Maulana Abul Kalam Azad University of Technology, WB
(Formerly known as West Bengal University of Technology)
Syllabus of B.Sc in Environment Science
Effective from academic session 2023-24

Major Paper Code: BENVS- 401	SEM-IV
Paper Name: Alteration Of Atmosphere and Climate	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Lecture hour: 45	End semester exam: 70
Tutorial hour: 0	Continuous Assessment: 30
Practical hour: 0	Practical/Seasonal internal continuous evaluation:0
Total hours: 0	Practical/Seasonal external examination: 0
Credit: 4	Mode of Exam: Offline

Course Objective:

1. Identify the basic forces and processes that govern global weather and climatic conditions
2. Describe and explain the distribution of various climatic types over the surface of the earth
3. Identify both anthropogenic and natural causes of climate change
4. Recognize and debate the arguments of both sides in the global warming debate
5. Evaluate the positive and negative implications of proposed global warming mitigation strategies
6. Explain the current theory regarding the depletion of stratospheric ozone and its consequences
7. Identify the sources of, and the chemical reactions involved in, the production of acid rain
8. Describe the conditions that could lead to regional drought and desertification
9. Summarize the impact of cataclysmic climate change (i.e., planetary impact and nuclear winter)

Course Outcome:

1. Knowledge of various human activities is increasing emmissions of natural greenhouse gases, and are also contributing to sulphate aerosols in the troposphere.
2. Scientific Skills: Show ability to apply scientific knowledge & experimental skills in critical and organized manner for evaluation and elucidation of complex environmental problems and issues related to terrestrial ecosystems; physical environment; air, water, and soil contamination; human health hazards; biodiversity loss; food security and agricultural issues; solid waste management; and other specialized areas of electronics.
3. Environmental Problem-Solving: Address and solve scientific vis-a-vis environmental problems via rational and original thinking; keep updates of different solution avenues and select appropriate options considering public health, cultural, and societal factors.
4. Environmental Policy and Regulation: Strong academic integrity, professional code of conduct, ethical values, and sense of responsibility towards societal needs and sustainability.
5. Sustainable Practices: Graduates will be familiar with current environmental scenarios, scientific and technological progress, lifestyle change, and biophysical evolutions with a futuristic view. Commitment to the SDGs in terms of economic welfare, social equity and proactive long-term environment management.

Detailed Content:

MODULE I: 3 Hours

Meteorology: introduction, definition, scales in meteorology, branches and applications. Earth Radiation balance: Sun's Energy output, Incoming radiation, Energy spectra of sun and earth, Insulation, Insulation over the globe, insulation losses in atmosphere, long wave radiation, Global radiation balance, Solar energy.

MODULE II: 10 Hours

Atmospheric circulation and energy balance 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, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture and Indus valley civilization; effect of urbanization on micro climate; Asian brown clouds. Earth's energy balance; energy transfers in atmosphere; Earth's radiation budget; green house gases (GHGs); greenhouse effect; global conveyor belt.

MODULE III: 12 Hours

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

Chemistry of atmospheric particles and gases; smog – types and processes; photochemical processes; ions and radicals in atmosphere; acid-base reactions in atmosphere; atmospheric water; role of hydroxyl and hydroperoxyl radicals in atmosphere.

MODULE IV: 12 Hours

Global warming and climate change Evolution and development of Earth's atmosphere; atmospheric structure and composition; significance of atmosphere in making the Earth, the only biosphere; Milankovitch cycles, atmospheric windows. Trends of global warming and climate change; drivers of global warming and Global Warming Potential (GWP) & climate change; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.

MODULE V: 8 Hours

Ozone layer depletion, environmental policy & agreements 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.

Reference Books:

- Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
- Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries with Policy and Science Considerations. Martinus Nijhoff Publishers.
- Rajni Kant, Keshav Kant. 2021. Air Pollution and Control Engineering | AICTE Recommended, Khanna Publishing House.
- Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
- Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
- Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
- Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
- Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.

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Major Paper Code: BENVS- 402	SEM-IV
Paper Name: Biodiversity & Conservation Biology	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Lecture hour: 45	End semester exam: 70
Tutorial hour: 30	Continuous Assessment: 30
Practical hour:	Practical/Seasonal internal continuous evaluation:
Total hours: 75	Practical/Seasonal external examination:
Credit: 5	Mode of Exam: Offline

Course Objective:

1. Prepare students to have a good understanding of cellular and organism-level plant and animal structures, taxonomy and metabolic processes.
2. Equip students to identify plant vegetative and floral structures and be able to identify native and non-native herbaceous and woody plants.
3. Enhance understanding of students on the general principles of ecology as how it related to terrestrial and aquatic plant and animal conservation and management.
4. Enhance the ability of students to identify species, characteristics, habitat requirements and life cycles of birds, fish and mammalian wildlife species.
5. Impart field based training to students how it will be applicable to solve problems related to wildlife conservation and management.
6. Students will be equipped with knowledge on wildlife conservation and management relates to the economy and environment, both currently and in the future.
7. Students will be able to critically evaluate current events and public information related to wildlife conservation and management as being scientifically based or opinion based and contributes to the knowledge base of information.

8. Encourage the students to carry out the research works in frontier areas of Wildlife and Biodiversity Conservation.

Course Outcome:

1. Knowledge: Understand the factors affecting the need to find sustainable practices for production of food, feed and fiber crops and how to implement them.
2. Scientific Skills: Recognize species within some particular group of organisms and explain key aspects of their ecology, phylogeny, and conservation needs
3. Environmental Problem-Solving: Students will be able to critically evaluate current events and public information related to wildlife conservation and management as being scientifically-based or opinion-based and contribute to the knowledge base of information.
4. Environmental Policy and Regulation: Strong academic integrity, professional code of conduct, ethical values, and sense of responsibility towards societal needs and sustainability.
5. Sustainable Practices: Graduates will be familiar with current environmental scenarios, scientific and technological progress, lifestyle change, and biophysical evolutions with a futuristic view. Commitment to the SDGs in terms of economic welfare, social equity and proactive long-term environment management.

Detailed Content:

MODULE I: 5 Hours

Introduction- Definition, Genetic diversity, Species diversity, Ecosystem diversity: Structural and functional aspects. Bio-geographic classification of India. Basic concepts of conservation biology, history of conservation biology, the value of biodiversity and conservation, current practice in conservation, conservation of

genetic diversity, conservation of species diversity, conservation of ecosystem diversity, relevance of ecosystem diversity as well as services in conservation.

MODULE II: 10 Hours

Value of Biodiversity- Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values. Utilitarian values of biodiversity- goods, services and information. Biodiversity an ecosystem functioning. Biodiversity and stability of ecosystem functioning. Biodiversity at global, national and local levels India as a Mega Diversity Nation. Hotspots of Biodiversity: Criteria for determining hot spots. Indo-Burma (Eastern Himalaya), Western Ghats and Sri Lanka.

MODULE III: 10 Hours

Threats to Biodiversity- Habitat loss, pollution, species introduction, global climate change overexploitation, poaching of wildlife. Rare species, genetic diversity of rare species, habitat loss and fragmentation. Extinction: mass extinction, extinction process, ecosystem degradation, over exploitation, invasive species. Human factors: social factors, economics, politics and action. Man, wildlife conflicts. Endangered and endemic species of India, common plant species, common animal species.

MODULE IV: 10 Hours

Conservation of Biodiversity- Strategies for conservation: In-situ and ex-situ conservation- environmental assessment, protected areas-biosphere reserves, national parks, sanctuaries, tiger reserves-project tiger. Ex situ conservation- Managed ecosystems, biological resources and gene banks, botanical gardens, bio-parks, simulated ex situ conservation strategies, valuing biological resources, ecotourism. Strategies for Conservation: Top-down and bottom- up protocols for conservation. In situ conservation. - Protected areas, Wildlife sanctuaries, National parks, Biosphere reserves. Strategies for ex situ conservation – Botanical Gardens,

Seed banks, Field gene banks, Test tube gene banks, pollen banks, DNA bank, in vitro conservation.

MODULE V: 10 Hours

Ecosystem Restoration and Management Practices- Global biodiversity and its importance, Different approaches of biodiversity conservation and management, registering biodiversity. Valuing biodiversity resources and their contribution to agriculture, community health and environment.
Causes of biodiversity loss. Techniques of species reintroduction and restoration of the degraded habitat. Biodiversity policy and legislation. Wildlife conservation and management: Status of biodiversity conservation in India.

MODULE VI: 10 Hours

Conservation Practices in India and World- Organizations involved in resource conservation IUCN, WWF, UNEP, UNESCO, Biodiversity International, IPGRI, FAO, BSI, ZSI. Phytogeography – Hotspots of India and world. General account on activities of DBT, BSI, NBPGR, ZSI, FSI, NBFGR and NBAGR NFPTCR, Sacred groves, Biodiversity register.

Reference Books:

- An, S., & Verhoeven, J. T. (Eds.). (2019). Wetlands: Ecosystem Services, Restoration and Wise Use (Vol. 238). Springer
- M.P. Poonia & S.C. Sharma (2021). Environmental Studies, Khanna Publishing House.
- Carina Hoorn, Allison Perrigo, Alexandre Antonelli (2018). Mountains, Climate and Biodiversity John Wiley and Sons Ltd ,Oxford,UK.
- Copsey, J. A., Black, S. A., Groombridge, J. J., & Jones, C. G. (Eds.). (2018). Species Conservation: Lessons from Islands. Cambridge University Press.
- Dudgeon, D. (2020). Freshwater Biodiversity. Cambridge University Press.

- Fiedler P.L and Kareiva, P.M. (1997) Conservation biology Chapman and Hall International Thompson Publishing.USA
- Gabriel M. (2000) Biodiversity and conservation Oxford and IBH publishing company Pvt Ltd. New Delhi.
- Heywood, V.H. & Watson, R.T. (1995) Global Biodiversity Assessment.
- Huston, M.A. (1994). Biological Diversity: The coexistence of species on changing landscapes. Cambridge University Press, UK.
- Iriondo, J. M., Maxited, N. and Dulloo, M.E (2008) Conserving plant genetic diversity in protected areas – population management of crop wild relatives. Biddles Ltd. Kings' Lynn.
- Juniper, T. (2019). Rainforest: Dispatches from Earth's Most Vital Frontlines. Island Press.
- Rajni Kant, Keshav Kant (2021). Air Pollution and Control Engineering | AICTE Recommended, Khanna Publishing House.
- Krishnamoorthy, K.V (2004) An Advanced textbook on Biodiversity- principles and Practice:
  Oxford and IBH publishing company Pvt. Ltd. New Delhi.

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Major Paper Code: BENVS- 403 & BENVS 493	SEM-IV
Paper Name: Waste Management	Maximum Marks: 100+100
Teaching Scheme	Examination Scheme
Lecture hour:	End semester exam: 70
Tutorial hour: 45	Continuous Assessment: 30
Practical hour: 30	Practical/Seasonal internal continuous evaluation:0
Total hours: 0	Practical/Seasonal external examination: 0
Credit: 3+1	Mode of Exam: Offline

Course Objective:

The overall objectives of the waste management assessment are summarised below:

1. to assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated.
2. to identify any potential environmental impacts from the generation of waste at the site.
3. to recommend appropriate waste handling and disposal measures / routings in accordance with the current legislative and administrative requirements; and
4. to categorize waste material where practicable (inert material / waste fractions) for disposal considerations i.e. public filling areas / landfill

Course Outcome:

1. Knowledge: Explain the principles & concepts of waste management.
2. Scientific Skills: Plan an effective & efficient waste management system.
3. Environmental Problem-Solving: Apply various techniques of energy recovery from waste.

4. Environmental Policy and Regulation: Strong academic integrity, professional code of conduct, ethical values, and sense of responsibility towards societal needs and sustainability.
5. Sustainable Practices: Graduates will be familiar with current environmental scenarios, scientific and technological progress, lifestyle change, and biophysical evolutions with a futuristic view. Commitment to the SDGs in terms of economic welfare, social equity and proactive long-term environment management.

Detailed Content:

MODULE I: 10 Hours

INTRODUCTION TO SOLID WASTE MANAGEMENT:

Classification of solid wastes (source and type based), solid waste management (SWM), elements of SWM, ESSWM (environmentally sound solid waste management) and EST (environmentally sound technologies), factors affecting SWM, Indian scenario, progress in MSW (municipal solid waste) management in India. Indian and global scenario of e-waste,

MODULE II: 10 Hours

WASTE GENERATION ASPECTS:

Waste stream assessment (WSA), waste generation and composition, waste characteristics (physical and chemical), health and environmental effects (public health and environmental), comparative assessment of waste generation and composition of developing and developed nations, a case study results from an Indian city, handouts on solid waste compositions. E-waste generation.

MODULE III: 10 Hours

COLLECTION, STORAGE, TRANSPORT AND DISPOSAL OF WASTES:

Waste Collection, Storage and Transport: Collection components, storage-containers/collection vehicles, collection operation, transfer station, waste

collection system design, record keeping, control, inventory and monitoring, implementing collection and transfer system, a case study. Waste Disposal: key issues in waste disposal, disposal options and selection criteria, sanitary landfill, landfill gas emission, leachate formation, environmental effects of landfill, landfill operation issues, a case study.

MODULE IV: 10 Hours

WASTE PROCESSING TECHNIQUES & SOURCE REDUCTION, PRODUCT RECOVERY & RECYCLING:

Purpose of processing, mechanical volume and size reduction, component separation, drying and dewatering. Source Reduction, Product Recovery and Recycling: basics, purpose, implementation monitoring and evaluation of source reduction, significance of recycling, planning of a recycling programme, recycling programmed elements, commonly recycled materials and processes, a case study.

MODULE IV: 5 Hours

HAZARDOUS WASTE MANAGEMENT AND TREATMENT:

Identification and classification of hazardous waste, hazardous waste treatment, pollution prevention and waste minimization, hazardous wastes management in India. E-waste recycling.

Practical

Major Paper Code: BENVS-493

Credit: 1

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- AV presentation by students (on specific topics).
- Discussion of case studies based on research findings.
- Model making and Poster presentations.

REFERENCE BOOKS

1. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons.

2. McDougall, F.R., White, P. R., Franke, M., &Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons

3. Gupta O.P. 2021, Elements of Solid Hazardous Waste and Management | AICTE Recommended, Khanna Publishing House.

4. Gupta O.P. 2021, Energy Technology | AICTE Recommended, Khanna Publishing House.

5. Tietenberg, T. H. & Lewis, L. 2010. Environmental Economics and Policy. Addison-Wesley

6. Singh, K. &Shishodia, A. 2007. Environmental Economics: Theory and Applications. Sage Publications