BANKURA UNIVERSITY

(West Bengal Act XIX of 2013- Bankura University Act, 2013)

Main Campus, Bankura Block-II, P.O.: Purandarpur, Dist.: Bankura, Pin- 722155, West Bengal

Office of the Secretary

Faculty Council for Undergraduate Studies

Ref: BKU/FCUG/198/2024 Date: 23/07/2024

NOTIFICATION

As directed, the undersigned is pleased to inform all concerned that Bankura University has initiated the process to implement New Curriculum and Credit Framework for Undergraduate Programme, UGC 2022 (as per NEP 2020) for 4-years Undergraduate programme with Environmental science as Major, Minor etc. from the academic session 2023-2024. The Syllabus for the purpose will be framed and finalized as per the guidelines of appropriate authority. As an important corollary to the process, the workshop will be organized on the date mentioned herewith to get the feedback from the stakeholders. Present Students, Alumni, Guardians, Academicians and other stakeholders related to the specific programme/course are requested for their kind participation in the workshop and to present their views/ observations etc. The stakeholders may go through the draft syllabus attached herewith and convey their observations to the office of the undersigned on ugsecretaryoffice@bankurauniv.ac.in within seven days from the date of publication of notice.

Date: 26.07.2024

Time: 7:30 PM

Google Meet joining info Video call link: https://meet.google.com/ihp-sitr-miy

Sd/-
Dr. Arindam Chakraborty
Secretary
Faculty Council for Undergraduate Studies

Second Year (Diploma Course in Environmental Science)

SEMESTER–III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/ 301/MJC-3	Water and Water Resources Water and Water Resources (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 302/MJC-4	Land and Soil Conservation and Management Land and Soil Conservation and Management (Practical)	4	10	25 15	50	3	NA	2
S/ENV/ 303/MN-3	Water and Water Resource Water and Water Resources (Practical)	4	10	25 15	50	3	NA	2
SH/ENV/ 304/MD-3	Gender and Environment	3	10	40	50	2	NA	2
ACSHP/304/AECC-3	MIL	2	10	40	50	2	NA	NA
S/ENV/ 305/SEC-3	Soil Management and Ecotourism. Soil Management and Ecotourism (Practical)	3	10	25 15	50	2	NA	2
Total in Semester - III		**20**	**60**	**240**	**300**	**15**		**14**

N.B. MI – Minor Paper; MD – Multidisciplinary Paper; Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1hour/Week

SEMESTER–IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/ENV/401/MJC-5	Ecology and Ecosystem Ecology and Ecosystem (Practical)	4	10	25 15	50	3	NA	 2
S/ENV/402/MJC-6	Environmental Biotechnology Environmental Biotechnology(Practical)	4	10	25 15	50	3	NA	 2
S/ENV/403/MJC-7	Atmosphere and Global Climate Change Atmosphere and Global Climate Change(Practical)	4	10	25 15	50	3	NA	 2
S/ENV/404/MJC-8	Systematics and Biogeography Systematics and Biogeography(Practical)	4	10	25 15	50	3	NA	 2
S/ENV/404/MN-4	Ecology and Ecosystem Ecology and Ecosystem(Practical)	4	10	25 15	50	3	NA	 2
ACSHP/405/AECC-4	MIL	2	10	40	50	2	NA	NA
Total in Semester - IV		**22**	**60**	**240**	**300**	**17**		**10**
TOTAL in SECOND YEAR		**42**	**120**	**480**	**600**			

N.B:-MJC-Major Paper, MI – Minor Paper; ML– Multidisciplinary Paper; Theory: 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week. * Diploma in Physiology will be awarded to a student if he or she completes Summer Internship of 4 credits at least 1 in 2 years in addition to total 82 credits in Semester

SEMESTER –III

Major T- 3
WATER AND WATER RESOURCES
(S/ENV/301/MJC-3)
Total credit- 04

Unit1: Introduction (04 Lectures)
Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapotranspiration; classification of water resources (oceans, rivers and lakes).

Unit 2: Properties of water (04 Lectures)
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.

Unit 3: Surface and subsurface water (8 Lectures)
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.

Unit 4: Wetlands and their management (08 Lectures)
Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India.

Unit 5: Water resource in India (08 Lectures)
Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management.

Unit 6: Water resources conflicts (8 Lectures)

Water resources and sharing problems, case studies on Kaveri and Krishna river water disputes; 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; agreements to resolve these conflicts.

Major P-3
WATER AND WATER RESOURCES
(SH/ENV/301/MJC-3)

Practical: Marks: 15

A) Estimation of water parameters - DO, combined CO2, salinity.
B) Estimation of water parameters- hardness, alkalinity, acidity. C) Estimation of water parameters- chloride and BOD.

Suggested 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. Water Plow Press

SEMESTER –III
Major T- 4
LAND AND SOIL CONSERVATION AND MANAGEMENT
(S/ENV/302/MJC-4)
Total credit- 04

Unit 1: Introduction (05 Lectures)
Land as a resource, soil health; ecological and economic importance of soil; types and causes of soil degradation; impact of soil loss and soil degradation on agriculture and food security; need for soil conservation and restoration of soilfertility.

Unit 2: Fundamentals of soil science (5 Lectures)
Soil formation; classification of soil; soil architecture; physical properties of soil; soil texture; soil water holding capacity; soil temperature; soil colloids; soil acidity and alkalinity; soil organic matter. Development of soil profile: Laterite and Pedzol.

Unit 3: Soil degradation–causes (10 Lectures)
Soil resistance and resilience; nature and types of soil erosion; non-erosive and erosive soil degradation; losses of soil moisture and its regulation; nutrient depletion; soil pollution due to mining and mineral extraction, industrial and urban development, toxic organic chemicals, and organic contaminants in soils; recycling of soil nutrients.

Unit 4: Land use changes and cost of land degradation (12 Lectures)
Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators 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; future effects of soil degradation.

Unit 5: Controlling land degradation (08 Lectures)
Sustainable land use planning; role of databases and data analysis in land use planning control and management; land tenure and land policy; legal, institutional and sociological factors; participatory land degradation assessment; integrating land degradation assessment into conservation.

Practical: Marks: 15
A. Characterization of soil Laterite, Pedzol— Texture, Bulk density, Porosity
B. Determination of Soil parameters—pH and Colour.

Suggested Readings

1. Brady, N.C. & Well, R.R. 2007.The Nature and Properties of Soils (13thedition A) Characterization of soil Laterite, Pedzol— Texture, Bulk density, Porosity), Pearson Education Inc.

2. Gadgil, M. 1993. Biodiversity and India's degraded lands. Ambio 22: 167-172.
3. Johnson, D.L. 2006. Land Degradation (2ndedition). Rowman&Little field Publishers.
4. Marsh, W. M. & Dozier, J. 1983. Landscape Planning: Environmental Applications. John Wiley and Sons.
5. Oldeman, L. R. 1994. The global extent of soil degradation. Soil resilience and sustainable land use, 9. (http://library.wur.nl/isric/fulltext/isricu_i26803_001.pdf).
6. Pandit, M.K. et al., 2007. Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. Biodiversity Conservation 16:153-163.
7. Pandit, M.K. & Kumar, V. 2013. Land use and conservation challenges in Himalaya: Past, present and future. In: Sodhi, N.S., Gibson, L. & Raven, P.H. Conservation Biology: Voices from the Tropics. pp. 123-133. Wiley-Blackwell, Oxford, UK
8. Peterson, G. D., Cumming, G. S. & Carpenter, S. R. 2003. Scenario planning: a tool for conservation in an uncertain world. Conservation Biology 17:358-366.
9. Scherr, S. J. 1999. Soil degradation: A threat to developing-country food security by 2020 (Vol. 27). International Food Policy Research Institute.
10. Mahua Basu & S. Xavier: Fundamentals of Environmental Studies. Cambridge University press.
11. Chapman: Ecology. Cambridge University press

Other than Environmental Science Major Students

Minor T- III:
WATER AND WATER RESOURCES
(S/ENV/303/MN-3)
Total credit -04

Unit1: Introduction **(04 Lectures)**
Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapotranspiration; classification of water resources (oceans, rivers and lakes).

Unit 2: **Properties of water** **(04 Lectures**)
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.

Unit 3: **Surface and subsurface water** **(08 Lectures)**
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.

Unit 4: Wetlands and their management **(08 Lectures)**
Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India.

Unit 5: Water resource in India (08 Lectures)

Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management.

Unit 6: Water resources conflicts (8 Lectures)

Water resources and sharing problems, case studies on Kaveri and Krishna river water disputes; 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; agreements to resolve these conflicts.

Practical: Marks: 15

A) Estimation of water parameters - DO, combined CO_2, salinity.
B) Estimation of water parameters- hardness, alkalinity, acidity.
C) Estimation of water parameters- chloride and BOD.

Suggested 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. Water Plow Press

SEMESTER-III
GENDER AND ENVIRONMENT
S/ENV/304/MD-3

Unit 1: Introduction (2 lectures)
The socially constructed 'gender'concept.

Unit 2: Gender and society (04 lectures)
Gender existence in society; gender: matriarchy and patriarchy (case studies in an Indian context); gender equity issues in rural and urban settings.

Unit 3: Gender and the environment (08 lectures)
Relevance of the concept in an environmental context; evolution of gender hierarchies in historical and contemporary perspective; gendered division of roles in cultural, social and economic perspective; gender inequalities.

Unit 4: Gender, resources and the environment (08 lectures)
Human –Environment relationship; differential dependencies on environmental resources; implications of gendered responses to environmental degradation.

Unit 5: Gender and environmental management (08 lectures)
Women's participation in environmental movements and conservation; Role of women in environmental education, awareness and sustainable development.

Unit 6: Strategies for change (10 lectures)
Need for gender equity; Instruments for change: education, media, action groups, policy and management; role of ICT in resource availability and consumption.

Suggested Readings

1.Agarwal, B. 1992. The Gender and Environment Debate: Lessons from India. Feminist Studies (Minnesota).
2. Agarwal, B. 1997. Gender, Environment and Poverty Interlinks: Regional Variations and Temporal Shifts in Rural India: 1971-1991. World Development 25: 1-42.
3. Agarwal, B. 2001. Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework. World Development 29: 1623-1648.
4. Jackson, C.1993.Doingwhatcomesnaturally? Women and environment in development World Development 21: 1947-63.
5. Krishna, S. 2004. Livelihood and Gender. New Delhi, Sage.
6. Leach, M. 2007. Earth Mother myths and other ecofeminist fables: How a strategic notion rose and fell. Development and Change 38: 67-85.
7. Miller, B. 1993. Sex and Gender Hierarchies. Cambridge University Press
8. Stein, R. (ed.). 2004. New Perspectives on Environmental Justice: Gender, Sexuality, and Activism. Rutgers University Press.
9. Steingraber, S. 1998. Living Downstream: A Scientist's Personal Investigation of Cancer and the Environment. New York: Vintage Books.

SEMESTER-III
Soil Management and Ecotourism
S/ENV/305/SEC-3

Unit 1: Fundamentals of soil science (06 lectures)
Soil formation; classification of soil; soil architecture; physical properties of soil; soil texture; soil water holding capacity; soil temperature; soil colloids; soil acidity and alkalinity; soil organic matter, need for soil conservation and restoration of soil fertility.

Unit 2: Soil degradation – causes (6 lectures)
Soil resistance and resilience; nature and types of soil erosion; non-erosive and erosive soil degradation; losses of soil moisture and its regulation; nutrient depletion; soil pollution due to mining and mineral extraction, industrial and urban development.

Unit 3: Controlling land degradation (8 lectures)
Sustainable land use planning; role of databases and data analysis in land use planning control and management; land tenure and land policy; legal, institutional and sociological factors; participatory land degradation assessment; integrating land degradation assessment into conservation.

Unit 4: Ecotourism (4 lectures)
Elementary idea of Mass tourism and its Impact on environment and culture; Concept of Ecotourism, Guideline and policy (National and International) of ecotourism; Planning of ecotourism; Ecotourism circuit development; Types of Alternative Tourism, Elementary idea of Rural truism, Adventure tourism; Development, economical benefits and impacts of Ecotourism; Management of ecotourism; Ecotourism potentiality in India.

Practical: Marks: 15
A Characterization of soil Laterite, Pedzol— Texture, Bulk density, Porosity)
B) Determination of Soil parameters—pH, Colour, and conductivity.

Suggested Readings
1. Brady, N.C. & Well, R.R. 2007.The Nature and Properties of Soils (13 th edition), Pearson Education Inc.
2. Gadgil, M. 1993. Biodiversity and India's degraded lands. Ambio22: 167-172. 22 Bankura University B.Sc.(Programme)Environmental Science CBCS w.e.f. 2017-18
3. Johnson, D.L. 2006. Land Degradation (2 nd edition). Rowman&Little field Publishers.
4. Marsh, W. M. &Dozier,J. 1983. Landscape Planning: Environmental Applications. John Wiley and Sons.

5. Oldeman, L. R. 1994. The global extent of soil degradation. Soil resilience and sustainable land use, 9. (http://library.wur.nl/isric/fulltext/isricu_i26803_001.pdf).
6. Pandit, M .K. et al., 2007. Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. Biodiversity Conservation 16: 153-163.
7. Pandit, M.K. & Kumar, V. 2013. Land use and conservation challenges in Himalaya: Past, present and future. In: Sodhi, N.S., Gibson, L. & Raven, P.H. Conservation Biology: Voices from the Tropics. pp. 123-133. Wiley-Blackwell, Oxford, UK
8. Peterson, G. D., Cumming, G. S. & Carpenter, S. R. 2003. Scenario planning: a tool for conservation in an uncertain world. Conservation Biology 17: 358-366.
9. Scherr, S. J. 1999. Soil degradation: A threat to developing-country food security by 2020 (Vol. 27). International Food Policy Research Institute

SEMESTER-IV
Major T-5
ECOLOGY AND ECOSYSTEM
(S/ENV/401/MJC-5)
Total credit- 04

Unit1: Introduction (05 Lectures)
Basic concepts and definitions: ecology, landscape, habitat, biosphere, ecosystems, autecology; synecology; major terrestrial biomes.

Unit 2: Ecology of individuals (5 Lectures)
Liebig's Law of the Minimum; Shelford's Law of Tolerance; ecotypes; ecoclines; acclimation; ecological niche; types of niche.

Unit 3: Ecology of populations (08 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, densitydependent; limits to population growth.

Unit 4: Ecology of communities (06 Lectures)
Community structure and organization, species interactions: mutualism, ecological succession: primary and secondary successions types of successions, climax community concepts.

Unit 5: Ecosystem ecology (08 Lectures)
Types of ecosystem: forest, grassland, lotic, marine, ecosystem structure and function; abiotic and biotic components of ecosystem; primary and secondary production; ecosystem connections: food chain, food web; models of energy flow. Ecological pyramids: pyramids of number, biomass, and energy.

Unit 6: Biogeochemical cycles and nutrient cycling (08 Lectures)
Carbon cycle; nitrogen cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; nutrient supply and uptake; nutrient use efficiency; nutrient budget; nutrient conservation strategies.

Practical: Marks: 15

1. Identification with reasons of the following
a) Study of microfauna of water viz., plankton, (e.g., Keratella, Cyclops, Cypris, Nauplius larva, Bosmina, Moina).
b) Study of aquatic flora, e.g., Spirogyra, Zygnema, Pistia, Eichhornia, Hydrilla, Ipomoea, Azolla, Lemna (minor and major).

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 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-IV
Major T- 6
ENVIRONMENTAL BIOTECHNOLOGY
(SH/ENV/402/MJC-6)
Total credit- 04

Unit 1: Cell and Cellular Organelles (08 Lectures)
Genetic material of prokaryotes, eukaryotes and organelles; Chromosomal organization (euchromatin, heterochromatin-constitutive and facultative heterochromatin).

Unit 2: The Structure and Function of DNA, RNA and Protein (08 Lectures)
DNA: structural forms and their characteristics (B, A, Z); RNA: structural forms and their characteristics (rRNA, mRNA, tRNA), types of amino acids. Central dogma of biology,

Fundamentals of Recombinant DNA Technology.

Unit 3: Ecological restoration and bioremediation (14 Lectures)

Wastewater treatment: Primary, Secondary and Tertiary; solid waste treatment: sources and management (vermiculture and methane production, landfill. hazardous waste treatment); specific bioremediation technologies: land farming, biopiles, composting, bioventing.

Unit 4: Ecologically safe products and processes (10 Lectures)

PGPR bacteria: biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel.

Practical: Marks: 15 Credit: 02

A) Cytological preparation and Identification of Mitosis of *Alium* sp and Meiotic stages from Onion root tips (*Allium cepa*)
B) Estimate ABO blood grouping.

Suggested Readings

1.Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2ndedition). Wiley-Blackwell Publications.
2. Jordening, H.J. & Winter J. 2005. Environmental Biotechnology: Concepts and Applications. John Wiley & Sons.
3. Lodish, H.F., Baltimore, D., Berk, A. Zipursky, S.L. Matsudiara, P. & Darnell, J.1995. Molecular Cell Biology. W.H. Freeman.
4. Nelson, D.L. & Cox, M.M. 2013. Lehninger's Principles of Biochemistry. W.H.Freeman.
5. Rittman, B.E. & McCarty, P.L. 2001. Environmental Biotechnology. Principles and Applications. L McGraw-Hill, New York.
6. Scagg, A.H. 2005. Environmental Biotechnology. Oxford University Press.
7. Snustad, D.P. & Simmons, M.J. 2011. Principles of Genetics (6thedition). John Wiley & Sons.
8. Wainwright, M. 1999. An Introduction to Environmental Biotechnology. Springer.
9. B.C.Bhattacharyya&Rintu Banerjee: Environmental Biotechnology. Oxford University Press

SEMESTER-IV

Major T- 7

ATMOSPHERE AND GLOBAL CLIMATE CHANGE

(S/ENV/403/MJC-7)

Total credit- 04

Full marks: 25 Lectures 50

Unit1: Introduction (04 Lectures)

Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere in making the Earth, Milankovitch cycles.

Unit 2: Global energy balance (04 Lectures)

Earth's energy balance; energy transfers in atmosphere; Earth's radiation budget; green house gases (GHGs); greenhouse effect; global conveyor belt.

Unit 3: Atmospheric circulation (06 Lectures)

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.

Unit 4: Meteorology and atmospheric stability (06 Lectures)

Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.

Unit 5: Global warming and climate change (04 Lectures)

Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different green house gases (GHGs) causing the climate change.

Unit 6: Ozone layer depletion (08 Lectures)

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 and international protocols.

Unit 7: Climate change and policy (08 Lectures)

Environmental policy statement; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading.

Practical: Marks: 15

Submit a Project or Review work or Term-paper on
a) Global warming. or
b) Ozone layer depletion or
c) Any Global crisis or Catastrophic changes.

Suggested Readings:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Rout ledge Press, UK. 2. Lal D.S. 2006, Climatology, Sharda Pustak Bhawan, Allahabad

3. Singh S. 2009. Climatology, Prayag Pustak Bhawan, Allahabad
4. Siddhartha K. 2005, Atmosphere, Weather and Climate, Kisalaya Publications Pvt. Ltd, New Delhi
5. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
6. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
7. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
8. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
9. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
10. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
11. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. & Sen, K. 2004. Climate Change and India. Universities Press, India.
12. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2ndedition) Sage Publications.

SEMESTER-IV
Major T- 8
SYSTEMATICS AND BIOGEOGRAPHY
(S/ENV / 403/MJC-8)

Total credit- 04

Full marks: 25 Lectures 50

Unit 1: Concept and systematic approaches (04 Lectures)
Definition of systematics; taxonomic identification; keys; field inventory; herbarium; museum; botanical gardens; taxonomic literature; nomenclature; evidence from anatomy, palynology.

Unit 2: Taxonomic hierarchy (04 Lectures)
Concept of taxa (species, genus, family, order, class, phylum, kingdom); concept of species (taxonomic, typological, biological, evolutionary, phylogenetic); categories and taxonomic hierarchy.

Unit 3: Nomenclature and systems of classification (05 Lectures)
Principles and rules (International Code of Botanical and Zoological Nomenclature); ranks and names; types and typification; author citation; principle of priority and its limitations; classification systems of Bentham and Hooker.

Unit 4: Numerical and molecular systematic (05 Lectures)
Characters; variations; phenograms; cladograms; DNA barcoding; phylogenetic tree; clades: monophyly, paraphyly, polyphyly; homology and analogy; parallelism and convergence.

Unit 5: Introduction to Biogeography (05 Lectures)
Genes as unit of evolutionary change; mutation; genetic drift; gene flow; natural selection; geographic and ecological variation; biogeographical rules –Bergmann's rule, Allen's rule;

biogeographical realms and their fauna; endemic, rare, exotic, and cosmopolitan species.

Unit 6: Ecological Biogeography (04 Lectures)

Species' habitats; environment and niche concepts; biotic and abiotic determinants of communities; species-area relationships; concept of rarity and commonness; geography of diversification and invasion; phylogeography.

Unit 7: Conservation Biogeography (03 Lectures)

Application of biogeographical rules in design of protected area and biosphere reserves; use of remote sensing in conservational planning.

Practical: Marks: 15

A. Field study Report on tutorial based
and
B. Listing the procedure of Typification.
or
C. Preparation of Phylogenetic tree from hypothetical data.

Suggested Readings

1. Lomolino, M.V., Riddle, B.R., Whittaker, R.J. & Brown, J.H. 2010. Biogeography (4thedition). 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 (3rdedition). 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

SEMESTER-IV

ECOLOGY AND ECOSYSTEM
(SH/ENV/404/MN-4)
Total credit 04

Unit1: Introduction (05 Lectures)

Basic concepts and definitions: ecology, landscape, habitat, biosphere, ecosystems, autecology; synecology; major terrestrial biomes.

Unit 2: Ecology of individuals (5 Lectures)

Liebig's Law of the Minimum; Shelford's Law of Tolerance; ecotypes; ecoclines; acclimation; ecological niche; types of niche.

Unit 3: Ecology of populations (08 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, densitydependent; limits to population growth.

Unit 4: Ecology of communities (06 Lectures)

Community structure and organization, species interactions: mutualism, ecological succession: primary and secondary successions types of successions, climax community concepts.

Unit 5: Ecosystem ecology (08 Lectures)

Types of ecosystem: forest, grassland, lotic, marine, ecosystem structure and function; abiotic and biotic components of ecosystem; primary and secondary production; ecosystem connections: food chain, food web; models of energy flow. Ecological pyramids: pyramids of number, biomass, and energy.

Unit 6: Biogeochemical cycles and nutrient cycling (08 Lectures)

Carbon cycle; nitrogen cycle; hydrological cycle; nutrient cycle models; ecosystem input of nutrients; biotic accumulation; nutrient supply and uptake; nutrient use efficiency; nutrient budget; nutrient conservation strategies.

Practical: Marks: 15

1. Identification with reasons of the following

a) Study of microfauna of water viz., plankton, (e.g., Keratella, Cyclops, Cypris, Nauplius larva, Bosmina, Moina).

b) Study of aquatic flora, e.g., Spirogyra, Zygnema, Pistia, Eichhornia, Hydrilla, Ipomoea, Azolla, Lemna (minor and major).

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 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