- This paper aims to build conceptual understanding of students by exposing them to the basic principles behind various environmental processes.
- To introduce students to the concepts of physics and chemistry associated with particle movement, chemical processes and fundamentals of environmental chemistry, water & solid chemistry.
- To recognize the importance of chemical reactions in soil.

Expected Course Outcomes :

- Students will evaluate the role of light and matter in the environment.
- Ability to demonstrate understanding of the inherent forces and flows responsible for various naturally occurring events.
- Students will learn fundamental knowledge about – environmental chemistry, water and soil chemistry.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

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SEMESTER II

Discipline Specific Core (DSC-151)

PHYSICS AND CHEMISTRY OF ENVIRONMENT

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Unit 1: Fundamentals of environmental physics: (12 lectures)

Basic concepts of light and matter; quantum mechanics (relation between energy, wavelength and frequency), black body radiation, spectroscopic concepts: Introduction to the concept of absorption and transmission of light, Beer–Lambert law. Basic concepts of pressure, force, work and energy; laws of thermodynamics.

Unit 2: Fundamentals of environmental chemistry: (12 lectures)

Atomic structure, electronic configuration, periodic properties of elements (ionization potential, electron affinity and electronegativity), types of chemical bonds (ionic, covalent, coordinate and hydrogen bonds); mole concept, molarity and normality, acids, bases and salts, solubility products; solutes and solvents; redox reactions, concepts of pH and pE.

Unit 3: Atmospheric chemistry: (10 lectures)

Composition of atmosphere; photochemical reactions in atmosphere; smog formation, types of smog (sulphur smog and photochemical smog), aerosols; acid rain, reactions of NO2 and SO2; free radicals and ozone layer depletion, role of CFCs in ozone depletion.

Unit 4: Water chemistry: (10 lectures)

Chemical and physical properties of water; alkalinity and acidity of water, hardness of water, calculation of total hardness; solubility of metals, complex formation and chelation; colloidal particles; heavy metals in water.

Unit 5: Soil chemistry: (10 lectures)

Soil composition; relation between organic carbon and organic matter, inorganic and organic components in soil; soil humus; cation and anion exchange reactions in soil; nitrogen, phosphorus and potassium in soil; phenolic compounds in soil.

Suggested Readings:

1. Beard, J.M. (2013). Environmental Chemistry in Society (2ndedition). CRC Press.
2. Boeker, E. & Grondelle, R. 2011. Environmental Physics: Sustainable Energy and Climate Change. Wiley.
3. Connell, D.W. (2005). Basic Concepts of Environmental Chemistry (2ndedition). CRC Press.
4. Forinash, K. (2010). Foundation of Environmental Physics. Island Press.
5. Girard, J. (2013). Principles of Environmental Chemistry (3rd edition). Jones & Bartlett.
6. Harnung, S.E. & Johnson, M.S. (2012). Chemistry and the Environment. Cambridge University Press.
7. Hites, R.A. (2012). Elements of Environmental Chemistry (2nd edition). Wiley & Sons.
8. Manhan, S. E. (2000). Fundamentals of Environmental Chemistry. CRC Press.
9. Pani, B. (2007). Textbook of Environmental Chemistry. IK international Publishing House.

SEMESTER II

Discipline Specific Core (DSC-152)

PRACTICAL

Total Marks= 100

Total Credits=3

Course Objectives :

- To impart knowledge on various methods of studying diverse aspects of ecology and environmental science.
- To expose the students about the diverse environmental conditions and appreciate the effects and its interactions in field conditions.
- To acquire field-based skills and techniques in collection of quantitative and qualitative ecological information.
- To help the students in the use of different indices, tools and techniques for the collection of proper and systematic scientific data.

Expected Course Outcomes :

- Develop proper understanding of the different environmental factors that affects the terrestrial and aquatic ecosystems.
- Get acquainted with various methods and techniques of ecology and environmental sciences.
- Develop an understanding about continental drift.
- Develop proper understanding of sedimentary and metamorphic rocks.
- Students will learn about the techniques / analysis soil and water.

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SEMESTER II

Discipline Specific Core (DSC-152)

PRACTICAL

Total Marks= 100

Total Credits=3

(SECTION-A)

(ECOLOGY AND ECOSYSTEMS)

1. To study the allelopathic influence of plant species.
2. To prepare a checklist of invasive species.
3. To study the plankton communities in a fresh water ecosystem.
4. To study the road side species.
5. Field report: Visit to a forest/ river/ wetland ecosystem.

(SECTION-B)

(EARTH AND EARTH SURFACE PROCESSES)

6. Study of model for continental drift.
7. Identification of sedimentary and metamorphic rocks.
8. Study and interpretation of Geological time scale.
9. Study of Topographic map.
10. Study of landscapes of urban, semi-urban and rural areas.

(SECTION-C)

(PHYSICS AND CHEMISTRY OF ENVIRONMENT)

11. Determination of p^H of water samples.
12. Determination of p^H of soil samples.
13. To measure soil temperature of different sites.
14. To measure water holding capacity and moisture percentage of soil.
15. Determination of total hardness of water.

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SEMESTER II

Discipline Specific Minor (DSM-151)

BASIC CONCEPTS OF ECOLOGY

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives :

- To understand basic concepts of ecology.
- To understand the factors affecting ecosystem.
- To provide knowledge of bio-geochemical and sedimentary cycles and its importance.
- To develop knowledge of major Ecosystems of the world.

Expected Course Outcomes :

- The course will enable the students to gather in-depth knowledge on the basic concepts of ecology.
- The student will learn the abiotic and biotic factors that influence ecosystem structure.
- It will help understand the concepts of the basic laws in ecology.
- The student will understand the important biogeochemical cycles.
- The students will learn about various community concepts.

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SEMESTER II

Discipline Specific Minor (DSM-151)

BASIC CONCEPTS OF ECOLOGY

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Unit 1: Ecological concepts: **(10 lectures)**

Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, autecology; synecology; major terrestrial biomes; ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; ecological niche.

Unit 2: Ecology of populations: **(10 lectures)**

Concept of population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent.

Unit 3: Ecology of communities: **(10 lectures)**

Community structure and organization: keystone species, ecotone and edge effect; species interactions: positive and negative; ecological succession and climax community.

Unit 4: Ecosystem structure and function: **(10 lectures)**

Types of ecosystem: Terrestrial and aquatic ; abiotic and biotic components of ecosystem; food chain, food web; ecological efficiencies; ecological pyramids: pyramids of number, biomass, and energy.

Unit 5: Biogeochemical cycles: **(10 lectures)**

Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; input of nutrients in different ecosystems; ecosystem losses; nutrient supply and uptake.

Suggested Readings:

1. Groom. B. & Jenkins. M. (2000). Global Biodiversity: Earth's Living Resources in the 21st Century. World Conservation Press, Cambridge, UK.
2. Gurevitch, J., Scheiner, S. M., & Fox, G. A. (2002). The Ecology of Plants. Sinauer associates incorporated.
3. Loreau, M. & Inchausti, P. (2002). Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
4. Odum, E.P. (1971). Fundamentals of Ecology. W.B. Sounders.
5. Pandit, M.K., White, S.M. & Pocock, M.J.O. (2014). The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis. New Phytologist203: 697-703.
6. Pimentel, D. (Ed.). 2011. Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species. CRC Press.
7. Singh, J.S., Singh, S.P. & Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications.
8. Wilson, E. O. (1985). The Biological Diversity Crisis. Bio Science 35: 700-706.

SEMESTER –II

Interdisciplinary Course (IDC151)

Name of the paper: Natural Resources,Biodiversity Conservation and Environmental Pollution

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

Course Objectives:

- To impart the knowledge of natural resource and biodiversity and conservation.
- To impart basic knowledge relating to pollution; pollutants and sources
- To impart knowledge relating to types of pollution viz., air, water, soil and noise pollution; their impact on ecosystems and effects on human health.
- To impart concept of some major global environmental issues viz., climate change, greenhouse effect, global warming, ozone layer depletion, acid rain etc.
- To develop an understanding of urbanization and its impacts on environment

Expected Course Outcomes:

After completion of this course students will be able to:

- Understand the concept of natural resource and identify different types of natural resources
- Understand the importance of biodiversity and conservation.
- Gather knowledge about the various types of pollution; pollutants and their impacts on environment. Understand the critical linkage between environmental pollution and human health and also sensitize themselves to adverse impacts of pollution
- Develop perspective on important environmental issues and gain a comprehensive knowledge of these issues
- Develop an understanding of urbanization and its impacts on environment

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SEMESTER –II

Interdisciplinary Course (IDC151)

Name of the paper: Natural Resources, Biodiversity Conservation and Environmental Pollution

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

UNIT1: Natural Resources: **(10 lectures)**

Types of resource: renewable and non-renewable. Types of forest resources: its uses and importance; forest cover of India; non- timber forest products; shifting cultivation; JFM. Energy resources: fossil fuels, hydroelectric power, wind energy, solar energy, nuclear energy. Mineral Resources: types and distribution of important minerals in India.

UNIT2: Biodiversity and conservation: **(10 lectures)**

Definition and levels of biodiversity; biodiversity hot spots; values of Biodiversity; threats to biodiversity; conservation of biodiversity: In-situ and ex-situ conservation of biodiversity; Sacred groves of North East India; Tiger Task Force; The Indian Rhino Vision 2020; IUCN Red List Categories.

UNIT3: Environmental Pollution: **(10 lectures)**

Environmental pollution and pollutants; types of pollution: Air, water, soil and noise pollution: causes, effects and control; bio-magnification; particulate matter (PM); photochemical smog; troposheric ozone; radioactive pollutants; heavy metal pollution; eutrophication; indoor air pollutants; Solid waste Management.

UNIT4: Major environmental issues: **(10 lectures)**

Climate change, green house effect, global warming, ozone layer depletion, acid rain; construction of dams and associated environmental issues. Case studies: Chernobyl disaster, Kalpakkam disaster, Fukushima nuclear accidents, Minamata disaster, Bhopal gas tragedy.

UNIT5: Urbanization and environment: **(10 lectures)**

Development-induced displacement, resettlement and rehabilitation; impact of industry and technology on environment; urban sprawl, traffic congestion and social-economic problems; Urban heat island effect; modern agriculture and environmental degradation.

Suggested readings:

1. Asthana, D. K. (2006). Text Book of Environmental Studies. S. Chand Publishing.
Climate Change: Science and Politics. (2021). Centre Science and Environment, New Delhi
2. De, A.K., (2006). Environmental Chemistry, 6th Edition, New Age International, New Delhi.
3. Rana S. V. S (2009) Essentials of Ecology and Environmental Science Prentice Hall of India Pvt. Ltd.,
4. Santra S.C. (2010) Fundamentals of Ecology and Environmental Biology. New Central Book Agency, Kolkata.
5. Sharma, P. D., & Sharma, P. D. (2005). Ecology and environment. Rastogi Publications.
6. Odum, E.P., Odum, H.T. & Andrews, J. (1971). Fundamentals of Ecology. Philadelphia: Saunders.

7. Pepper, I.L, Gerba, C.P. & Brusseau, M.L. (2011). Environmental and Pollution Science. Academic Press.
8. Singh, J.S., Singh, S.P. and Gupta, S.R. (2014). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
9. Dobson, A.P. (1996). Conservation and Biodiversity. Scientific American Library, New York, NY.
10. Groombridge, B., and M. Jenkins. (2000). Global Biodiversity: Earth's Living Resources in the 21 st Century. World Conservation Press, Cambridge, UK.
11. Primack, R.B. (2002). Essentials of Conservation Biology, 3 rdedn., Sinauer Associates, Sunderland, Ma. USA.
12. Smith, P. and Warr, K. (1991). Global Environmental issues, Hodder and Stoughton, London.
13. IUCN. (2004). Red list of threatened species. A global species assessment. IUCN, Gland, Switzerland.

SEMESTER II

Skill Enhancement Courses (SEC-151)

ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Total Marks= 100

End Semester Examination = 50

Practical Examination = 30

Internal Test = 20

Total Credits=3

Course Objectives:

- The purpose of this course is to impart basic and key knowledge of Environmental Impact and Risk Assessment.
- This course will help in enhancing knowledge of Environmental Impact Assessment Process, methodologies of Environmental Impact assessment and Risk assessment.
- This course recognizes the growing need of industry to anticipate and incorporate environmental concerns and risks while developing large-scale projects.

Expected Course Outcomes:

After completion of this course, students will learn:

- Philosophies and historical development of EIA in India and elsewhere.
- Ability to demonstrate sound understanding of the EIA process and the methodologies to prepare an EIS.
- Ability to critically examine development actions with the fundamentals understanding of EIA and sustainable development, also about Risk assessment.

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SEMESTER II

Skill Enhancement Courses (SEC-151)

ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Total Marks= 100

End Semester Examination = 50

Practical Examination = 30

Internal Test = 20

Total Credits=3

Unit 1: Concept of EIA: **(08 lectures)**

Environmental impact assessment (EIA): Definitions, introduction and concepts; rationale and historical development of EIA; scope and methodologies of EIA.

Unit 2: Components and role of EIA: **(10 lectures)**

EIA - project components: Role of project proponents, project developers and consultants; Terms of Reference; impact identification and prediction; baseline data collection; Environmental Impact Statement (EIS), Environmental Management Plan (EMP).

Unit 3: EIA and Environmental management: **(12 lectures)**

Rapid EIA; Strategic Environmental Assessment; Social Impact Assessment; CostBenefit analysis; Life cycle assessment; environmental appraisal; environmental management - principles, problems and strategies; environmental planning; environmental audit; introduction to ISO and ISO 14000; sustainable development.

Unit 4: EIA regulations: **(08 lectures)**

EIA regulations in India; status of EIA in India; current issues in EIA; case study of hydropower projects/ thermal projects.

Unit 5: Risk assessment: **(10 lectures)**

Introduction and scope; project planning; exposure assessment; toxicity assessment; hazard identification and assessment; risk characterization; risk communication; environmental monitoring; community involvement; legal and regulatory framework; human and ecological risk assessment.

Practicals:

1) Environment Impact Assessment of any nearby industry, factory or similar area.
2) Studies on biological and other waste disposal mechanism of any nearby health centre or hospital.
3) To identify harmful wastes in any given water or soil sample.
4) To visit any nearby market area and quantification of the daily waste generated from such areas.
5) Students may be asked to make some close ended questionnaire and interview local community (n=30) on various aspects of environmental risk and environmental impact and prepare a report based on it.

Suggested Readings

1. Barrow, C.J. (2000). Social Impact Assessment: An Introduction. Oxford University Press.
2. Glasson, J., Therivel, R., Chadwick, A. (1994). Introduction to Environmental Impact Assessment. London, Research Press, UK.

3. Judith, P. (1999). Handbook of Environmental Impact Assessment. Blackwell Science. 4. Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill, NewYork, USA

SEMESTER II
Common Value Added Courses (VAC-151)
ENVIRONMENTAL STUDIES
Total Marks= 100
End Semester Examination = 70
Internal Examination = 30
Total Credits=3

Course Objectives:

- This course will introduce to the students the basic understanding of environmental studies environmental ethics & disaster management.
- This course will explore the interconnectedness among all the biotic and abiotic components of environment and the dynamic nature of the ecological processes in maintaining equilibrium in nature.
- This course will introduce to biodiversity of India and its conservation, and basic understanding of natural resources.
- This course will also explore types, causes, effects of environmental pollution.

Expected Course Outcome:

After completing this course, students will :

- Understand the basic concept and need of Ecology and Environmental Science.
- Understand the concept of structure and function of different components of the Environment and appreciate the interactions of different components of ecosystems.
- Understand the types, causes, effects of environmental pollution.
- Gather knowledge and develop an in-depth understanding on biodiversity of India and its conservation.
- Understand the concept of Land Resources, Forest Resources, Water Resources and Energy Resources.
- To learn about environmental ethics & disaster management.

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SEMESTER II

Common Value Added Courses (VAC-151)

ENVIRONMENTAL STUDIES

Total Marks= 100

End Semester Examination = 70

Internal Examination = 30

Total Credits=3

UNIT 1: Introduction to Environmental Studies: (12 lectures)

Definition, scope and importance of environmental studies. Concept of ecosystem; Producers, consumers and decomposers; Energy flow in an ecosystem; Food chain and food webs; Ecological pyramids; Ecological succession. Nutrient cycles (Carbon cycle and nitrogen cycle). Major ecosystems: Terrestrial (Forest) and Aquatic (Pond).

UNIT 2: Natural Resources and management: (12 lectures)

Concepts and types of natural resources (Renewable and non-renewable). Importance, threats and management of land resources, forest resources, water resources and energy resources.

UNIT 3: Biodiversity and conservation: (12 lectures)

Definition, levels of biodiversity (genetic, species and ecosystem diversity); Endemism ; global biodiversity hot spots. Biodiversity of India with special reference to North East India. Threats to Biodiversity: Habitats loss, poaching of wildlife, man-wildlife conflicts in Indian context. *In-situ* and *ex-situ* conservation of biodiversity.

UNIT 4: Environmental pollution and climate change: (12 lectures)

Environmental pollution: Types (Air, water, soil and noise pollution), causes, effects and controls, Solid waste Management. Climate change, global warming, ozone layer depletion, acid rain and its impact on environment. Environment Laws: Environment Protection Act; Air (Prevention and control of pollution) Act; Water (Prevention and control of pollution); Wildlife Protection Act.

UNIT 5: Environmental ethics and disaster management: (12 lectures)

Principle and concept of environmental ethics; Animal Welfare and Animal Rights, Deep ecology, Ecofeminism, Putting environmental ethics into practice. Environmental movement and awareness: Chipko, Silent valley, Bishnois of Rajasthan. Causes, impacts and management of floods, earthquake, cyclones and landslides.

SUGGESTED READINGS:

1. Bharucha, E. (2003). Textbook for Environmental Studies, University Grants Commission, New Delhi and Bharati Vidhyapeet Institute of Environmental Education and Research, Pune.

2. Carson, Rachel. (1962). Silent Spring (Boston: Houghton Mifflin, 1962), Mriner Books, 2002.

3. Economy, Elizabeth (2010). The River Runs Black: The Environmental Challenge to China's Future.

4. Gadgil, M. and Ramachandra, G. (1993). This fissured land: an ecological history of India. University of California Press.

5. Gleeson, B. and Low, N. (eds.) (1999). Global Ethics and Environment, London, Routledge.

6. Grumbine, R. Edward, and Pandit, M. K. (2013). Threats from India's Himalaya dams. Science 339. 6115: 36-37.

7. Heywood V. H. and Watson, R. T. (1995). Global Biodiversity Assessment. Cambridge University Press.

8. McCully, P. (1996). Silenced rivers: the ecology and politics of large dams. Zed Books.

9. McNeill, John R. (2000). Something New Under the Sun: An Environmental History of the Twentieth Century.

10. Odum, E. P., Odum, H. T. And Andrews, J. (1971). Fundamentals of Ecology. Philadelphia: Saunders.

11. Pepper, I. L., Gerba, C. P. and Brusseau, M. L. (2011). Environmental and Pollution Science. Academic Press.

12. Rao, M. N. and Datta, A. K. (1987). Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.

13. Raven, P. H., Hassenzahl, D. M. and Berg, L. R. (2012). Environment, 8th edition. John Wiley and Sons.

14. Ricklefs, R. E. and Miller, G. L. (2000). Ecology. W. H. Freeman, New York.

15. Robbins, P. (2012): Political Ecology: A critical introduction. John Wiley and Sons.

16. Rosencranz, A., Divan, S. and Noble, M. L. (2002). Environmental law and policy in India. Oxford University Press, India.

17. Sengupta, R. (2003). Ecology and Economics: An approach to sustainable development. OUP Catalogue.

18. Singh, J. S., Singh, S. P. and Gupta, S. R. (2006). Ecology, Environment and Resource Ecology, Environment and Resource Conservation. Anamaya Publishers.

19. Sodhi, N. S., Gibson, L. and Raven, P. HG. (eds). (2013). Conservation biology: voices from the Tropics. John Wiley and Sons.

20. Van Leeuwen, C. J. and Vermeire, T. G. (2007). Risk assessment of Chemicals.

21. World Commission on Environment and Development. (1987). Our Common Future. Oxford. Oxford University Press.

17/5/2023

FYUG SYLLABUS
(3RD AND 4TH SEMESTER)

ECOLOGY AND ENVIRONMENTAL SCIENCE

ASSAM UNIVERSITY, SILCHAR

2024

COURSE OUTLINE

emester	Course category, marks and credit	Course title	Unit names
III	**Discipline Specific Core (DSC-201)** **Total Marks= 100** **Total Credits=4**	**ATMOSPHERE AND GLOBAL CLIMATE CHANGE**	Unit 1: Global energy balance Unit 2: Atmospheric circulation Unit 3: Global warming and climate change Unit 4: Ozone layer depletion Unit 5: Climate change and policy
	Discipline Specific Core (DSC-202) **Total Marks= 100** **Total Credits=4**	**WATER AND WATER RESOURCES**	Unit 1: Physico-chemical parameters of water Unit 2: Surface and subsurface water Unit 3: Water resources in India Unit 4: Marine resource management Unit 5: Water resources conflicts and policies
	Discipline Specific Minor (DSM-201) **Total Marks= 100** **Total Credits=4**	**ATMOSPHERE AND CLIMATE CHANGE**	Unit 1: Energy balance Unit 2: Atmospheric circulation Unit 3: Global warming and climate change Unit 4: Ozone layer Unit 5: Climate change policies

	Interdisciplinary Course (IDC-201) **Total Marks= 100** **Total Credits=3**	**ENVIRONMENTAL POLLUTION AND MANAGEMENT**	Unit1: Concept and types Unit2: Air pollution Unit 3: Water pollution Unit 4: Soil pollution Unit 5: Noise, radioactive and E- pollution
	Skill Enhancement Courses (SEC-201) **Total Marks= 100** **Total Credits=3**	**REMOTE SENSING AND GIS** **Total Marks= 100** **Total Credits=3**	Unit I: Introduction to RS and GIS Unit II: Physics of remote sensing and image resolutions Unit III: Image interpretation techniques Unit IV: Data types and data analysis in GIS Unit V: Application of RS and GIS in natural resource management
IV	**Discipline Specific Core (DSC-251)** **Total Marks= 100** **Total Credits=4**	**LAND AND SOIL DEGRADATION AND MANAGEMENT**	Unit 1: Fundamentals of soil science Unit 2: Soil degradation Unit 3: Landuse changes and land degradation Unit 4: Evaluation of land degradation Unit 5: Land and soil conservation
	Discipline Specific Core (DSC-252) **Total Marks= 100**	**SYSTEMATICS AND BIOGEOGRAPHY**	Unit 1: Concept and approaches to systematics Unit 2: Numerical and

	Total Credits=4		molecular systematics Unit 3: Introduction to biogeography Unit 4: Speciation and extinction Unit 5: Biogeography and its application
	Discipline Specific Core (DSC-253) **Total Marks= 100** **Total Credits=4**	**AIR, WATER, SOIL & SYSTEMATICS (PRACTICAL)**	
	Discipline Specific Minor (DSM-251) **Total Marks= 100** **Total Credits=3**	**ECOLOGY, ATMOSHERE AND CLIMATE CHANGE (PRACTICAL)**	
	Discipline Specific Minor (DSM-252) **Total Marks= 100** **Total Credits=3**	**CONCEPT OF ATMOSPHERE AND CLIMATE CHANGE**	Unit 1: Introduction and concepts Unit 2: Circulation of Atmosphere Unit 3: Global warming and climate change Unit 4: Ozone layer Unit 5: Climate change and policies

SEMESTER III

Discipline Specific Core (DSC-201)
ATMOSPHERE AND GLOBAL CLIMATE CHANGE
Total Marks= 100
Total Credits=4

Unit 1: Global energy balance

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere,Methods of transfer of heat energy on earth: conduction, convection and radiation; earth atmosphere energy balance, Milankovitch cycles.

Unit 2: **Atmospheric circulation**

Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; tropical cyclone; Indian monsoon and its development; Meteorology and atmospheric stability;meteorological parameters (temperature, air pressure, light intensity, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion.

Unit 3: Global warming and climate change

Trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; atmospheric windows; impact of global warming; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses.

Unit 4: Ozone layer depletion

Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures.

Unit 5: Climate change and policy

Environmental policy debate; International agreements; Montreal protocol 1987;Kyoto protocol 1997;Paris Agreement (2015), Clean Power Plan (2015), India's Climate Change Policy; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.

Readings:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
3. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
4. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
5. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.

6. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
7. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
8. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
9. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2ndedition). Sage Publications.
10. Ross, M.T., & Murray. B.C. 2016. What is the fuel of the future ? Prospects under the Clean Power Plan. Energy Economics, 60, 451-459.
11. Savaresi, A. 2016. The Paris Agreement: A new beginning ? Journal of Energy & Natural Resources Law, 34(1), 16-26.

Discipline Specific Core (DSC-202)
WATER AND WATER RESOURCES
Total Marks= 100
Total Credits=4

Unit 1: Physico-chemical parameters of water

Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapo-transpiration; classification of water resources (oceans, rivers, lakes and wetlands); properties of water- Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity.

Unit 2: Surface and subsurface water

Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; importance of watershed and watershed management; rain water harvesting in urban settings; rain water harvesting in rural settings.

Unit 3: Water resources in India

Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands, Ramsar Convention, 1971; major wetlands and wetland resources of N E India.

Unit 4: Marine resource management

Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approaches, construction techniques and monitoring of coastal zones); definition and concept ofexclusive economic zones (EEZs), criteria for determining the extent of EEZs, common challenges faced by coastal states in managing their EEZs.

Unit 5: Water resources conflicts and policies

Water resources and sharing problems, multi-purpose river valley projects in India and their environmental and social impacts; case studies of dams- Narmada and Tehri dam – social and ecological losses versus economic benefits; International conflicts on water sharing between India and her neighbours; National water policy; National River linking plan.

Readings

1. Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India.
2. Brebbia, C.A. 2013. Water Resources Management VII. WIT Press.
3. CEA. 2011. Water Resources and Power Maps of India. Central Board of Irrigation & Power.
4. Grumbine, R.E. & Pandit, M.K. 2013. Threats from India's Himalaya dams. Science 339: 36-37.
5. Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. Water Resource Systems Planning and Analysis. Englewood Cliffs, NJ, Prentice Hall.
6. Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.

7. Schward& Zhang, 2003. Fundamentals of Groundwater. John Willey and Sons.
8. Souvorov, A.V. 1999. Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications.
9. Vickers, A. 2001. Handbook of Water Use and Conservation. WaterPlow Press.

Discipline Specific Minor (DSM-201)
ATMOSPHERE AND CLIMATE CHANGE
Total Marks= 100
Total Credits=4

Unit 1: Introduction and concepts

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere, transfer of heat energy, Milankovitch cycles.

Unit 2: **Atmospheric circulation**

Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; meteorological parameters (temperature, air pressure, light intensity, relative humidity, wind speed and direction, precipitation); atmospheric stability.

Unit 3: Global warming and climate change

Trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; impact of global warming; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses.

Unit 4: Ozone layer

Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures.

Unit 5: Climate change policies

Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997;Paris Agreement (2015), Clean Power Plan (2015), India's Climate Change Policy; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.

Suggested Readings:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
3. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
4. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
5. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
6. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
7. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
8. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
9. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2ndedition). Sage Publications.

10. Ross, M.T., & Murray. B.C. 2016. What is the fuel of the future ? Prospects under the Clean Power Plan. Energy Economics, 60, 451-459.

11. Savaresi, A. 2016. The Paris Agreement: A new beginning ? Journal of Energy & Natural Resources Law, 34(1), 16-26.

Interdisciplinary course (IDC-201)
ENVIRONMENTAL POLLUTION AND MANAGEMENT
No. of Credits: 3
Total Marks=100
Theory

Unit 1: Concept and Types

Definition of pollution; pollutants; sources- point source, non- point source; classification of pollutants- Natural and Anthropogenic; biodegradable and non- biodegradable; Environmental pollution- sources, causes, types; effects of pollution on environment and human health.

Unit 2: Air pollution

Ambient air quality: air quality index; sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on environment and human health (NOx, SOx, PM, CO, CO2, hydrocarbons and VOCs) and control measures; indoor air pollution.

Unit 3: Water pollution

Sources of surface and ground water pollution; water quality parameters and standards; eutrophication; effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases.

Unit 4: Soil pollution

Concepts of soil pollution and degradation; Causes of soil pollution and degradation; effect of soil pollution on environment, vegetation and other life forms; control strategies, Soil erosion

Unit 5: Noise pollution, Radioactive and E-pollution

Noise pollution – sources; permissible ambient noise levels; impacts; Radioactive materials and sources of radioactive pollution; effects of radiation; E- Pollution- sources; effects on environment and human health.

Suggested Readings:

1. Gurjar,B.R.,Molina,L.T.&OjhaC.S.P.2010.AirPollution:HealthandEnvironmentalImpacts. CRC Press,Taylor&Francis.
2. Hester,R.E.&Harrison,R.M.1998.AirPollutionandHealth.TheRoyalSocietyofChemistry, UK.
3. Park,K.2015.Park'sTextbookofPreventiveandSocialMedicine(23rdedition).Banarsi dasBhanotPublishers.
4. Pepper,I.L.,Gerba,C.P.&Brusseau,M.L.2006.EnvironmentalandPollutionScience.Elsevier AcademicPress.
5. Purohit,S.S.&Ranjan,R.2007.Ecology,Environment&Pollution.AgrobiosPublications.
6. Vesilind,P.J.,Peirce,J.J.,&WeinerR.F.1990.EnvironmentalPollutionandControl.Butterworth-Heinemann,USA.

Skill Enhancement Courses (SEC-201)
REMOTE SENSING AND GIS
Total Marks= 100
Total Credits=3

Unit 1: Introduction to RS and GIS

History and evolution of RS & GIS, types of RS, platforms and sensors, satellite mission in India, concept of GIS, components of GIS, integration of RS & GIS

Unit 2: Physics of remote sensing and image resolutions

Electromagnetic spectrum and its components, interaction of electromagnetic radiations with atmosphere, principle of transmission, absorption, reflection and emission, spectral signatures, concept and types of image resolutions

Unit 3: Image interpretation techniques

Visual interpretation techniques, elements of visual interpretation, digital interpretation techniques, supervised classification, unsupervised classification, introduction to advanced classification techniques of satellite imageries

Unit 4: Data types and data analysis in GIS

Projection systems, georeferencing, types of data, overlaying of data, querying of data, concept of digital elevation model

Unit 5: Application of RS and GIS

RS and GIS in forestry, water related studies, atmospheric studies, climate change monitoring, geological and geomorphological studies and urban studies

Readings:

Joseph G., and Jeganathan C. (2018).*Fundamentals of Remote Sensing* (3rdedn.). University Press.
Lillesand T. M.; Kiefer R. W. and Chipman J.W. (2015) *Remote Sensing and Image Interpretation.* (7th edn.)Wiley India.
Bhatta Basudeb (2021). Remote Sensing and GIS, (2nd edn.) Oxford University Press India
Newton, A.C. (2007).*Forest Ecology and Conservation: A Handbook of Techniques*. Oxford University Press.
Galati Stephen R. (2006). Geographic Information Systems Demystified. Artech House, Boston.
Canada Centre for remote sensing tutorial (2019) Fundamentals of Remote Sensing (available online)

Practicals on Remote Sensing and GIS

1. Browsing and downloading Satellite Imageries.
2. Ground truthing techniques.
3. Functioning of handheld navigation system.
4. Intrepretation of toposheets.
5. Finding geographic coordinates on toposheets.

Readings:

1. Sahoo, R.N., Sehgal, V.K., Pradhan, S., Gupta, V.K. and Kamble, K.H. 2012, Practical Manual on Basics of Remote Sensing Data Processing, GPS and GIS, Division of Agricultural Physics, Indian Agricultural Research Institute, New Delhi – 110 012, India, pp 100.

2. Lavender, S., & Lavender, A. (2023). Practical handbook of remote sensing. CRC Press.

3. Boro, A. (2021). *Handbook of Practicals in Remote Sensing GIS and GPS for Beginners*. Paperback edition.

4. Díaz-Delgado, R., Lucas, R., & Hurford, C. (2017). The Roles of Remote Sensing in Nature Conservation. A pratical guide and case studies, 1st ed, Cham, Switzerland: Springer, 1-318.

SEMESTER IV

CORE COURSE (DSC- 251)
LAND AND SOIL DEGRADATION AND MANAGEMENT
Total Marks= 100
No. of Credits: 4
Theory

Unit 1: Fundamentals of soil science

Land as a resource, soil health; soil formation; classification of soil; physical properties of soil; soil texture; soil water holding capacity; soil organic matter; soil micronutrients (nitrogen, sulphur, potassium and phosphorus)

Unit 2: Soil degradation

Types and causes of soil degradation; types of soil erosion; nutrient depletion; impact of soil loss and soil degradation on agriculture and food security; soil pollution due to mining and mineral extraction, industrial and urban development, toxic contaminants in soils(organic and inorganic).

Unit 3: Landuse changes and land degradation

Biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradation - deforestation, desertification; habitat loss, loss of biodiversity; range land degradation; land salinization; human population pressure, poverty, socio-economic and institutional factors;

Unit 4: Evaluation of land degradation

Economic valuation of land degradation; onsite and offsite costs of land degradation; loss of ecosystem services; effects on farming communities; effects on food security; effects on nutrient cycles.

Unit 5: Land and soil conservation

Sustainable land use planning; need for soil conservation and restoration of soil fertility; role of databases and data analysis in landuse planning control and management; land tenure and land policy; participatory land degradation assessment; integrating land degradation assessment into conservation.

Suggested Readings:

1. Brady,N.C.&Well,R.R.2007.TheNatureandPropertiesofSoils(13Thedition),PearsonEducationInc.
2. Gadgil,M.1993.BiodiversityandIndia'sdegradedlands.Ambio22:167-172.
3. Johnson, D.L. 2006. Land Degradation (2nd edition). Rowman and Littlefield publishers
4. Marsh,W.M.&Dozier,J.1983.LandscapePlanning:EnvironmentalApplications.JohnWileyand Sons.

5. Oldeman,L.R.1994.Theglobalextentofsoildegradation.Soilresilienceandsustainablelanduse,9.(http://library.wur.nl/isric/fulltext/isricu_i26803_001.pdf).
6. Pandit,M.K.et.al.2007.Unreportedyetmassivedeforestationdrivinglossofendemicbiodiversityin Indian Himalaya.BiodiversityConservation16:153-163.
7. Pandit,M.K.&Kumar,V.2013.LanduseandconservationchallengesinHimalaya:Past,presentandfuture.In:Sodhi,N.S.,Gibson,L.&Raven,P.H.ConservationBiology:Voicesfrom theTropics.pp.123-133.Wiley-Blackwell,Oxford,UK
8. Peterson,G.D.,Cumming,G.S.&Carpenter,S.R.2003.Scenarioplanning:atoolforconservationinan uncertainworld.ConservationBiology17:358-366.

9. Scherr,S.J.1999.Soildegradation:A threattodeveloping-countryfoodsecurityby2020 (Vol. 27).InternationalFoodPolicyResearchInstitute.

Discipline Specific Core (DSC-252)
SYSTEMATICS AND BIOGEOGRAPHY
Credits= 4
TOTAL MARKS: 100

UNIT:1 CONCEPT AND APPROACHES TO SYSTEMATICS

Definition of systematics; taxonomic identification; keys; field inventory; herbarium; museum; botanical gardens; taxonomic literature; nomenclature; evidence from anatomy, palynology, ultrastructure, cytology, phyto-chemistry,; taxonomy databases.

UNIT:2 NUMERICAL AND MOLECULAR SYSTEMATICS

Characters; variations; Operational Taxonomic Units; character weighting and coding; phenograms; cladograms; DNA barcoding; phylogenetic tree (rooted, unrooted, ultrametric trees); clades: monophyly, paraphyly, polyphyly, homology and analogy; parallelism and convergence.

UNIT:3 INTRODUCTION TO BIOGEOGRAPHY

Genes as unit of evolutionary change; mutation; genetic drift; gene flow; natural selection; geographic and ecological variation; Concepts of biogeography; biogeographical rules- Gloger's rule, Bergmann's rule, Allen's rule, Geist rule.

UNIT:4 SPECIATION AND EXTINCTION

Types and processes of speciation- allopatric, parapatric, sympatric; ecological diversification; adaptive radiation, convergent and parallel evolution; dispersal and immigration; means of dispersal and barriers to dispersal; extinction.

UNIT:5 BIOGEOGRAPHY AND ITS APPLICATION

Biogeographical zones of India; Biogeography of North-East India; Application of biogeographical rules in design of protected area and biosphere reserves; biogeographical realms and their fauna; endemic, rare, exotic, and cosmopolitan species.

Suggested Readings:

1. Lomolino, M.V., Riddle, B.R., Whittaker, R.J. & Brown, J.H. 2010. Biogeography (4th edition). Sinauer Associates, Sunderland
2. Mani, M.S. 1974. Ecology and Biogeography in India. Dr. W Junk Publishers., The Hague.
3. Singh, G. 2012. Plant Systematics: Theory and Practice (3rd edition). Oxford & IBH Pvt. Ltd., New Delhi.
4. Wheeler, Q.D. & Meier R. 2000. Species Concepts and Phylogenetic Theory: A Debate. Columbia University Press, New York.
5. Williams, D. M., Ebach, M.C. 2008. Foundations of Systematics and Biogeography. Springer.
6. Wilkins , J. S. 2009. Species: A History of the Idea (Vol. 1). University of California Press.
7. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices . Oxford and IBH publications Co. Pvt. Ltd. New Delhi.

8. Gaston, K. J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.

PRACTICAL
Discipline Specific Core (DSC-253)
AIR, WATER, SOIL & SYSTEMATICS
Total Marks- 100
Total Credits-4

SECTION- A

1. Comparative analysis of maximum-minimum temperature of past 30 years using data obtained from a meteorological station.
2. Study of heat-island effect.
3. Filed visit to nearby meteorological station.

SECTION- B

1. To determine pH of water of different water bodies (Pond, River, Lakes & Ground water)
2. To determine the transparency of water of Pond ecosystem by Secchi disc.
3. Study of simple ecosystems-pond, river etc. and submit a report.
4. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
5. Visit to a wetland ecosystem and submit a report

SECTION- C

1. To determine the colour of soil samples by Munsell-soil colour chart.
2. To determine the pH of soil sampler by pH meter.
3. To determine the texture of soil sampler by sieving method.
4. To determine the moisture content of soil sampler by oven drying method.
5. To study the profile of a soil in the field.

SECTION-D

1. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label.
2. To prepare a checklist of birds in and around college campus.
3. Visit to a centre of Botanical Survey of India.

PRACTICAL
Discipline Specific Minor (DSM-251)
ECOLOGY, ATMOSHERE AND CLIMATE CHANGE
Total Marks- 100
Total Credits-3

SECTION- A

1. To study the allelopathic influence of one plant species.

2. To prepare a checklist of invasive species.

3. To study the plankton communities in a fresh water ecosystem.

4. To study the distribution of road side species and investigate the changes in species richness.

5. Field report: Visit to a forest/ river/ wetland ecosystem.

SECTION- B

1. Comparative analysis of maximum-minimum temperature of past 30 years using data obtained from a meteorological station.

2. Study of heat-island effect.

3. Filed visit to nearby meteorological station.

Discipline Specific Minor (DSM-252)
CONCEPT OF ATMOSPHERE AND CLIMATE CHANGE
Total Marks= 100
Total Credits=3

Unit 1: Introduction and concepts

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere, transfer of heat energy, Milankovitch cycles.

Unit 2: **Circulation of Atmosphere**

Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; meteorological parameters (temperature, air pressure, light intensity, relative humidity, wind speed and direction, precipitation); atmospheric stability.

Unit 3: Global warming and climate change

Trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; atmospheric windows; impact of global warming; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses.

Unit 4: Ozone layer

Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures.

Unit 5: Climate change and policies

Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997;Paris Agreement (2015), Clean Power Plan (2015),India's Climate Change Policy; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.

Suggested Readings:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
3. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
4. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
5. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
6. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
7. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.

8. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
9. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2ndedition). Sage Publications.
10. Ross, M.T., & Murray. B.C. 2016. What is the fuel of the future ? Prospects under the Clean Power Plan. Energy Economics, 60, 451-459.
11. Savaresi, A. 2016. The Paris Agreement: A new beginning ? Journal of Energy & Natural Resources Law, 34(1), 16-26.