

तार : विश्वविद्यालय
Gram : UNIVERSITY



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बुन्देलखण्ड विश्वविद्यालय, झाँसी BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

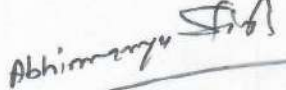
संदर्भ...BU/Env.Sc/2022-1058

दिनांक...2/12/2022

The Minutes of Meeting of BOS

In reference to the BOS of department of Environmental
Science....., Institute of Environment and
Development Studies..... held on 14/6/2022 regarding the
revision of syllabus in tune with CBCS/NEP-2020 and subsequent
approval from Academic Council. This is to certify that the syllabus is
100% revised.


Registrar
Bundelkhand University
JHANSI


For HOD/Coordinator
Dr. Adimanyu Singh
Co-ordinator
Institute of Environmental Science
Bundelkhand University, Jhansi (U.P.)

INSTITUTE OF ENVIRONMENT AND DEVELOPMENT STUDIES
BUNDELKHAND UNIVERSITY, JHANSI

Minutes of Board of Studies Meeting for the session 2021 – 22

According to the letter no. BU/Acad./2022/6310-6350 dt. 09.06.2022, the Board of Studies meeting of Institute of Environment and Development Studies, B.U. Jhansi was held on 14.06.2022 regarding the modification and upgradation of syllabus of the courses B.Sc. (Hons.) Environmental Science, M.Sc. Environmental Science and Post Graduation Diploma in Environmental Management (PGDEM) in the meeting hall of VC Committee room. In this meeting following members were present:

1. Dr. Vinit Kumar, *Convener, BoS, IE DS*
2. Dr. Smriti Tripathi, *Coordinator, IE DS*
3. Dr. A.K. Giri, *Member*
4. Dr. Abhimanyu Singh, *Member*
5. Dr. Amit Pal, *Member*
6. Dr. Sandeep Arya, *Member*
7. Prof. R.P. Singh, *External Expert*
8. Dr. Sanjay Singh, *External Expert*
9. Prof. N.C. Gautam, *External Expert*
10. Prof. Kusum Arunachalam, *External Expert*

In this meeting held on 14.06.2022 the upgradation and minor syllabus revision of B.Sc. (Hons.) Environmental Science, M.Sc. Environmental Science and Post Graduation Diploma in Environmental Management (PGDEM) was discussed and implemented. The expert panel list for examination of the session 2022 -23 was also finalized in this meeting. Implementation of New Education Policy (NEP) at (UG and PG) level for the academic session 2022 – 23 is also accepted in this BoS meeting.



Co-ordinator
Institute of Environment & Development Studies
Bundelkhand University, JHANSI (U.P.)

Dr. Smriti Tripathi
Coordinator, IE DS
BU, Jhansi

**Institute of Environment and Development Studies
Bundelkhand University, Jhansi**

**Syllabus M.Sc. Environmental Sciences
(2022 onwards)**

Program Educational Objectives (PEOs)	
PEO1	Compiled in the postgraduate curriculum will enable you to establish a solid understanding of environmental science and self-learning ability to pursue further education.
PEO2	Students will be able to acquire the knowledge and ability to apply it to environmental issues facing society today, whether local, regional or international in scope and consistent with sustainability and economy.
PEO3	Students will be able to improve their critical thinking and research skills, enabling them to do more research and learn more in the field.
PEO4	To prepare students to make intelligent decisions on a range of environmental issues, mitigation measures and cutting-edge technologies.
PEO5	To prepare students for successful occupations in the public sector, business, academia, non-profit organizations and other relevant sectors.

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
The programme specified outcomes (PSOs) are a list of competencies and abilities that specify the skills and abilities that a post-graduate will possess at the program's conclusion. Students who successfully complete the M.Sc. in Environmental Sciences will be able to choose their occupations in the public sector, business, academia, non-profit organizations and other relevant sectors.	
PSO1	Develop relevant skills and in-depth knowledge of the principles, processes, and phenomena relating to environmental challenges.
PSO2	To be able to build analytical capabilities as well as to use statistical techniques, ICT and instrumentation techniques for the collection and analysis of scientific data and environmental analysis.
PSO3	Learning ability to plan and execute environmental initiatives, prepare scientific reports, communicate research findings and contribute to the management of the environment.
PSO4	The capacity to use experimentally based environmental strategies and methodologies and scientific knowledge to address environmental pollution issues and promote sustainable development.
PSO5	The capacity to build a solid foundation enables students to pursue careers in teaching, research and development, public service, and front-line environmental science research.


Co-ordinator
Institute of Environment & Development Studies
Bundelkhand University, JHANSI (U.P.)

Programme/Class: Degree		Year: First	Semester: First
Theory		Subject: Environmental Sciences	
Course Code: DES – 101		Course Title: PRINCIPLES OF ENVIRONMENT & ECOLOGY	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Learn basic concept of environmental science and human ecology. • Develop understanding about ecology. • Gain knowledge about biotic and abiotic factor. • Able to understand population dispersion and regulation. • Understand the structure of the population and community. • Also able to understand the theories of origin of life. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Introduction to Environmental Sciences: Definition, scope and importance; Human ecology and human settlement. Earth, Man and Environment Interactions. Geographical Classification and Zones – Torrid, Temperate and Frigid Zones.		14
II	Fundamentals of Ecology: Definition, Principle, Branches and Scope of Ecology. Ecological Factors: Abiotic – Physical and chemical Factors, Biotic – Limiting Factors - Species Interaction: Commensalism, Amensalism, Mutualism, Competition, Parasitism, Prey-Predator Relationship. Sedimentary Cycles (P, S, Fe), Gaseous Cycles (C, N, O) and Hydrological Cycle.		12
III	Population Ecology: Population - Definition, Characteristics, Population Density, Natality, Mortality, Age Distribution, Growth Patterns, Population Fluctuation, Population Equilibrium, Biotic Potentials, Population Dispersion and Regulation of Population. Ecological Age Pyramids. Survivorship Curves and its Types.		10
IV	Community Ecology: Definition, Characteristics, Dominance, Structure, Stratification, Periodicity, Fluctuation within Community, Communal Interdependence, Ecotone, Edge Effect, Ecological Niche and Ecological Equivalents. Ecological Succession, Types, Process, Climax and Significance of Succession.		14
V	Evolution: Evolution, origin of life and speciation; Theories of organic evolution, Hardy Weinberg genetic equilibrium, Genetic polymorphism and selection; Economically important microbes, plants and animals.		10
<p>Suggested Books:</p> <ul style="list-style-type: none"> • Environmental Science and Technology, Stanley E. Manahan, (2007), Lewis Publishers. • A Text Book of Ecology, S. K. Dubey (2006), Dominant Publishers. • Environment, Peter H. Raven, Berg, David M. Hassenzahl (2010), John Wiley & Sons. • Fundamentals of Ecology, Eugene P. Odum, Gary W. Barrett (2012), Cengage Learning. • Ecology Principles and Applications, J. L. Chapman & M. J. Resiss (2010), Cambridge University Pre • Environmental Science, G. Tyler Miller, Scott E. Spoolman (2014), Cengage Learning • Environmental Science, Botkin, Keller (2012), John Wiley & Sons. • Environmental Science, S. C. Santra (2016), New Central Book Agency Pvt. Ltd. 			

Programme/Class: Degree		Year: First	Semester: First
Theory		Subject: Environmental Sciences	
Course Code: DES – 102		Course Title: Environmental Chemistry	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Learn basic fundamental of environmental chemistry. • Developing understanding about fundamental concept of general chemistry. • Understand the structure and composition of atmosphere. • Learn about the soil profile. • Develop basic understanding about the water. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Introduction: Fundamentals of environmental chemistry, stoichiometry, laws of thermodynamics, oxidations-reduction.		10
II	Fundamental Concepts of General Chemistry: Formation of Molecules, Molecular Weight, Equivalent Weight, Strength of the Solution – Molality, Molarity, Normality, Valency and Oxidation State, Oxidation and Reduction Reactions, Metals and Nonmetals, Aromatic and Aliphatic Organic Compounds, Saturated and Unsaturated Hydrocarbons.		10
III	Atmospheric Chemistry: Structure and Composition of Atmosphere, Classification of Elements, Particulate Matter, Ions and Radicals in the Atmosphere. Chemical and Photochemical Reactions, Formation of Smog, PAN, Acid Rain. Oxygen and Ozone Chemistry., Green House Gases and Global Warming, Wind Direction, Wind Speed and Temperature.		14
IV	Soil Chemistry: Soil Profile, Soil Horizons – Physical, Chemical and Biological Characteristics, Nature of Soil – Soil Structure and Texture. Soil Macro and Micro Nutrients — Soil Water – Soil Air – Soil Temperature – Soil Organic Matter. Soil Colloids – Ion Exchange Capacity. inorganic and organic components of soil, nitrogen pathway and NPK in soil		12
V	Hydropheric Chemistry: Water chemistry, Physico-chemical characteristics of water, Physical and chemical aspects of inland water bodies like lakes, streams, river and wetlands, heavy metals in water, pesticides, organic pollutants.		14
<p>Suggested Books:</p> <ul style="list-style-type: none"> • Environmental Chemistry, Stanley E. Manahan (1999), CRC Press. • Environmental Chemistry, Peter O' Neil, (2004), Blackie Academic & Professional. • Basic Concept of Environmental Chemistry, Des W. Connell (2005), Taylor & Francis. • The Principles of Environmental Chemistry, James E. Girard (2005), Jones & Bartlett. • Environmental Science & Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press. • Environmental Chemistry, Colin Baird & Michael Cann (2008), W. H. Freeman & Co., • Environmental Chemistry with Green Chemistry. Asim K. Das & Mahua Das (2012), Books & Allied Pvt. Ltd., • Fundamentals Concepts of Environmental Chemistry, G. S. Sodhi (2011), Narosa Publishing House. • Environmental Chemistry, A. K. De (2010), New Age International Pvt. Ltd. 			

Programme/Class: Degree		Year: First	Semester: First
Theory		Subject: Environmental Sciences	
Course Code: DES - 103		Course Title: Abiotic Environment	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand the geological time scale. • Learn about the climatology. • Develop understanding about water resources. • Gain knowledge about the major rocks and minerals. • Learn about the Köppen's climate classification system. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Understanding of the Earth: Origin of earth, Geological time scale, Internal Structure and composition of Earth, Rocks, Tectonic framework of India; Plate-tectonics, Volcano, Soil profile, Physical, chemical and biological properties of soil, Soil erosion, Mineral resources, Soils of India, Major natural hazards – earthquake, cyclone, landslides, etc.; concept of isostasy.		10
II	Atmosphere: Atmospheric profile, Climatology, Types of wind, Wind as ecological factor. Classification of Climate of India, Meteorological analysis, Inversion.		10
III	Hydrosphere: General physico-chemical properties of water, types of water, Global water balance & Ice sheet, Distribution & precipitation, Water as an ecological factor, Hydrological cycle, Water resources – oceans, surface and ground water.		14
IV	Rocks: Major rock and ore forming minerals: Properties of minerals; Igneous, sedimentary and metamorphic rocks. Impact of mining on environment.		12
V	Climate: Köppen's climate classification system; General relationship between landscape, biomes and climate.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • T. R. Oke. 2006. Boundary layer climates. Methuen & Co. Ltd. • S. Pal Arya. 2001. Introduction to Micrometeorology. Academic Press. • H. R. Byers. 2006. General Meteorology. McGraw-Hill. • K. S. Valdiya. 1987. Environmental Geology. Tata McGraw-Hill. • S. J. M. Wallace and P. V. Hobbs. 2006. Atmospheric Science – An introductory survey 			

Programme/Class: Degree		Year: First	Semester: First
Theory		Subject: Environmental Sciences	
Course Code: DES - 104		Course Title: National & Global Environmental Issues	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the ozone depletion. • Learn about the climate change. • Understanding about the environment management. • Gain knowledge about the national environment issues. • Learn about the green chemistry. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Global climatic change: Ozone layer depletion and protection, El-Nino, International treaties, protocols and conventions on emission reduction, ozone layer protection and trans-boundary movement of hazardous waste. United Nation's efforts for environmental protection & sustainable development, Other international and national organizations for environmental protection, environmental movements, Agenda –21.		10
II	Climate Change & Green House Gases: Definition of Climate Change – Causes and Impacts of Climate Change, Green House Gases (Sources, Effects), Extreme Weather Events. Role of Oceans and Forests as Carbon Sinks, Effect of Climate Change on Weather and Climatic Patterns, Ice Caps, Glaciers, Agriculture, Biodiversity, Sea Level, Tourism.		10
III	Environmental Management: Oil pollution, GAP, National Lake conservation program, Some environmental fragile areas, Desertification & its control, Water crisis & conservation of water.		14
IV	National Environmental Issues: Indian environmental problems, National calamities (earthquake, floods etc.), Different environmental episodes, Population explosion and birth control measures, Conventional & non-conventional sources of energy. Eco-ethics, Rehabilitation & resettlement problems, Urban problems related to energy.		12
V	Social issues and environment: Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products. Environmental education & awareness, Community participation, Role of women in Environmental protection.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004. • Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006. • Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005. 			

Programme/Class: Degree		Year: First	Semester: Second
Theory		Subject: Environmental Sciences	
Course Code: DES – 201		Course Title: Biological Processes & Systems	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Learn about the principles of physical chemistry. • Study about microbial flora of soil. • Understanding about the environmental stress. • Gain knowledge about the microbial ecology. • Learn about the microbial interaction. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Biochemical ecology: Elements of Biochemistry; Principles of physical chemistry; Kinetics, dissociation & association constants; Nucleic acid structure & functions; Genetic code; Energy yielding pathways & metabolism; Proteins, Nitrogen metabolism; Lipids, vitamins and biological clock; process of fatty acid oxidation.		10
II	Biogeochemistry: Microbial Flora of Soil – Interactions among Soil Microorganisms – Nitrogen Cycle – Carbon Cycle – Sulfur Cycle – Phosphorous Cycle – Nitrogen Fixation by Photosynthetic Bacteria, Cyanobacteria and Methanogenic Bacteria – Biotechnology in the Reduction of Carbon Dioxide Emission.		10
III	Stress ecology: Environmental stress and adaptations; Plant & animal hormones; Nutrition, Reproduction, Learning & behavior; Water balance; Photo-regulation; angiospermic seeds, seed germination, anatomy and seed dormancy.		14
IV	Microbial ecology: Microbes – classification & significance; Mineral growth & nutrition; Food, medical, industrial & soil microbiology; Culture & media; Fermentation; Control agents of microbes; Role of microbes in soil; Water & degradation of xenobiotics; Recent issues in microbiology.		12
V	Environmental Microbial Applications: Microbial Interactions, Sedimentary Biogeochemical Cycles – Fe, P and S, Gaseous Cycle – C, N and O, Soil Microorganisms Associated with Vascular Plants, Bioindicators, Biosensors, Biofertilizers, Biopesticides, Bioplastics, Bioleaching & Biomining, Biodeterioration and Biofuels.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Microbiology, K. J. Pelzer, E. C. S. Chan & N. R. Kreig (2008), Tata Magraw. • Environmental Microbiology, Raina M. Maier & Lanl. Pepper (2000), Elseiver • Environmental Biotechnology Principles and Applications, Bruce. E. Rittmannn (2001), Graw- Hill Book Co • Environmental Microbiology, John F. T. Spencer & A. L. R. Spencer (2004), Humana Press. • Microbiology An Introduction, Tortara, Funke & Case (2007), Benjamin Publishers. • Fundamentals of Microbiology, Jeffrey C. Pommerville (2007), Johns & Bartle. • Microbiology, Jacauelyn G. Black (2008), John Wiley & Sons. 			

Programme/Class: Degree		Year: First	Semester: Second
Theory		Subject: Environmental Sciences	
Course Code: DES- – 202		Course Title: Biodiversity – Forestry & Wildlife	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the level and types of biodiversity. • Learn about the forest ecology. • Understanding about the flora and fauna of india. • Gain knowledge about the habitat destruction of biodiversity. • Learn about the conservation and management of biodiversity. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Biodiversity: Definition, levels and types of biodiversity; Value of biodiversity; Threat to biodiversity; Biodiversity conservation, Conservation through legal aspects; Biodiversity at Global & National level; Future strategies for India; Bio-geographical classification, Hot-spots of Biodiversity.		10
II	Forest ecology: Role of vegetation in nature; Forest types of India; Forest management & conservation; Silviculture, Rangeland management, Minor Forest Produce, JFM, Agro-forestry.		10
III	Importance of wildlife: Common flora and fauna in India; Endangered and threatened species; Protected Areas; National Parks and Sanctuaries; Role of National and International organizations for protection of wildlife; Biodiversity Laws, Red Data Book.		14
IV	Threats to Biodiversity: Habitat Alteration, Invasive Species, Pollution, Population Explosion, and Overexploitation of Resources- Habitat Destruction, Fragmentation, Transformation, Degradation and Loss: Causes, Patterns and Consequences on the Biodiversity of Major Land and Aquatic Systems Invasive Species Pathways, Biological Impacts on Terrestrial and Aquatic Systems. Extinction: Types of Extinctions, Processes Responsible for Species Extinction, Current and Future Extinction Rates, IUCN Threatened Categories, Sixth Extinction/Biological Crisis.		12
V	Biodiversity Management: Conservation and Management, Protection of Natural Habitats, National and International Protected Area, Current Practices in Conservation - In Situ Conservation and Ex Situ Conservation of Threatened Species - Cryopreservation, Gene Banks, Gene Pool and Species Conservation. National Parks and Sanctuaries. Common Flora and Fauna in India, The Biological Diversity Act, 2002, Biological Diversity Rules, 2004 – Patent Act - Intellectual Property Rights (IPR). Agenda 21.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Biodiversity and Human Health, Aguirre, A. Alonso (2009), Eco Health, 6 (1), 153-156. • Ecology: from Individuals to Ecosystems, Begon M, Townsend CR & Harper JL (2006), John Wiley and Sons. • Ecology, Environmental and Resource Conservation, Singh JS, Singh SP and SR Gupta (2008), Anamaya Publishers, India • Ecology and Field Biology, Smith R and Smith RM (2000),6th ed., Prentice Hall. • Global Biodiversity – Status of the Earths Living Resources, Brian Groombridge(1992) Chapman & Hall, London 			
Programme/Class: Degree		Year: First	Semester: Second

Theory		Subject: Environmental Sciences	
Course Code: DES – 203		Course Title: Water, Soil Pollution And Management	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the hydrological cycle. • Learn about the domestic sewage and industrial effluent. • Understanding about the treatment of waste water. • Gain knowledge about the sources of soil pollution. • Learn about the water quality index. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Sources of water and pollution: Distribution, Hydrological Cycle, Structure and Polarity of Water Molecule, Properties of Water Sources – Availability & Quality of Surface Water (River, Stream Lake, Dam) & Ground Water (Open Well & Bore Well)- Sources of Pollution-Point and Non Point- Types and Effects of Water Pollutants, Water Borne Diseases		10
II	Characteristics of waste: Characteristics of Domestic Sewage and Industrial Effluents with Reference to Paper, Electroplating, Pharmaceutical, Dairy, Distillery, Dyeing, Nuclear, Fertilizer Industries.		10
III	Control and management of water pollution: Primary Treatment, Conventional Biological or Secondary Treatment, Tertiary or Advanced Treatment, Membrane Process, Sludge Stabilization and Disposal. Case Studies – MinamataDisease (Hg), Itai-Itai (Cd), Fukushima Daiichi Nuclear Disaster.		14
IV	Soil Pollution: Characteristics of Soil – Structure, Texture, Colour, Porosity, Ph, EC, Organic Matter, Micro and Macro Nutrients, Cation Exchange Capacity, Physical Properties – Bulk Density, Porosity, Soil Water, Soil Temperature, Soil Acidity, Salinity - Main Sources of Soil Pollution (Agriculture, Cattle Raising, Industry and Urban Centres) - Main Types of Soil Pollutants- Organic and Inorganic Contaminants (Pesticides and Heavy Metals) - Methods for Soil Remediation-In-Situ Decontamination, Ex-Situ Decontamination: On-Site and Off-Site; and Confinement/Isolation of The Affected Area.		12
V	Water Pollution Management: Specifications for Drinking Water Acts (The Water (Pollution And Control Of Pollution) Act, 1974 and The Environmental (Protection) Act, 1986), Water Quality Index (WQI) – Watershed Management-Types, Objectives and Factors Affecting Watershed Management,		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Wastewater Engineering: Treatment and Reuse. G. Tchobanoglous, F. L. Burton, and H.D.Stensel.(2003),4th ed. Metcalf & Eddy Inc., New York, NY: McGraw-Hill. • Environmental Chemistry, De AK, (2003), 5th Edition, New Age International (P) Limited, Publishers, New Delhi, ISBN 81 – 224 – 1488 – 5. • Environmental Chemistry, Sharma BK and Kaur H,(1994), Goel Publishing House, Meerut. • Environmental Chemistry, Bhatia SC,(2002),CBS Publishers and Distributors. New Delhi. • Chemistry for Environmental Engineering, Sawyer CN, Mc Carty PL and Perkinn GF, (1994), II edition. McGraw Hill. • Watershed Management in India, Murty JVS, (1994), Wiley Eastern Ltd., New Delhi. 			

Programme/Class: Degree		Year: First	Semester: Second
Theory		Subject: Environmental Sciences	
Course Code: DES – 204		Course Title: Air Pollution And Management	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> • Study about the classification of air pollution. • Learn about the atmospheric stability. • Understanding about the air quality standard. • Gain knowledge about the air pollution control. • Learn about the air quality monitoring. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Sources And Effects Of Air Pollutants: Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants		10
II	Dispersion Of Pollutants: Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.		10
III	Air Quality Standards: Air Quality Standards, Air Quality Index, Indoor Air Quality, Control Methods Absorption, Adsorption, Condensation, Chemical Reactions, Incinerations.		14
IV	Air Pollution Control: Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries		12
V	Air Quality Management: Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries Environmental Impact Assessment and Air quality Biological abatement of air pollution, scope of green belt development, phytoremediation. Economic aspects of air pollution control.		14
Suggested Readings: <ul style="list-style-type: none"> • Air Pollution, M. N. Rao and H.V.N. Rao, (2014), McGraw Hill Education • Advanced Air and Noise Pollution control, Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung, (2005), Humana press. • Pollution Management (I Air Pollution), S.K. Agarwal, (2002), A.P.H Publishing Corporation. • Environmental Science and Technology, Stanley E. Manahan, (1997), Lewis Publishers. • Fundamentals of Air Pollution, Richard W. Boubel, Donald L. Fox, D. Bruce, Turner and Arthur C. Stren, (2005), Academic press. • Pollution Management (V- Noise Pollution), S. K. Agarwal, (2002), A.P.H. Publishing Corporation. • Atmospheric Science for Environmental Scientists, C.N. Hewitt and A. V. Jackson, (2009), Wiley- Blackwell. 			

Programme/Class: Degree		Year: Second	Semester: Third
Theory		Subject: Environmental Sciences	
Course Code: DES -301		Course Title: EIA, Environmental Audit & Disaster Management	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the introduction of EIA. • Learn about the Environmental audit. • Understanding about the environmental conferences. • Study about the basic concept of disaster. • Learn about the disaster management. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Introduction: Generalized approach to impact analysis; concept of significant effect; Development of EIA; Elements of EIA; Procedures for reviewing EIA & statement; Methodologies of EIA; Models used in EIA; Public participation of EIA; Assessment of impacts on energy generation projects, dams, mining, cement industries, fertilizer plants, tourism, highway projects, port and harbors.		10
II	Environmental audit: Approach & methodology; concept of Eco-audit; Industrial safety audit; ISO 14000 & 18000 series; Total quality management (TQM); Ecological footprints, Cost-benefit analysis, economics of pollution control.		10
III	Environmental Ethics : Implementation of International Emission Trading, Resource Consumption Patterns and the need for Equitable Utilization-Equity-Disparity in the Northern and Southern Countries, Urban and Rural Equity Issues- The need for General Equity, World Summit 1972, RIO Conference Agenda 21, Montreal Protocol, Kyoto Protocol, Climate Change Mitigation.		14
IV	Basic concept of disaster: Industrial & technological disaster; disaster profile of India; Institutional framework & disaster management in India; Natural hazards and their zoning & risk assessment; Role of media, government and Non government agencies in disaster management; Emergency planning for floods, landslides, earthquakes, volcanoes and cyclones, etc.		12
V	Disaster Preparedness and management: Community Preparedness in Natural Disasters- Role of Information, Education, Emerging Trends in Disaster Management International Decade for Natural Disaster Reduction (IDNDR), Policy for Disaster Reduction, Problems of Financing and Insurance. Training for Emergency. Regulation/Guidelines for Disaster Tolerance Building Structures.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Environmental Impact Statements, Bregmam J.I (1999), Lewis Publishers, London. • Environmental Science and Engineering, Suresh K.Dhameja, (2005), Published by Sanjeev Kumar Kataria, Delhi. • Effective Environmental Assessment, Eccleston C.H, (2000), Lewis Publishers, London. • Natural Hazards, Bryant Edwards (2005), Cambridge University Press, U.K. • Space Technology for Disaster management: A Remote Sensing & GIS Perspective, Roy, P.S. (2000), Indian Institute of Remote Sensing (NRSA), Dehradun. • Natural Disaster, Sharma, R.K. & Sharma, G. (2005), (ed) APH Publishing Corporation, New Delhi . 			

Programme/Class: Degree		Year: Second	Semester: Third
Theory		Subject: Environmental Sciences	
Course Code: DES - 302		Course Title: Environmental Management & Laws	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the environmental issues and problems. • Study about environmental policies. • Understanding about the environmental issues in rural. • Gain knowledge about the remote sensing. • Learn about the environmental acts. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Environmental Protection: issues and problems; International & national efforts for Environmental protection; Issues involved in enforcement of environmental legislation;		10
II	Environmental Policies: Constitutional Provision of India regarding Environment ((Article 48 A, 51A and 21)). Policy strategies in pollution control & Conservation; Wildlife Protection Act; Forest Conservation Act 1980; Indian Forest Policy.		10
III	Environmental management in industries: Urbanization & municipal environmental issues; Rural environmental problems & solutions		14
IV	Remote Sensing and GIS: Basic concepts & technique of remote sensing; GIS application in environment, agriculture, forestry & land use planning; Indian remote sensing programme and future strategies		12
V	Environmental Acts: Air (Prevention and Control of Pollution) Act and Rule 1982; The Water (Prevention & Control of Pollution) Act. The Environment Protection Act and Rules; Rules on Hazardous Wastes & Hazardous Chemicals; Ozone Protection;		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • N. K. Uberoi, Environmental Management, Excel Books, New Delhi • Frederick and Lutgens, The Atmosphere, Pearson • Principles of Geographical Information System, Burrough P.H and McDonnelli (1998), Oxford University Press. • Fundamentals of Remote Sensing (2nd edition), George Joseph (2008) ,Universities press, Hyderabad. • Remote Sensing and Image Interpretation,Lillie’s T. M. and Kiefer R.W (2003) , John Wiley and Sons. • Environmental Production, Law and Policies,Jane Holder and Maria Lee, (2007), Second Ediction. • Introduction to Environmental Impact Assessment,Natural and Built Environment Series. John Glasson (2005), Routledge, Taylor and Francis. 			

Programme/Class: Degree		Year: Second	Semester: Third
Theory		Subject: Environmental Sciences	
Course Code: DES – 303		Course Title: Eco toxicology & Environmental Health	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the toxicants. • Learn about the dose-response relationship. • Study about the bioaccumulation and biomagnification. • Gain knowledge about the occupational health. • Learn about the epidemiological issues. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Toxicants & toxicology: Definition of Toxicology, Toxicity and Toxicants. Classification of toxic agents – natural toxins (Animal, Plant and microbial toxins) and Anthropogenic toxicants (Chemical toxins). Classes of environmental toxicants;		10
II	Toxicity assessment: Pathological problems peculiar to ecotoxicology; Dose-response relationship; Exposure assessment; Influence of ecological factors on effects of toxicity; Somatic & germinal effects.		10
III	Risk assessment: Bioaccumulation, Biotransformation, Biomagnification, Biodegradation (with examples); Mutagenesis & carcinogenesis; Biomonitoring		14
IV	Effect of toxicants: Impact on individual species, community & ecosystem level; Occupational health; problems, safety, chemical hazards; Environmental health – air, water, food & soil borne diseases;		12
V	Prevention & control: Epidemiological issues (related to Arsenic, Fluoride, Silica etc.), Population growth, explosion, family welfare programme, Value education, Human Rights, Women & Child Welfare, HIV / AIDS.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Principles of Ecotoxicology, C. H. Walker, S.P. Hopkin, R. M. Sibly and D.B. Peakall, (2006), Third Edition, CRC Press (Taylor & Francis Group). • Hazardous Materials Chemistry for Emergency Responders, Robert Burke, (2000), Lewis Publishers. • Fundamentals of Ecotoxicology, Michael C. Newman, (2001), Lewis Publishers. • LU's Basic Toxicology (Fundamentals, Target Organs and Risk Assessment), Sixth Edition, Samkacew and Byung-Mu Lee,(2013), CRC Press (Taylor & Francis Group). • Environmental Toxicants-Human Exposure and Their Health Effects, Morton Lippmann, (2000), John Wiley and Sons Publication. • Environmental Contaminants-Assessment and Control, Daniel A. Vallero, (2005), Academic Press. • Environmental Toxicology – Biological and Health Effects of Pollutants, Ming-Ho Yu, (2004), Second Edition, CRC Press (Taylor & Francis Group). 			

Programme/Class: Degree		Year: Second	Semester: Third
Theory		Subject: Environmental Sciences	
Course Code: DES - 304		Course Title: Resource Conservation & Management	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the natural resources. • Learn about the Renewable & Non-renewable resources. • Understanding about the resource conservation. • Gain knowledge about the management of the resources. • Learn about the energy conservation. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Introduction about natural resources: Kinds of natural resources; Need to manage; Resources management: Preservation, Conservation & Restoration; Extrinsic and intrinsic environmental resource potential values (the five E's); Patterns of resource depletion; Conservation of mineral resources, concept of five 'R'		10
II	Resources: Renewable & Non-renewable; Depletion of Natural resources; Water resources & environment: Factors influencing the surface water: Resources & reserves, Ocean ore and recycling of resources; Environmental Impact of exploitation, processing and smelting of minerals, Role of NGT, Swatch Bharat Abhiyan, OTEC		10
III	Resource Conservation: Reducing the need for resources; Resource economics; Jobs and life in a sustainable world; The Human population challenge (Earth's carrying capacity); Sustainable use of Energy resources; Conservation of Soils.		14
IV	Resource Management: Gasohol; Use more methane fuel, Use genetically engineering methods to develop gasoline plants; Halt the deforestation in the tropics, Reforestation; Energy intensity index; Law of diminishing returns; Approach to Natural Resource Management: Exploitation, Utilitarian approach, Sustainable approach; Watershed management; Wasteland management, Wetland management; Rain water harvesting.		12
V	Sustainable Management of resources: Role of an individual in conservation of natural resources; Equitable use of resources for sustainable life styles; Urban problems related to energy; Water conservation: Rain water harvesting. Resettlement and rehabilitation of people, its problems and concerns; Environmental ethics, issues and possible solution		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Ecology of Natural Resources, FerancoisRamade (1991), John Wiley. • Text book of Environmental Studies, EranchBharucha (2005), Universities Press. • Environmental Studies, Kumarasamy K, Alagappa Moses A and Vasanthi M (2004), Bharathidasan University Publishers. • Environmental Science and Technology, Stanley E. Manahan (2007), Taylor & Francis, CRC Press. • Instant notes Ecology, Aulay Mackenzie, Andy S. Ball and Sonia R. Virdee (2002), Bios Scientific Pub. Ltd., • Environmental Science, Physical Principles and Application, Egbert Boeker and Rienk van Gondelle (2001), John Wiley & Sons. • Environmental Science, Santra, S.C (2005), New Central Book Agency (P) Ltd., 			

Programme/Class: Degree		Year: Second	Semester: Fourth
Theory		Subject: Environmental Sciences	
Course Code: DES – 401		Course Title: Ecotourism	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> • Understand about the concept of ecotourism. • Learn about the component of ecotourism. • Understanding about the ecotourism practices. • Gain knowledge about the developing of ecotourism. • Study about case study related to ecotourism. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Definition and concept of ecotourism: Social and ecological impacts of tourism & Definition of ecotourism. Concept of Ecotourism, Ecotourism and related sub-sectors of the tourism industry, Ecotourism criteria, Quebec declaration on ecotourism Identifying and describing ecotourism products		10
II	Components and approaches of Ecotourism: Components of ecotourism, Ecotourism and the environment, Ecotourism and conservation, Ecotourism and protected areas Components of ecotourism, Ecotourism and economic benefits, Ecotourism and social benefits, Ecotourism and local community, Ecotourism and education		10
III	Ecotourism Practices: Ecotourism practices, Transportation, Facilities (reduce, replace, reuse, recycle), Services (types, activities, and code of ethics), The ecotourists (types, and code of ethics) Eco-labeling and green-washing		14
IV	Ecotourism Management: Developing an ecotourism product, Identifying products, Advantages and Disadvantages of Ecotourism- Eco-branding and Eco-labeling of Ecotourism Products - Marketing of Ecotourism, Ecotourism and Sustainable Development - Management Issues in Ecotourism, Ecotourism-based/related employment, Scope and areas of employment.		12
V	Case Studies of Ecotourism: Case Study - Parambikulam Tiger Reserve, Kaziranga National Park, Ecotourism spots in Tamil Nadu (Ooty, Kodaikanal, Elagiri, Yerkaud). A World Heritage Site in Assam, Ecotourism in Bagalkot District, Karnataka, The Kabini River Lodge. Gender and Sustainable Development in Mountains in Garhwal Himalaya,		14
Suggested Readings: <ul style="list-style-type: none"> • The Encyclopedia of Ecotourism, Weaver, D. B. (2001), CABI. • Encyclopedia of Ecotourism, Volume I, II and III, Sinha, P.C (2003), Anmol Publications Pvt. Ltd., • Ecotourism and sustainable Development, N. Mukherjee (2008). Cybetech Publications • Global Ecotourism, Prabhas Chandra (2003), Kaniskha Publishers • Ecotourism. An Introduction, Fennell A David. (2003), Routledge, London and New York. • Ecotourism Impacts, Potentials and Possibilities, Wearing and Neil (2000), Oxford: Butterworth & Heinemann. • Case studies in ecotourism, Buckley, R. (2003), Cambridge: CABI. • Environmental impacts of ecotourism, Buckley, R. ed. (2004), Oxfordshire: CABI. 			

Programme/Class: Degree		Year: Second	Semester: Fourth
Theory		Subject: Environmental Sciences	
Course Code: DES – 402		Course Title: Current Research Methodology In Environment	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the concept of research. • Learn about the measure of central tendency. • Understanding about the descriptive statistics. • Gain knowledge about the statistical analysis. • Learn about the graphical presentation. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Research: Introduction to research, Concept and theory, Induction and deduction; Objectives of research. Types of research, Research process, Research Formulation – Defining and formulating the research problem		10
II	Introduction to Statistics: Scope, Limitations of Statistics, Statistical Method and Experimental Method. Collection of Data, Sampling, Classification and Tabulation of Data. Diagrammatic & Graphic Presentation of Data. Information Technology: Information Types, Needs, Data Processing,		10
III	Descriptive Statistics: Introduction, Measure of Central Tendency- Mean, Mode, Median, Measure of Shapes. Properties of Mean, Variance and Standard Deviation, Co-Efficient of Variation. Sampling Theories and Hypothesis Testing, Techniques and Experimental Designs. Testing Hypothesis: Significance Level and X ² Test, T and F Test.		14
IV	Statistical Analysis: Correlation, Regression and ANOVA: Analysis of Variance: One Way and Two Way ANOVA, MONOVA, Regressions: Defining the Fit, Correlation, Polynomial Regression, Multiple Regression, P-Value.		12
V	Biostatistics & Computer Applications: Tabulation of Data. Graphical Presentation of Data; Line Graph, Bar Chart, Cumulative Bar Chart, Percentage Bar, Chart, Pie Chart and Three Dimensional Graphs. Frequency Analysis; Univariate and Bivariate Frequency Tables. Calculation of Mean, Median and Mode. Calculation of Modal Frequency; Grouping Table and Analysis Table. Testing and Hypothesis; Application of 'T' Test. Calculation of Correlation and Regression. Data Sheet and Data Management. Simple Statistical Work Using Excel Spread Sheet		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Statistics for Environmental Science and Management, Bryan FJ, Manly (2008), ISBN 9781420061475. • Scientific methods for Ecological Research, Ford ED, (2000), Cambridge University Press. • Statistics for Earth and Environmental Scientist., John Schuenemeyer, Larry Drew, (2011). • Fundamentals of Biostatistics, Rosner B, (1986),, Duxbury Press, Boston • Statistical Methods, Snedecor W and G Cochran, (1967), Oxford and IBH Publishing Co. Calcutta • Biostatistical Analysis, Zar JH, (1984). Prentice-hall, Inc Englewood Cliff, New Jersey 			

Programme/Class: Degree		Year: Second	Semester: Fourth
Theory		Subject: Environmental Sciences	
Course Code: DES – 403		Course Title: Sustainable Management And Sustainable Development	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the sustainable development. • Learn about the environmental stress and economic growth. • Understanding about the Energy- environment interactions. • Gain knowledge about the Innovative models of sustainable development. • Learn about the Environment protection policies. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	Introduction to Sustainable Development: Concept, nature and scope of Sustainable development. Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty		10
II	Environmental Economics, Energy and Sustainable Development: Trade-off between environmental stress and economic growth; Environmental Kuznet's Curve hypothesis - theory and empirical evidence; Environmental accounting; Externalities; Different types of goods, Common property resource and Tragedy of the Commons; Poverty and environment		10
III	Energy Economics and Climate Change: Introduction to energy economics; Energy-environment interactions; Options to address energy related environmental problems – Regulatory approach to environmental management, economic instruments for pollution control, Assessment and selection of instruments, Nuclear energy and climate change; Promises and limits of bioenergy; International climate change agreements – UNFCCC, The Kyoto Protocol		14
IV	Integrated approaches: Innovative models of sustainable development. Public private partnership, decentralization of power. Strategies to become a developed country. Future trends in integrated approaches.		12
V	Environmental Protection measures: Environment protection policies, waste management, Pollution control, reduce the use, reuse and recycle, sustainable energy, preservation of forest and water sources, Demand and supply management.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Downing, Theodore E. 2002. Avoiding New Poverty: Mining-Induced Displacement and Resettlement, International Institute for Environment and Development. • Falenda, Sudan K. 2009. Encyclopedia of Environment and Development, Serials Publication: New Delhi. • Gilbert, Alan and Josef Guglar. 1982. Cities, Poverty and Development: Urbanization in the Third World, New York, Delhi: Oxford University Press. • Gowdy, John and Aneel Salman. 2008. "Climate Change and Economic Development: A Pragmatic Approach", The Pakistan Development Review, Vol. 46, No. 4. • Held, David, Charles Roger and Eva-Maria Nag. 2013. Climate Governance in the Developing World, Cambridge: Polity. Human Development Report. 2006. • Beyond scarcity: Power, Poverty and the Global Water Crisis, New York: UNDP 			

Programme/Class: Degree		Year: Second	Semester: Fourth
Theory		Subject: Environmental Sciences	
Course Code: DES – 404		Course Title: Environmental Microbiology	
<p>Course outcomes: After completing the course the student will be able to:</p> <ul style="list-style-type: none"> • Understand about the Environmental Microbiology. • Learn about the Distribution and sources of air borne microorganisms. • Understanding about the Microbial communities in natural water. • Gain knowledge about the Introduction and historical background of soil microbiology. • Learn about the Composition of sewage. 			
Credits: 4		Compulsory	
Max. Marks: 30 +70		Min. Passing Marks: As per norms.	
Unit	Topic		No. of Lectures
I	General Environmental Microbiology Environmental Microbiology: Definition and Scope, Environmental microbial processes including nutrient cycle (Carbon, Sulphur Nitrogen and Phosphorus Cycle).Famous Environmental microbiologist and their work in India		10
II	Microbial population in Air: Distribution and sources of air borne microorganisms, Air borne diseases, Bioremediation of metals, acid mine drainage		10
III	Microbial Population in Water: Microbial communities in natural water, Sanitary quality of water: bacteriological evidence of faecal pollution, indicators of faecal pollution. Bacteriological analysis techniques of water		14
IV	Microbial Diversity in Soil: Introduction and historical background of soil microbiology, Soil microflora- bacteria, fungi, actinomycetes, algae, protozoa and viruses. Interactions among soil microorganisms: neutralism, symbiosis, protozoa cooperation, commensalism, ammensalism, parasitism and predation.		12
V	Sewerage system: Composition of sewage, kinds of sewerage systems-sanitary, storm and combined sewers Microorganisms in sewage-fungi, protozoa, algae, bacteria and viruses. Sewage treatment and disposal.		14
<p>Suggested Readings:</p> <ul style="list-style-type: none"> • Environmental Microbiology by Mitchell R, 2nd Edition WILEY INDIA publications, 2016. • Environmental Microbiology by Buckley R G CBS Publications, 2005. • Environmental Microbiology by Annet Blogger, Oxford Book Company, 2010. • Microbiology, K. J. Pelzer, E. C. S. Chan & N. R.Kreig, Tata Magraw hill Publications, 2008. • Environmental Microbiology, Raina M. Maier & Lanl. Pepper, Elseiver,(2000) • Environmental Biotechnology Principles and Applications, Bruce. E. Rittmann, Graw- Hill Book Co, (2001) 			