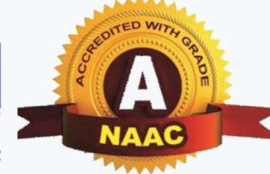




SWAMI VIVEKANAND
SUBHARTI
UNIVERSITY
Meerut
UGC Approved



Ordinance No. :- V-126-B-39

(Approved in Academic council meeting held on 11.03.2026

Proposed to be ratified in forthcoming executive council)

Evaluation Scheme and Syllabus

of

B.Sc. Environmental Science

FOUR – YEAR UNDER GRADUATE

PROGRAM

(AS PER NEP-2020)

Keral Verma Subharti College of Science

Swami Vivekanand

SUBHARTI UNIVERSITY

Meerut

(Effective from session 2025-26)

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

PROGRAM OBJECTIVES

PO1 – Build Strong Foundations in Environmental Science

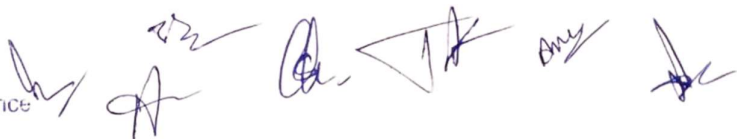
PO2 – Develop Analytical and Scientific Inquiry Skills

PO3 – Foster Problem-Solving for Environmental Challenges

PO4 – Promote Ethical, Sustainable, and Responsible Environmental Stewardship

PO5 – Build Professional Competence for Industry, Research, and Governance

PO6 – Develop Communication, Teamwork, and Community Engagement Skills



PROGRAM OUTCOMES

Outcome 1: Understand Core Environmental Concepts

Outcome 2: Conduct Environmental Monitoring and Laboratory Analysis

Outcome 3: Apply GIS, Remote Sensing, and Statistical Tools

Outcome 4: Evaluate Environmental Impacts and Perform EIA/Risk Assessment

Outcome 5: Address Solid Waste, Air, Water, and Soil Pollution Problems

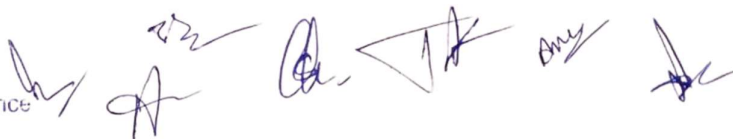
Outcome 6: Conserve Biodiversity and Understand Wildlife Management

Outcome 7: Manage Natural Resources Sustainably

Outcome 8: Understand Environment–Society Linkages

Outcome 9: Perform Fieldwork, Research, and Independent Projects

Outcome 10: Demonstrate Professional and Communication Skills

A series of seven handwritten signatures in blue ink, arranged horizontally. The signatures vary in style, with some being more stylized and others more legible. They appear to be official signatures of faculty or staff members.

CREDIT DISTRIBUTION TABLE

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT KERAL VERMA SUBHARTI COLLEGE OF SCIENCE										
Department of Life Science										
B.Sc. Environment Science (Session 2025-26 onwards)										
		I	II	III	IV	V	VI	VII	VIII	Total
1	Major	6	6	9	15	10	14	16	4	80
2	Minor	3	3	3	3	6	6	4	4	32
3	Multi Disciplinary	3	3	3						9
4	Ability Enhancement Course	2	2	2	2					8
5	Skill Enhancement Course	3	3	3						9
6	Value Added Course	3	3							6
7	Internship					4				4
8	Research								12	12
	Total	20	20	20	20	20	20	20	20	160



EVALUATION SCHEME

I YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Environmental Science													
Batch:2025-26			SEM:I										
S. No.	Course Type	Course Code	Course Name	Teaching Load			Credits	Internal Assessment	External Assessment	Total	Remark		
				L	T	P							
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 1	BSES-101	Fundamentals of Environmental Sciences	4	0	0	4	5	10	15	70	100	
2	Practical I (Based on Major 1)	BSES-101P	Practical: Fundamentals of Environmental Sciences	0	0	4	2	5	10	15	70	100	
3	Minor 1			3	0	0	3	5	10	15	70	100	
4	Multi-Disciplinary			3	0	0	3	5	10	15	70	100	
5	Ability Enhancement Course	AEC-01	English communication	2	0	0	2	5	10	15	70	100	
6	Skill Enhancement Course			1	0	3	3	5	10	15	70	100	
7	Value Added Course			3	0	0	3	5	10	15	70	100	
8	Qualifying	VAC-RB	Rastra bodh	2	0	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							20	35	70	105	490	700	

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SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Environmental Science													
Batch:2025 -26			SEM: II										
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/PP T/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Major 2	BSES-201	Earth and Earth Surface Processes	4	0	0	4	5	10	15	70	100	
2	Practical II Major 2	BSES-201P	Practical: Earth and Earth Surface Processes	0	0	4	2	5	10	15	70	100	
3	Minor 2		To be chosen	3	0	0	3	5	10	15	70	100	
4	Multi-Disciplinary 2		To be chosen	3	0	0	3	5	10	15	70	100	
5	Ability Enhancement Course 2	AEC-01	English communication	2	0	0	2	5	10	15	70	100	
6	Skill Enhancement Course 2		To be chosen	1	0	3	3	5	10	15	70	100	
7	Value Added Course 2			3	0	0	3	5	10	15	70	100	
8	Qualifying	VSC-IKS	IKS	2	0	0	2	5	5	10	30	50	Qualifying
TOTAL CREDITS / ASSESSMENT							20	35	70	105	490	700	

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

DETAILED SYLLABUS
Semester - I

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		
CourseCode: BSES-101	CourseTitle: Fundamentals of Environmental Sciences,	

Credits: 4	Core: Compulsory
Max.Marks: 100	Min.Passing Marks: 40

Unit	Topic	No. of Lectures (60)
	<p>Course Outcomes: CO1: Learn fundamental concept of environmental science CO2: Develop understanding about environmental education, justice and environmentalism. CO3: Gain knowledge about origin of life and related theories. CO4: Able to understand the relationship between man and environment. CO5: Understand the structure and composition of different spheres of earth. CO6: Also able to understand the different meteorological parameters</p>	
I	Concept of Environment: Bhartiya Gyan Parampara aur bhartiya Vaigyanik; Definition, Principles and Scope of Environmental Science; Moral and Aesthetic Nature of Environmental Science; Objectives and Historic roots of the subject; Need for Public Awareness.	14
II	Environmental Education: Goals of environmental education; Environmental Literacy, Environmental Careers, Environmental Justice, Individual Organisms, Environmentalism, Environmental Education at Primary, Secondary level.	12
III	Evolution: Origin of life and speciation, Darwinism and modern synthetic theory of evolution, Natural Selection; Biochemical basis of origin of life; Hardy Weinberg Equilibrium; genetic drift.	15
IV	Man and Environment: Man-Environment relationships; Impacts of human activity on environment (Agriculture, transportation, mining, urbanization, industrialization); Environmental Degradation and Conservation Issues, Modern concept of environmental conservation, Sustainability and Carrying Capacity.	14
V	Meteorology: Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere; Meteorological Parameters- Pressure, Temperature, Precipitation, Humidity, Wind Speed and Direction, Wind Rose, Inversion.	15

Suggested Books:

1. Environmental Science by William P. Cunningham and Mary Ann Cunningham; McGraw-Hill publications.
2. Environmental Science: Earth as a Living Planet by Botkin and Keller; JOHN WILEY & SONS, INC.
3. A text Book of Environment Studies, Asthana, D.K. and Asthana, M. 2006, S. Chand & Co.
4. Environmental Encyclopedia, Jaico Publ. House, Mumbai, 196p
5. Atmosphere, Weather and Climate, Barry, R.G. 2003, Routledge Press, UK.
6. Environmental Science: S.C. Santra, New Central Book Agency.

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		
Course Code: BSES-102A	Course Title: Natural Hazards & Disaster Management	

Unit	Topic	No. of Lectures (45)
	<p>Course Outcomes</p> <p>CO1: Understand the basic concepts of natural hazards, including types, causes, and effects.</p> <p>CO2: Develop the ability to assess risk and vulnerability related to natural disasters in various regions.</p> <p>CO3: Gain knowledge of disaster preparedness and mitigation strategies to reduce impacts on communities.</p> <p>CO4: Learn the phases of disaster response and recovery, and understand the roles of different stakeholders involved in disaster management.</p>	
I	Natural hazards: Hydrological, atmospheric & geological hazards; earthquake: seismic waves, epicenter; volcanoes: causes of volcanism, geographic distribution; floods: types and nature, frequency of flooding; landslides: causes and types of landslides, landslide analysis; drought: types of drought - meteorological, agricultural, hydrological, and famine; Glacial Lake Outburst Floods (GLOF); tornadoes, cyclone & hurricanes; tsunamis: causes and location of tsunamis; coastal erosion, sea level changes and its impact on coastal areas and coastal zone management.	12
II	Anthropogenic hazards: Impacts of anthropogenic activities such as rapid urbanization, injudicious ground water extraction, sand mining from river bank, deforestation, mangroves destruction; role of construction along river banks in elevating flood hazard; disturbing flood plains. deforestation and landslide hazards associated with it; large scale developmental projects, like dams and nuclear reactors in hazard prone zones; nature and impact of accidents, wildfires and biophysical hazards. Case studies of Bhopal, Minamata and Chernobyl disaster.	11

III	Risk and vulnerability assessment: Concept of risk and vulnerability; two components of risk: likelihood and consequences, qualitative likelihood measurement index; categories of consequences (direct losses, indirect losses, tangible losses, and intangible losses); application of geoinformatics in hazard, risk & vulnerability assessment. Concept of mitigation; types of mitigation: use of technologies in mitigations such as barrier, deflection and retention systems; importance of planning, exercise, and training in preparedness; role of public and media in hazard preparedness.	12
IV	Disaster management in India: Lessons from the past considering the examples of Bhuj earthquake, tsunami disaster, and Bhopal tragedy; National Disaster Management Framework, national response mechanism, role of government bodies such as NDMC and IMD; role of armed forces and media in disaster management; role of space technology in disaster management; case study of efficient disaster management during cyclone 'Phailin' in 2013.	10
SUGGESTED READINGS: <ol style="list-style-type: none"> Schneid, T.D. & Collins, L. 2001. Disaster Management and Preparedness. Lewis Publishers, New York, NY. Coppola D. P. 2007. Introduction to International Disaster Management. Butterworth Heinemann. Cutter, S.L. 2012. Hazards Vulnerability and Environmental Justice. EarthScan, Routledge Press. Keller, E. A. 1996. Introduction to Environmental Geology. Prentice Hall, Upper Saddle River, New Jersey. Pine, J.C. 2009. Natural Hazards Analysis: Reducing the Impact of Disasters. CRC Press, Taylor and Francis Group. Smith, K. 2001. Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge Press. Wallace, J.M. & Hobbs, P.V. 1977. Atmospheric Science: An Introductory Survey. Academic Press, New York. 		

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		
Course Code: BSSES-102B	Course Title: BIOTECHNOLOGY FOR HUMAN WELFARE	

Subject:	BIOTECHNOLOGY FOR HUMAN WELFARE
	Course Outcomes CO1: Understand the fundamental concepts and applications of biotechnology in improving human life. CO2: Learn the role of biotechnology in healthcare, including vaccine development, diagnostics, and therapeutic products.

	CO3: Gain knowledge about the use of biotechnology in agriculture, food production, and environmental sustainability. CO4: Understand ethical, social, and safety issues related to biotechnological advancements and their impact on society.
Unit I	Hours: 12 Definition and Historical Background. Scope and Interdisciplinary Nature Branches of Biotechnology: Red, Green, White, Blue biotechnology Biotechnology in Developing Countries. Biotechnology for Sustainable Development Goals (SDGs)
Unit II	Hours: 13 Biotechnology in Agriculture Transgenic Plants: Bt Cotton, Golden Rice, Flavr Savr Tomato. Crop Improvement using Genetic Engineering: Insect and pest resistance Herbicide tolerance; Stress tolerance (drought, salinity) Biofertilizers and Biopesticides. Molecular Farming: Edible vaccines and nutraceuticals. Controversies and biosafety concerns of GMOs
Unit III	Hours: 10 Biotechnology in Medicine and Health Care: Recombinant DNA Technology in Medicine: Insulin, Growth Hormone, Interferons. Gene Therapy: Somatic and germline therapy. Monoclonal Antibodies: Hybridoma technology and diagnostics. Vaccines: Conventional and recombinant (e.g., Hepatitis B, COVID-19 mRNA vaccines). Pharmacogenomics and Personalized Medicine Ethical and regulatory issues
Unit IV	Hours: 10 Industrial Applications: Production of enzymes, organic acids, bioethanol, and bioplastics. Fermentation processes and bioreactor basics Microbial Biotechnology in Industry. Environmental Applications: Bioremediation and Bioaugmentation. Treatment of industrial effluents and solid waste, Bioindicators and Biosensors. Biotechnology for pollution control and biodiversity conservation

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		
Course Code: BSES-102C	Course Title: Biochemistry in Health and Disease	

Subject:	Biochemistry in Health and Disease
	Course Outcomes

	<p>CO1: Understand the biochemical basis of normal physiological processes in the human body.</p> <p>CO2: Learn the biochemical alterations associated with major diseases and metabolic disorders.</p> <p>CO3: Gain knowledge about diagnostic biomarkers and laboratory tests used in identifying disease conditions.</p> <p>CO4: Understand the role of biochemical pathways in disease prevention, treatment, and therapeutic interventions.</p>
Unit I	<p>Hours: 10</p> <p>Fundamentals of Clinical Biochemistry Review of Basic Biochemistry: Biomolecules (carbohydrates, lipids, proteins, nucleic acids). Enzyme functions, kinetics, and clinical relevance Homeostasis and Biochemical Regulation. Biochemical Composition of Blood and Urine. Specimen Collection and Clinical Significance. Acid-Base Balance and Buffer Systems in the Human Body</p>
Unit II	<p>Hours: 12</p> <p>Carbohydrate, Lipid & Protein Metabolism in Health and Disease Carbohydrate Metabolism: Glycolysis, Gluconeogenesis, Glycogen metabolism. Disorders: Diabetes mellitus (Type 1 and 2), Hypoglycemia Lipid Metabolism: β-Oxidation, Ketogenesis, Cholesterol biosynthesis Disorders: Obesity, Atherosclerosis, Fatty liver disease. Protein and Amino Acid Metabolism: Urea cycle, Transamination, Deamination Disorders: PKU, Maple syrup urine disease, Liver cirrhosis</p>
Unit III	<p>Hours: 10</p> <p>Biochemistry of Hormones and Endocrine Disorders Classification and Mechanism of Hormone Action: Peptide and steroid hormones. Hormones of the Pituitary, Thyroid, Adrenal, and Pancreas Endocrine Disorders: Hypo-/Hyperthyroidism. Addison's disease, Cushing's syndrome. Insulin resistance and Metabolic Syndrome. Diagnostic Biomarkers and Hormone Assays</p>
Unit IV	<p>Hours: 13</p> <p>Clinical Enzymology and Diagnostic Biochemistry. Plasma Enzymes as Disease Markers: Liver: ALT, AST, ALP, GGT. Heart: CK-MB, LDH, Troponins. Pancreas: Amylase, Lipase. Tumor Markers and Cancer Biochemistry: PSA, CEA, AFP. Biochemical Basis of Jaundice, Myocardial Infarction, Renal Failure. Diagnostic Techniques: Colorimetry, ELISA, Electrophoresis</p>

Programme/Class: Certificate	Year: First	Semester: First
Subject: Environmental Science		

CourseCode:M-DIS-LSM	CourseTitle:Land & Soil Conservation & Management
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Unit	Topic	No. of Lectures (45)
	<p>Course Outcomes</p> <p>CO1: Understand the fundamental concepts of soil formation, properties, and classification.</p> <p>CO2: Learn the causes and effects of soil degradation, erosion, and land-use changes.</p> <p>CO3: Gain knowledge about various soil and land conservation techniques for sustainable management.</p> <p>CO4: Understand the role of soil conservation in agriculture, environmental protection, and long-term ecosystem stability.</p>	
I	Fundamentals of soil science: Land as a resource, ecological and economic importance of soil; 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 salinity and sodicity; soil organic matter; micronutrients of soil; nitrogen, sulphur, potassium and phosphorus economy of soil; soil biodiversity; soil taxonomy maps.	12
II	Soil degradation – causes, Types and causes of soil degradation; 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, impact soil degradation on agriculture and food security; industrial and urban development, toxic organic chemicals, and organic contaminants in soils; fertilizers and fertilizer management; recycling of soil nutrients.	13
III	Land use changes and land degradation: Land resources: types and evaluation; biological and physical phenomena in land degradation; visual indicators of land degradation; drivers of land degradation deforestation, desertification; habitat loss, loss of biodiversity; range land degradation; land salinization; human population pressure, poverty, socio-economic and institutional factors; drivers of land use and land cover change in major geographic zones and biodiverse regions with particular reference to the Himalaya and the Western Ghats.	13
IV	Land degradation and its control: Economic valuation of land degradation; on-site and off-site costs of land degradation; loss of ecosystem services; effects on nutrient cycles; future effects of soil degradation; emerging threats of land degradation to developing countries 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; integrating land degradation assessment into conservation.	12

Text Books:

1. Brady, N.C. & Well, R.R. 2007. The Nature and Properties of Soils (13th edition), Pearson Education Inc.

Reference Books:

1. Gadgil, M. 1993. Biodiversity and India's degraded lands. *Ambio* 22: 167-172.
2. Johnson, D.L. 2006. *Land Degradation* (2nd edition). Rowman & Littlefield Publishers.
3. 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.

Programme/Class:Certificate	Year:First	Semester:First
Subject:Environmental Science		
CourseCode:SEC-RSG	CourseTitle:Remote Sensing, Geographic Information System & Modeling	

Unit	Topic	No. of Lectures
	<p>Course Outcomes</p> <p>CO1: Understand the basic principles of remote sensing and the characteristics of satellite imagery.</p> <p>CO2: Learn the fundamental concepts of Geographic Information Systems (GIS) and their applications in spatial data analysis.</p> <p>CO3: Gain skills in interpreting remotely sensed data and using GIS tools for mapping and decision-making.</p> <p>CO4: Understand the role of spatial modeling in environmental studies, resource management, and predictive analysis.</p>	45
I	Remote Sensing: definitions and principles; electromagnetic (EME) spectrum; interaction of EMR with Earth's surface; spectral signature; satellites and sensors; aerial photography and image interpretation.	12

II	Geographical Information Systems: definitions and components; spatial and non-spatial data; raster and vector data; database generation; database management system; land use/ land cover mapping; overview of GIS software packages; GPS survey, data import, processing, and mapping.	13
III	Applications and case studies of remote sensing and GIS in geosciences, water resource management, land use planning, forest resources, agriculture, marine and atmospheric studies.	10
IV	Basic elements of statistical analyses: sampling; types of distribution – normal, binomial, poisson; measurements of central tendency and dispersion; skewness; kurtosis; hypothesis testing; parametric and non-parametric tests; correlation and regression; curve fitting; analysis of variance; ordination.	10
Suggested Books: Zar, J.H. 2010. Biostatistical Analysis (5th edition). Prentice Hall Publications. Edmondson, A. & Druce, D.1996.Advanced Biology Statistics. Oxford University Press. Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons. Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer. Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman.		

DETAILED SYLLABUS II SEMESTER

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Environmental Science		
CourseCode: BSSES-201	CourseTitle: Earth and Earth Surface Processes	

Unit	Topic	No. of Lectures (60)
	Course Outcomes CO1: Describe the origin, structure, and composition of the Earth. CO2: Classify geological materials including rocks and minerals. CO3: Explain weathering, erosion, and geomorphic processes shaping Earth's surface. CO4: Assess the role of tectonic activity in landscape formation. CO5: Demonstrate field techniques for observing landforms and Earth processes. CO6: Interpret maps, cross-sections, and geological data.	
I	History of Earth: Solar system formation and planetary differentiation; formation of the Earth: formation and composition of core, mantle, crust, atmosphere and hydrosphere; chemical composition of Earth; geological time scale and major changes on the Earth's surface; Holocene and the emergence	10

	of humans, role of humans in shaping landscapes; development of cultural landscapes.	
II	Earth system processes: Movement of lithosphere plates; mantle convection and plate tectonics, major plates and hot spots, plate boundaries; sea floor spread; earthquakes; volcanic activities; orogeny; isostasy; gravitational and magnetic fields of the earth; origin of the main geomagnetic field; continental drift, Pangaea and present-day continents, paleontological evidences of plate tectonics; continental collision and mountain formation with specific example of the Himalaya.	12
III	Minerals and rocks: Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks; weathering: physical, biogeochemical processes; erosion: physical processes of erosion, factors affecting erosion; agents of erosion: rivers and streams, glacial and aeolian transportation and deposition of sediments by running water, wind and glaciers.	12
IV	Earth surface processes: Atmosphere: evolution of earth's atmosphere, composition of atmosphere, physical and optical properties, circulation; interfaces: atmosphere-ocean interface, atmosphere-land interface, ocean-land interface; land surface processes: fluvial and glacial processes, rivers and geomorphology; types of glaciers, glacier dynamics, erosional and depositional processes and glaciated landscapes; coastal processes.	14
V	Importance of being a mountain: Formation of Peninsular Indian mountain systems - Western and Eastern Ghats, Vindhya, Aravalli, etc. Formation of the Himalaya; development of glaciers, perennial river systems and evolution of monsoon in Indian subcontinent; formation of Indo-Gangetic Plains, arrival of humans; evolution of Indus Valley civilization; progression of agriculture in the Indian subcontinent in Holocene; withdrawing monsoon and lessons to draw.	12

Suggested Books:

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

9. Pelletier, J. D. 2008. Quantitative Modeling of Earth Surface Processes (Vol. 304). Cambridge: Cambridge University Press. Chicago.

Programme/Class:Certificate	Year:First	Semester:Second
CourseCode:BSSES-202	CourseTitle:Solid Waste Management	

Unit	Topic	No. of Lectures (45)
	Course Outcomes CO1: Describe sources, types, and characteristics of solid waste. CO2: Evaluate waste collection, segregation, and disposal methods. CO3: Explain composting, recycling, and waste-to-energy technologies. CO4: Recommend sustainable waste-management strategies.	
I	Solid & industrial waste management Sources and generation of solid waste, their classification and chemical composition; characterization of municipal solid waste; hazardous waste and biomedical waste; impact of solid waste on environment, human and plant health; different techniques used in collection, storage, transportation and disposal of solid waste (municipal, hazardous and biomedical waste); landfill; thermal treatment (pyrolysis and incineration) of waste material; stack emission control and emission monitoring; effluent treatment plant and sewage treatment plant.	12
II	Resource Recovery 4R- reduce, reuse, recycle and recover; biological processing - composting, anaerobic digestion, aerobic treatment; reductive dehalogenation; mechanical biological treatment; green techniques for waste treatment. Concept of waste-to-energy (WTE), energy recovery from waste; refuse derived fuel (RDF); different WTE processes: combustion, pyrolysis, landfill gas (LFG) recovery; anaerobic digestion; gasification	11
III	Integrated waste management Concept of Integrated waste management; waste management hierarchy; methods and importance of Integrated waste management. Cradle-to-grave approach; lifecycle inventory of solid waste; role of life cycle assessment (LCA) in waste management; advantage and limitation of LCA; case study on LCA of a product.	11
IV	Policies for solid waste management Municipal Solid Wastes (Management and Handling) Rules 2000; Hazardous Wastes Management and Handling Rules 1989; Bio-Medical Waste (Management and Handling) Rules 1998; Eco-friendly or green products. Practicals: Based on the theory and field-based.	11

	<p>SUGGESTED READINGS:</p> <ol style="list-style-type: none"> 1. Bagchi, A. 2004. Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons. 2. Asnani, P. U. 2006. Solid waste management. India Infrastructure Report 570. 3. Blackman, W.C. 2001. Basic Hazardous Waste Management. CRC Press. 4. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. 2008. Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons. 5. US EPA. 1999. Guide for Industrial Waste Management. Washington D.C. 6. White, P.R., Franke, M. & Hindle P. 1995. Integrated Solid waste Management: A Lifecycle Inventory. Blackie Academic & Professionals. 7. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. 2008. Improving Municipal Solid waste Management in India. The World Bank, Washington D.C. 	
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Programme/Class:Certificate	Year:First	Semester:Second
Subject:Environmental Science		
CourseCode:M-DIS-SB	CourseTitle:SystematicsandBiogeography	

Unit	Topic	No. of Lectures (45)
	<p>Course Outcomes</p> <p>CO1: Describe principles of taxonomy and systematics.</p> <p>CO2: Explain patterns of species distribution.</p> <p>CO3: Analyze biogeographical regions and ecological factors.</p> <p>CO4: Apply classification methods to biodiversity studies.</p>	
I	<p>Conceptandsystematicapproaches:Concept of taxa (species, genus, family, order, class, phylum, kingdom); concept ofspecies(taxonomic,typological,biological,evolutionary,phylogenetic);categoriesand taxonomic hierarchy.Definition of systematic; taxonomic identification; keys; field inventory; herbarium; museum;botanicalgardens;taxonomicliterature;nomenclature;evidencefromanatomy, palynology,ultrastructure,cytology,phyto-</p>	12

	chemistry, numerical and molecular methods; taxonomy databases.	
II	Taxonomic hierarchy, Nomenclature & Systems of classification: Principles and rules (International Code of Botanical and Zoological Nomenclature); ranks and names; types and typification; author citation; valid publication; rejection of names; principle of priority and its limitations; names of hybrids; classification systems of Bentham and Hooker; Angiosperm Phylogeny Group (APG III) classification. Operational Taxonomic Units; DNA barcoding; phylogenetic tree (rooted, unrooted, ultrametric trees).	13
III	Biogeography, Speciation and extinction: Genes as a unit of evolutionary change; mutation; genetic drift; gene flow; natural selection; geographic and ecological variation; biogeographical rules – Gloger’s rule, Bergmann’s rule, Allen’s rule, Geist rule; biogeographical realms and their fauna; endemic, rare, exotic, and cosmopolitan species. Types and processes of speciation – allopatric, parapatric, sympatric; ecological diversification; adaptive radiation, convergent and parallel evolution; dispersal and immigration; means of dispersal and barriers to dispersal; extinction.	10
IV	Historical, ecological & conservation biogeography: Paleo-records of diversity and diversification; role in biogeographic patterns – past and present; biogeographical dynamics of climate change and Ice Age. Species’ habitats; environment and niche concepts; biotic and abiotic determinants of communities; species-area relationships; concept of rarity and commonness; Island Biogeography theory; Equilibrium Theory of Island Biogeography. Application of biogeographical rules in design of protected area and biosphere reserves.	10
	<p>Text Books:</p> <ul style="list-style-type: none"> • Mani, M.S. 1974. <i>Ecology and Biogeography in India</i>. Dr. W Junk Publishers., The Hague. • Williams, D.M., Ebach, M.C. 2008. <i>Foundations of Systematics and Biogeography</i>. Springer. <p>Reference Books:</p> <ul style="list-style-type: none"> • Lomolino, M.V., Riddle, B.R., Whittaker, R.J. & Brown, J.H. 2010. <i>Biogeography</i> (4th edition). Sinauer Associates, Sunderland. • Singh, G. 2012. <i>Plant Systematics: Theory and Practice</i> (3rd edition). Oxford & IBH Pvt. Ltd., New Delhi. • Wheeler, Q.D. & Meier R. 2000. <i>Species Concepts and Phylogenetic Theory: A Debate</i>. Columbia University Press, New York. • Wilkins, J.S. 2009. <i>Species: A History of the Idea</i> (Vol. 1). University of California Press. 	

Programme/Class: Certificate	Year: First	Semester: Second
Course Code: SEC-ER	Course Title: Environmental Impact and Risk Assessment	

Unit	Topic	No. of Lectures
	<p>Course Outcomes</p> <p>CO1: Describe the steps involved in EIA and risk assessment. CO2: Analyze environmental impacts of development projects. CO3: Prepare a basic EIA report.</p>	
I	Environmental impact assessment (EIA): definitions, introduction and concepts; rationale and historical development of EIA; scope and methodologies of EIA. Cost-Benefit analysis; Lifecycle assessment; environmental appraisal; environmental management – principles, problems and strategies; environmental planning; environmental audit; introduction to ISO 14000; sustainable development.	10
II	Role of project proponents, project developers and consultants; Terms of Reference; impact identification and prediction; baseline data collection; Environmental Impact Statement (EIS), Environmental Management Plan (EMP)	12
III	EIA regulations in India; status of EIA in India; current issues in EIA; case study of hydropower projects/ thermal projects. Rapid EIA; Strategic Environmental Assessment; Social Impact Assessment.	10
IV	Risk assessment: introduction and scope; project planning; exposure assessment; toxicity assessment; hazard identification and assessment; risk characterization; risk communication; environmental monitoring; community involvement; legal and regulatory framework; human and ecological risk assessment.	13
<p>Text Books:</p> <ul style="list-style-type: none"> - Marriott, B. 1997. <i>Environmental Impact Assessment: A Practical Guide</i>. McGraw-Hill, New York, USA. <p>Reference Books:</p> <ul style="list-style-type: none"> - Barrow, C. J. 2000. <i>Social Impact Assessment: An Introduction</i>. Oxford University Press. - Glasson, J., Therivel, R., Chadwick, A. 1994. <i>Introduction to Environmental Impact Assessment</i>. London, Research Press, UK. - Judith, P. 1999. <i>Handbook of Environmental Impact Assessment</i>. Blackwell Science. - McIntyre, N. E. 2000. Urban ecology as an interdisciplinary field: differences in the use of 'urban' between the social and natural sciences. <i>Urban Ecosystems</i> 4: 5-24. - Montgomery, M. R. 2009. Urban Transformation of the developing world. <i>Science</i> 319: 761-764. 		

II YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT												
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE												
Department of Life Science												
Course Name - B.Sc. Environmental Science												
Batch:2025 -26			SEM:III									
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Internal Assessment	External Assessment	Total	Remark	
				L	T	P						
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)	
1	Major 3	BSES-301	Environmental Biology	4	0	0	3	5	10	15	70	100
2	Practical III (Based on Major 3+4)	BSES-301P	Environment biology and Water Resource Lab	0	0	4	3	5	10	15	70	100
3	Major 4	BSES-302	Water and Water Resources	4	0	0	3	5	10	15	70	100
4	Minor 3		To be chosen	3	0	0	3	5	10	15	70	100
5	Multi-Disciplinary 3		To be chosen	3	0	0	3	5	10	15	70	100
6	Ability Enhancement Course 3 (Disaster Risk Management)	AEC-03	Disaster Risk Management	2	0	0	2	5	10	15	70	100
7	Skill Enhancement Course 3		To be chosen	1	0	3	3	5	10	15	70	100
TOTAL CREDITS / ASSESSMENT							20	35	70	105	490	700

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT												
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE												
Department of Life Science												
Course Name - B.Sc. Environmental Science												
Batch:2025 -26			SEM:IV									
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Internal Assessment	External Assessment	Total	Remark	
				L	T	P						
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/ PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)	
1	Major 5	BSE S-401	Biodiversity and its Conservation	4	0	0	4	5	10	15	70	100
2	Practical IV (Based on Major 5+6+7)	BSE S-401P	Environmental Pollution and Microbial TechnologyLab	0	0	4	3	5	10	15	70	100
3	Major 6	BSE S-402	Environmental Pollution & Management	4	0	0	4	5	10	15	70	100
4	Major 7	BSE S-403	Environment and Microbial Biotechnology	4	0	0	4	5	10	15	70	100
5	Minor 4		To be chosen	3	0	0	3	5	10	15	70	100
6	Ability Enhancement Course 3 (Course on NCC/NSS/NGO,s/ Scout Guide / Sports)	AEC - 04A/ B/C/ D/E	Course on NCC/NSS/NGO,s / Scout Guide / Sports)	2	0	0	2	5	10	15	70	100
TOTAL CREDITS / ASSESSMENT							20	30	60	90	420	600

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

DETAILED SYLLABUS III SEMESTER

Programme/Class:Certificate	Year:Second	Semester:Third
CourseCode:BSSES-301	CourseTitle:EnvironmentalBiology	

Unit	Topic	No. of Lectures (60)
	Course Outcomes CO1: Explain the principles of ecology and levels of biological organization. CO2: Discuss population, community, and ecosystem dynamics. CO3: Analyze biotic interactions and energy flow in ecosystems. CO4: Evaluate human impacts on biological systems. CO5: Perform biological sampling and biodiversity assessment. CO6: Interpret ecological data using basic statistical tools.	
I	Ecology: Introduction of Ecology (Definition, History, Branches and Scope). Basic principles of Environment and Ecology; Environmental factors (Abiotic and biotic) their importance and role.	10
II	Ecosystem: Components, structure and function of ecosystem; Major ecosystems (terrestrial, aquatic, and marine); Trophic Levels, food chain and food webs; Energy flow in Ecological systems; Ecological Pyramids, Productivity.	10
III	Autecology: Population Characteristics - Dispersion, Density, Natality, Mortality, Age-Structure, Population Growth; Human population & growth; Ecological niche and habitat; Positive and Negative Interactions of Populations.	14
IV	Synecology: Community Structure, Growth Forms; Methods of Plant Community Analysis; Concept of Keystone Species, Ecotone, Ecotypes, Ecophene, ecological indicators; Ecological Succession.	12
V	Biogeochemical Cycles: Hydrological, Gaseous and Sedimentary Cycle - Carbon, Oxygen, Nitrogen, Phosphorus and Sulphur Cycles; Major biome of the world.	14

Suggested Books:

1. Ecology and Environment: P.D. Sharma., Rastogi Publication.
2. Fundamental of Ecology: E. P. Odum, W. B. Saunders Company, USA
3. Ecology, 2nd Edition by Paul Colinvaux, Wiley.
4. Ecology: From Individuals to Ecosystems by Michael Begon & Colin R. Townsend & John L. Harper; Blackwell publishing.
5. Ecology: Theories and Applications (4th Edition) by Peter Stiling; Prentice Hall.
6. Text Book of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam.

Programme/Class:Certificate	Year:Second	Semester:Third
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CourseCode: BSES-302	CourseTitle: Water and Water Resources
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Unit	Topic	No. of Lectures (60)
	<p>Course Outcomes</p> <p>CO1: Describe global and regional water distribution and hydrological cycles. CO2: Identify surface and groundwater sources and their characteristics. CO3: Assess water quality parameters and standards. CO4: Evaluate threats to freshwater resources and conservation strategies. CO5: Apply water sampling techniques and laboratory analysis. CO6: Prepare simple water resource management plans.</p>	
I	<p>Introduction: Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapo- transpiration; classification of water resources (oceans, rivers, lakes and wetlands). Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity, electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.</p>	14
II	<p>Surface and subsurface water: Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings.</p>	10
III	<p>Wetlands and their management: 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. Marine resource management: Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approach, construction techniques and monitoring of coastal zones).</p>	12
IV	<p>Water resource in India: 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.</p>	12
V	<p>Water resources conflicts: Water resources and sharing problems, case studies on Kaveri and Krishna river water disputes; Multi- purpose river valley projects in India and their environmental and social impacts; case studies of dams- Narmada and Tehri dam – social and ecological losses versus economic benefits; International conflicts on water sharing between India and her neighbours; agreements to resolve these conflicts.</p>	12

Suggested Books:

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 Ecogonomics: The Ecology and Economics of Marine Natural Resource Management*. Elsevier Publications.
9. Vickers, A. 2001. *Handbook of Water Use and Conservation*. WaterPLOW Press.

Programme/Class:Certificate	Year:Second	Semester:Third
CourseCode:BSSES-304	CourseTitle:Environment and Society	

Unit	Topic	No. of Lectures (45)
	Course Outcomes CO1: Explain relationships between environment and human society. CO2: Analyze social issues related to environmental problems. CO3: Evaluate environmental ethics, equity, and sustainability. CO4: Propose community-based environmental solutions.	
I	Development-environmentconflict: Social and cultural construction of 'environment'; environmental thought from historicalandcontemporaryperspectiveinlightoftheconceptsofGrossNetHappinessandAldoLeopold's Land Ethic. Developmental issues and related impacts such as ecological degradation;environmental pollution; development-induced displacement, resettlement, and rehabilitation;problems,concerns,andcompensativemechanisms;discussion onProjectAffectedPeople(PAPs).	12
II	Urbanizationandenvironment: Production and consumption oriented approaches to environmental issues in Indian aswell as global context; impact of industry and technology on environment; urban sprawl, trafficcongestionandsocial-economicproblems;conflictbetweeneconomicandenvironmentalinterests.	11
III	Environment,socialinequalitiesandregulatoryframework. Inequalities of race, class, gender, region, and nation-state in access to healthy and safeenvironments;history and politicssurrounding	11

	environmental, ecological and social justice; environmental ethics, issues and possible solutions. Regulatory framework: Brief account of Forest Conservation Act 1980, 1988; Forest Dwellers Act 2008; Land Acquisition Act 1894, 2007, 2011, 2012; Land Acquisition Rehabilitation and Resettlement Act 2013.	
IV	Community participation” State, corporate, civil society, community, and individual-level initiatives to ensure sustainable development; case studies of environmental movements (Appiko Movement, Chipko Movement, Narmada Bachao Andolan); corporate responsibility movement; appropriate technology movement; environmental groups and movements, citizen groups; role played by NGOs; environmental education and awareness.	11
	<p>Text Books:</p> <ul style="list-style-type: none"> - Elliot, D. 2003. <i>Energy, Society and Environment, Technology for a Sustainable Future</i>. Routledge Press. <p>Reference Books:</p> <ul style="list-style-type: none"> - Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. <i>Understanding Environment</i>. Sagar Publication India Pvt. Ltd., New Delhi. - Guha, R. 1989. <i>Ecological change and peasant resistance in the Himalaya</i>. Unquiet Woods, Oxford University Press, Delhi. - Leopold, A. 1949. <i>The Land Ethic</i>. pp.201-214. Chicago, USA. - National Research Council (NRC). 1996. <i>Linking Science and Technology to Society's Environmental Goals</i>. National Academy Press. - Pandit, M.K. 2013. Chipko: Failure of a Successful Conservation Movement. In: Sodhi, N.S., Gibson, L. & Raven, P.H. <i>Conservation Biology: Voices from the Tropics</i>. pp.126-127. Wiley-Blackwell, Oxford, UK. 	

Programme/Class: Certificate	Year: Second	Semester: Third
Course Code: M-DIS-UE	Course Title: Urban Ecosystems	

Unit	Topic	No. of Lectures (45)
	<p>Course Outcomes</p> <p>CO1: Describe components and functions of urban ecosystems.</p> <p>CO2: Evaluate urban environmental challenges.</p>	

	CO3: Analyze urban planning approaches for sustainability. CO4: Suggest sustainable city management practices.	
I	Environment in an urban setting Introduction to urbanization; urban sprawl and associated environmental issues. Man as the driver of urban ecosystem; commoditization of nature; metros, cities and towns as sources and sinks of resources; resource consumption and its social, cultural, economic and ecological perspectives; urban transformation; increasing challenges posed by modernity for the environment; urban pollution (air, water, soil).	12
II	Urban dwelling Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure, urban settings as loci of sustainability; challenges associated with sustainability and urban future.	13
III	Natural spaces in a city Concept of 'controlled nature'; scope, importance and threat to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; urban natural forest ecosystem as green lungs.	10
IV	Planning and environmental management Urban planning and its environmental aspects from historical and contemporary perspectives; benefits of environmental management; introduction to green buildings; urban governance; political complexity of applying ecological science to urban policy and planning, smart cities, management of urban environment; alternative resources; policy and management decisions.	10

Text Books:

- Gaston, K.J. 2010. *Urban Ecology*. Cambridge University Press, New York.
- Richter, M. & Weiland, U. (ed.). 2012. *Applied Urban Ecology*. Wiley-Blackwell, UK.

Reference Books:

- D'Monte, Darryl. 1985. *Industry versus Environment Temples or Tombs*. Three Controversies, Delhi, CSE.
- Ernstson, H. 2011. *Re-translating nature in post-apartheid Cape Town: The material semiotics of people and plants at Bottom Road*. In: Heeks, R., (Ed.) Conference on "Understanding Development through Actor-Network Theory", London School of Economics, 30 June, London.
- Grimm, N.B., Faeth, S.H., et al. 2008. Global Change and the Ecology of Cities. *Science* **319**:756-760.
- Hinchliffe, S. & Whatmore, S. 2006. Living cities: Towards a politics of conviviality. *Science as Culture* **15**:123-138.

Programme/Class: Degree		Year: Second	Semester: Third
CourseCode:SEC-ANP		CourseTitle:Air and Noise: Pollution and Abatement	
Courseoutcomes: Aftercompletingthecourse the studentwillbeable to:			
<ol style="list-style-type: none"> 1. Understand the fundamentals of origin, impacts and control of different air pollutants. 2. CO₂: Explain the types, nature and behavior of air pollutants under the influence of atmospheric conditions. 3. Appraise the monitoring techniques and control measures to curb the air pollution, considering the standards limits. 4. Understand the technical aspects of sound waves and controlling methods for vibration and noise pollution. 			
Credits:3		Compulsory	
Maximum Marks: 100		Minimum Passing Marks: 40	
Uni t	Topic	No. ofLectur es	
I	AN INTRODUCTION TO AIR POLLUTION Air Pollution: World and Indian scenario; Sources and classification of air pollutants; Criteria Air Pollutants and their properties; Atmospheric Aerosols; Long Range Transport of Atmospheric Pollutants; Impacts of air pollutants on health, plants and materials; The Air (Prevention and Control of Pollution) Act, 1981 and its amendments, National Air Quality Standards	10	
II	AIR POLLUTION MONITORING Air pollutants sampling: Sedimentation, High-volume Filtration, Tape sampler, Impingement and Electrostatic precipitator; Collection of gaseous air pollutants: Grab sampling, Absorption in liquid, Adsorption on solids, Freeze out sampling; Indoor Air Monitoring. Source Sampling: Representative sampling, isokinetic sampling, Flue gas analyzer principles for monitoring CO _x , NO _x , SO _x , Hydrocarbon. Air Pollutants Dispersion and Modelling: Meteorological aspects of air pollutants dispersion, Plume behavior; Gaussian Plume Model, Line source model and Area source model.	15	
III	AIR POLLUTION CONTROL TECHNOLOGIES Particulate pollutants Control: Gravitational Settling Chambers, Cyclonic separator, Fabric filter System, Electrostatic precipitators, Wet scrubbers Gaseous Pollutants Control: Absorption; spray chambers (and towers or columns), plate or tray towers, packed towers, and venturi scrubbers; Adsorption, Pressure-Swing Adsorption (PSA), Condensation: Surface and contact condensers; Combustion: Direct-flame, thermal and catalytic combustion Vehicular Pollution Control: Air-Fuel ratio, Catalytic convertor: Selective catalytic reduction (SCR), Selective non-catalytic reduction (SCNR), Bharat Stage Emission Standards (BSES)	10	
IV	NOISE POLLUTION Definition; Sources; Decibel Scale, Sound Pressure Level, Combining Decibel,	10	

Frequency Weighting Networks, Noise Indices (L10, L50, L90, Leq, LDN, TNI). Noise & vibration measurement and noise standards, Noise control and abatement measures: Active and Passive methods, Impact of noise and vibrations on human health.
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. Bell, L.H. and Bell, D.H., 1994. Industrial noise control: Fundamentals and applications. New York. 2. New York. 3. Cheremisinoff, N.P., 2002. Handbook of air pollution prevention and control. Elsevier. 4. Clarke, A.G. ed., 2012. Industrial air pollution monitoring. Springer Science & Business Media. 5. Rao, C.S., 2007. Environmental pollution control engineering. New Age International. 6. Tiwary, A. and Williams, I., 2018. Air pollution: measurement, modelling and mitigation. CRC Press. 7. Vallero, D.A., 2014. Fundamentals of air pollution. Academic press. 8. Wang, L.K., Pereira, N.C. and Hung, Y.T. eds., 2005. Advanced air and noise pollution control. Totowa, NJ, USA: Humana Press. 9. Wark, K., Warner, C.F. and Wayne T, D., 1998. Air pollution: its origin and control. Addison-Wesley.

DETAILED SYLLABUS IV SEMESTER

Programme/Class:Degree	Year:Second	Semester:Fourth
CourseCode:BSSES-401	CourseTitle:BiodiversityanditsConservation major	
<p>Courseoutcomes:Aftercompletingthe coursethe student willbeable to:</p> <ul style="list-style-type: none"> • Gainknowledgeonbiodiversity itsvalue andvariousapproachforconservations. • BiodiversityofIndia androleoflocal communities andtraditionalknowledgeinconservation. • DevelopknowledgeaboutbiodiversityidentificationandIUCN. • Understandthevariousconservationprocess. • Learnwildlife itsimportance,threat andmanagement. 		
Credits:4	Compulsory	
Max.Marks:100	Min.Passing Marks: 40	
Unit	Topic	No. ofLectures (60)
I	Biodiversity: Basicconceptsandimportance;Types(Speciesdiversity,Geneticdiversity, Ecosystem diversity); Measurement of Biological Diversity; Biological andPhylogeneticSpeciesConcept;Basic ConceptofSpecies andSpeciation.	10

II	Identification: Concept and basis of identification of Biodiversity Hotspots; hotspots in India. Factors for Decline of Biological Diversity, Concept of Extinction, Threatened and Endangered Species; IUCN categorization.	12
III	Conservation: Approaches for Conservation of Biological Diversity: <i>In-situ</i> conservation, <i>Ex-situ</i> conservation; Role of local communities and traditional knowledge in conservation; Biodiversity convention; International and national efforts to conserve biodiversity.	14
IV	Biodiversity of India: India as a mega diversity nation; Biogeographic zones of country; Forest Types and Forest Cover in India; National parks, Sanctuaries, and Sacred groves in India; important conservation projects; Concepts of gene pool, Biopiracy and bio-prospecting.	14
V	Wildlife: General introduction; Definition, Importance; Reason for wildlife Depletion; Wildlife Management; Protection of Wild Flora, Fauna and Natural Habitats.	10
Suggested Books: <ol style="list-style-type: none"> 1. The Biodiversity of India, Bharucha Erach, Mapin Publishing Pvt. Ltd. 2. Ecology and Environment: P.D. Sharma., Rastogi Publication. 3. Biodiversity: An Introduction, Gaston, K. J. & Spicer, J. I., Blackwell Science, London, UK. 4. Global Biodiversity: Status of the Earth's Living Resources, World conservation Monitoring Centre, Groombridge, B., UNEP, Cambridge. 5. Biodiversity: a beginner's guide, John I. Spicer, New World Publications. 6. Environmental Science: S. C. Santra, New Central Book Agency. 		

Programme/Class: Degree		Year: Second	Semester: Fourth
Course Code: BSES-402		Course Title: Environmental Pollution & Management	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> • Understand the basic concept of pollution and its effect on environment. • Develop understanding about history, sources, types and effect of air, water and soil pollution. • Gain skills on various control measures of pollution problems. • Understand the solid waste pollution, noise pollution, radioactive and thermal pollution. 			
<ul style="list-style-type: none"> • Gain knowledge about sustainable management of different wastes. 			
Credits: 4		Compulsory	
Max. Marks: 100		Min. Passing Marks: 40	
Unit	Topic	No. of Lectures (60)	
I	Environmental Pollution: Introduction; Roots of Our Environmental Problems; Pollution and Pollutants; Principal Pollutants; Classification of Pollutants; Cost of Pollutants; Types of Environmental Pollution; Pollution and Environmental Ethics	10	

	cs.	
II	Air pollution: History, Sources, Types, Effects and Control of air pollutants (Particulate Matter, Oxides of CO _x , NO _x , SO _x); Factors affecting distribution of air pollution; Photochemical Smog; Monitoring of air quality; Greenhouse effect, Ozone depletion, and Acid Rain; National Air Quality Monitoring Program; AQI.	14
III	Water Pollution: Types and sources of Water Pollutions; impact on humans, plants and animals; Water Quality Parameters- DO, BOD, COD, Acidity, Alkalinity, Salinity, Hardness; Drinking Water Quality Standards; Water Treatment- Adsorption, Flocculation, Ion Exchange and Reverse Osmosis Methods; Eutrophication, Algal bloom.	14
IV	Soil Pollution: Physico-Chemical and Biological Properties of Soil (structure, texture, inorganic, organic); Soil Pollution sources and control measures; Metal and Pesticides; Solid Waste Pollution: Municipal solid waste, Biomedical Waste, Hazardous Waste; Container Systems; Solid Waste management: Concept of 3R; Composting and Vermicomposting.	12
V	Noise Pollution: Source of noise, Noise exposure level, Effect of noise, Noise Pollution Control; Radioactive Pollution: Types of radiations, Sources of radiations, Biological effects of radiations; Thermal pollution: Cause, Effect and Control; E-Waste.	10
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. A text book of environmental chemistry and pollution control, Dara, S. S., S. Chand & Company Ltd, New Delhi. 2. Environmental Pollution, Khitoliya, R. K., S. Chand and Company, New Delhi. 1. Air Pollution, Rao. M. N. and Rao, H. V. N., Tata McGraw -Hill Publishing Company, New Delhi. 2. Environmental Pollution and Control, 4th edition, J. Jeffrey Peirce, Ruth E Weiner, E Aarne Vesilind, Boston Oxford Johannesburg Melbourne New Delhi Singapore. 3. Principles of Environmental Chemistry, 3rd edition, J. E. Girard, Jones & Bartlett Learning, Company, Burlington. 4. The Science of Environmental Pollution, 3rd edition, Frank R. Spellman, CRC Press, Taylor & Francis Group. 		

Programme: Degree	Year: Second	Semester: Fourth
Course Code: BSES-403	Course Name: Environment and Microbial Biotechnology	
<p>Course Outcomes: On the successful completion of the course, student will be able to: This paper presents an objective view of the application of biotechnological know-hows in tackling environmental problems. It starts with basic knowledge about molecular biology and later links to application-based processes and techniques.</p>		
Credits: 4	Compulsory	

Max.Marks:100		Min.Passing Marks: 40
Unit	Topic	No. of Lectures (60)
I	<p>The Structure and Function of DNA, RNA and Protein:</p> <p>DNA: structural forms and their characteristics (B, A, C, D, T, Z); physical properties: UV absorption spectra, denaturation and renaturation kinetics; biological significance of different forms; Synthesis.</p> <p>RNA: structural forms and their characteristics (rRNA, mRNA, tRNA; SnRNA, Si RNA, miRNA, hnRNA); biological significance of different types of RNA; synthesis.</p> <p>Protein: hierarchical structure (primary, secondary, tertiary, quaternary), types of amino acids; post- translational modifications and their significance; synthesis; types and their role: structural, functional (enzymes).</p> <p>Central dogma of biology; genetic material prokaryotes, viruses, eukaryotes and organelles; mobile DNA; chromosomal organization (euchromatin, heterochromatin - constitutive and facultative heterochromatin).</p>	12
II	<p>Recombinant DNA Technology: Recombinant DNA: origin and current status; steps of preparation; toolkit of enzymes for manipulation of DNA: restriction enzymes, polymerases (DNA/RNA polymerases, transferase, reverse transcriptase), other DNA modifying enzymes (nucleases, ligase, phosphatases, polynucleotide kinase); genomic and cDNA libraries: construction, screening and uses; cloning and expression vectors (plasmids, bacteriophage, phagmids, cosmids, artificial chromosomes; nucleic acid microarrays</p>	12
III	<p>Ecological restoration and bioremediation: Wastewater treatment: anaerobic, aerobic process, methanogenesis, bioreactors, cell and protein (enzyme) immobilization techniques; treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment);</p>	12
IV	<p>specific bioremediation technologies: land farming, prepared beds, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wetlands, use of bioreactors for bioremediation; phytoremediation; remediation of degraded ecosystems; advantages and disadvantages; degradation of xenobiotics in environment, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides, heavy metals degradative pathways.</p> <p>Bioremediation of contaminated sites due to industrial pollution, oil spills, pesticides, explosives. In situ and ex situ bioremediation techniques, role of genetically engineered microbes in bioremediation</p>	12
V	<p>Ecologically safe products and processes: PGPR bacteria: biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation, accumulation</p>	12

	and concentration of metals, metal leaching, extraction; exploitation of microbes in copper and uranium extraction.	
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Suggested Reading

1. Biotechnology, U.Satyanarayan. Books and Allied Pvt. Ltd
2. Applied Microbiology, Tata McGraw Hill New Delhi.
3. An introduction to Microbial culture: M .K. Razdan Elsevier publication
4. Biotechnology and genomics: P.K. Gupta
5. Evans, G.G. & Furlong, J. 2010. *Environmental Biotechnology: Theory and Application* (2nd edition). Wiley-Blackwell Publications.
6. Jordening, H.J. & Winter J. 2005. *Environmental Biotechnology: Concepts and Applications*. John Wiley& Sons.
7. Lodish, H.F., Baltimore, D., Berk, A. Zipursky, S.L. Matsudiar, P. & Darnell, J. 1995.
8. *Molecular Cell Biology*. W.H. Freeman.
9. Nelson, D.L. & Cox, M.M. 2013. *Lehninger's Principles of Biochemistry*. W.H. Freeman.
10. Rittman, B.E. & McCarty, P.L. 2001. *Environmental Biotechnology. Principles and Applications*. McGraw-Hill, New York.
11. Scagg, A.H. 2005. *Environmental Biotechnology*. Oxford University Press.
12. Snustad, D.P. & Simmons, M.J. 2011. *Principles of Genetics* (6th edition). John Wiley& Sons.
13. Wainwright, M. 1999. *An Introduction to Environmental Biotechnology*. Springer.

Programme: Degree	Year: Second	Semester: Fourth
CourseCode: BSES-406	CourseTitle: Human-Wildlife Conflict and Management	
Course Outcomes: After completing the course, the student will be able to:		
<ol style="list-style-type: none"> 1. Deals with the conflicts that have arisen as a result of shrinkage of wildlife habitats and the same being shared by human communities. 2. Raises questions about the moral obligations of humans, need for conservation, and social impacts of conflicts. 3. Introducing the student to the scientific and social perspective of conservation. 		

Unit	Topic	No. of Lectures (45)
I	Evolution of the concept of wildlife management: Journey of mankind from predator to conservator; prehistoric association between wildlife and humans: records from Bhimbetka wall paintings; conservation of wildlife in the reign of King Ashoka: excerpts from rock edicts; Bishnoi community; understanding wildlife management, conservation and policies regarding protected areas in 21 st century; positive values provided by wildlife conservation	11

	(monetary, recreational, scientific and ecological benefits).What is the role of government, wildlife biologists and social scientists, concept of deep and shallow ecology.	
II	Wildlife conservation laws in India: Need of environmental management; wildlife conservation: moral obligation? philosophy of wildlife management; Types of protected areas (Wildlife Sanctuaries, National Parks, Biosphere Reserves); IUCN categories of protected areas, Natural World Heritage sites; concept of core and buffer area in a protected range, brief introduction to Wildlife Protection Act of 1972, Forest act 1927, Environmental Protection Act 1986, and Forest conservation Act 1920; introduction of Tiger task force, Status of current protected areas in India.	11
III	Socio-economic and legal basis of conflicts: Concepts of development and encroachment, who is the intruders: human or animal? Impact of conflict on humans and wildlife, impact of habitat fragmentation, social inequality in terms of forest conservation: forest produce as a need vs. forest exploitation, introduction to tribal rights in India, demographic profile of tribes in India, importance of forest produce to tribal populations, Forest dwellers (Recognition of forest right) Act, 2006. Insight into the important wildlife conflicts: Keoladeo National park conflict of Bharatpur, Human and elephant conflicts of Kerala, Fisherman and tiger conflict of Sundarbans forest, shifting cultivation in North east India.	12
IV	Human wildlife coexistence: Symbiotic relationship between tribals and forest, forest and development, focus on the inclusive growth of tribes: community participation in forest management, case study of Chipko movement, sacred groves forests, India's Bishnoi community and their conservation practices; ecological economic welfare and development: conservation of indigenous culture and traditions, role of international organizations: Man and biosphere programmes; concept of conservation reserves and community reserves, importance of wildlife corridors in minimizing the conflicts and conservation.	11
	Text Books: <ul style="list-style-type: none"> - Woodroffe, R. 2005. <i>People and Wildlife: Conflict and Coexistence</i>. Cambridge. - Woodroffe, R., Thirgood, S., & Rabinowitz, A. 2005. <i>People and Wildlife, Conflict or Coexistence?</i> (No. 9). Cambridge University Press. Reference Books: <ul style="list-style-type: none"> - Conover, M. 2001. <i>Resolving Human Wildlife Conflicts</i>, CRC Press. - Dickman, A. J. 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict. <i>Animal Conservation</i> 13: 458-466. - Messmer, T. A. 2000. The emergence of human-wildlife conflict management: Turning challenges into opportunities. <i>International Biodeterioration & Biodegradation</i> 45: 97-102. - Paty, C. 2007. <i>Forest Government and Tribe</i>. Concept Publishing Com 	

	<p>pany.</p> <ul style="list-style-type: none">- Treves, A. & Karanth, K. U. 2003. Human-- -carnivore conflict and perspectives on carnivore management worldwide. <i>Conservation Biology</i> 17: 1491-1499.	
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III YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Environmental Science													
Batch:2025 -26			SEM:V										
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Internal Assessment	External Assessment	Total	Remark		
				L	T	P							
THEORY and PRACTICAL SUBJECTS								Attendance (5)	quiz/PPT/Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 8	BSES-501	Natural Resources and its Management	4	0	0	4	5	10	15	70	100	
2	Practical V (Based on Major 8+9)	BSES-501P	Natural Resources, Environmental Microbiology and Biotechnology Lab		0	4	2	5	10	15	70	100	
3	Major 9	BSES-502	Environmental Microbiology and Biotechnology	4	0	0	4	5	10	15	70	100	
4	Minor 5		To be chosen	3	0	0	3	5	10	15	70	100	
5	Minor 6		To be chosen	3	0	0	3	5	10	15	70	100	
6	Internship	BSES-506I	Internship	2	0	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							20	30	60	90	420	600	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT												
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE												
Department of Life Science												
Course Name - B.Sc. Environmental Science												
Batch:2025 -26			SEM:VI									
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Internal Assessment	External Assessment	Total	Remark	
				L	T	P						
THEORY and PRACTICAL SUBJECTS							Attendance (5)	quiz/ PPT/ Assignment (10)	Mid Sem Test (15)	End Sem Exam (70)		
1	Major 10	BSES-601	Water Pollution and Control Technologies	4	0	0	4	5	10	15	70	100
2	Practical VI (Based on Major 10+11+12)	BSES-601P	Techniques in environmental Science	0	0	4	2	5	10	15	70	100
3	Major 11	BSES-602	Ecology and Biodiversity	4	0	0	4	5	10	15	70	100
4	Major 12	BSES-603	Environmental Geosciences	4	0	0	4	5	10	15	70	100
5	Minor 7		To be chosen	3	0	0	3	5	10	15	70	100
6	Minor 8		To be chosen	3	0	0	3	5	10	15	70	100
TOTAL CREDITS / ASSESSMENT							20	30	60	90	420	600

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

DETAILED SYLLABUS V SEMESTER

Programme: Degree		Year: Third	Semester: Fifth
Course Code: BSES-501		Course Title: Natural Resources and its Management	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> Develop the understanding on natural resources and their significance. Able to know the strategies for sustainable management. Understand the basic principles and application of remote sensing and GIS techniques. Gain skills on renewable energy resources and bio-energy options. Understand the present scenario of states on different environmental issues related to mining. 			
Credits: 4		Compulsory	
Max. Marks: 100		Min. Passing Marks: 40	
Unit	Topic	No. of Lectures (60)	
I	Natural Resources: Concept and types of natural resources; classification of natural resources; Factors influencing resource availability, distribution and uses; Interrelationships among different types of natural resources.	10	
II	Land Resource: Soil types, profile and composition; degradation of land and agricultural lands; impact of land use on environment; Soil Management: Soil erosion and Conservation, Desertification; Soil reclamation. Water Resources: Surface and Ground Water- distribution and supply; Causes of water resource depletion; water resource management- Ground water recharging, rain water harvesting; Watershed management; Wetlands: definition, importance and classification.	14	
III	Forest Resource: Types and extent of forests in India; forest fragmentation; Importance of Forest; Exploitation of Forest resources; Deforestation; Forest Management; National forest policy; Carbon Sequestration. Agriculture Resources: Types of Agriculture; Basic Resources of Agriculture; Major Crop of India; Agriculture and Environment; Effect of Modern Agriculture; Fertilizer-Pesticides Problems; Agroforestry; Social Forestry.	12	
IV	Energy Resource: Concept of Conventional and Non-conventional Energy Resources; Fossil fuels; Hydro-power; Tidal Energy; Ocean Thermal Energy Conversion; Wind Power; Geothermal Energy; Solar Energy. Bioenergy: Methods to produce energy from biomass; Biogas Plant; Nuclear energy; Hydrogen as an alternative Fuel; Energy use pattern in India; Emissions of CO ₂ in developed and developing countries including India.	14	

V	Mineral Resources: Types, distribution and reserves of mineral resources; use and exploitation; environmental effects of mining; Case Studies- Mining in Aravali Hills; Bundelkhand Region; Sand mining in UP; Remote Sensing and GIS: Basic Principles and Application.	10
Suggested Books: <ol style="list-style-type: none"> 1. Ecology and Environment: P.D. Sharma., Rastogi Publication. 2. Ecology of Natural Resources, Ramade, F., John Wiley & Sons Ltd. 3. Singh, J.S., Singh, S.P. and Gupta, R.S., Ecology, Environment and Resource Conservation, Anamaya Publishers, New Delhi. 4. Text Book of Environmental Studies, Erach Bharucha, Orient Longman Pvt. Ltd., Ernakulam. 5. Encyclopedia of Indian Natural History, Hawkins R.E., Bombay Natural History Society, Bombay. 6. Fundamental of Remote sensing, Joseph, G., 2018, University Press (India) Private Ltd, Hyderabad. 		

Programme/Class: Degree		Year: Third	Semester: Fifth
Course Code: BSES-502		Course Title: Environmental Microbiology and Biotechnology	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> • Impart knowledge on microbial diversity and recent advancement. • Gain in-depth knowledge of role of beneficial and pathogenic microorganisms in environment. • Understand the application of microbes for production of different eco-friendly products. • Understand molecular biotechnology and its applications in Environmental management. • Learn about Bioethics, biosafety and IPR. 			
Credits: 4		Compulsory	
Max. Marks: 100		Min. Passing Marks: 40	
Unit	Topic	No. of Lectures	
I	Environmental Microbiology 1: Concept and scope; distribution of microbes in nature- soil/air/water; Cultivation of microorganism; Extreme Environment Adaptation- Archae Bacteria, Acidophilic, Alkalophilic, Thermophilic, Barophilic, Osmophilic and Radiodurant Microbes.	10	
II	Environmental Microbiology 2: Importance of microbes in the environment; Microbial pathogens and Parasites and their effects on Human, Animal and Plant health, Indicator microorganisms in air, water and soil Environment; Biological treatment of wastewater; Bioremediation.	14	

III	Food microbiology: Spoilage and Preservation of foods; Fermented food; food poisoning; Microbiology of milk; Industrial Microbiology: Industrial use of bacteria, fungi, yeast, biogas production, vaccine production; Role of microbes in production of biopolymers and biodegradable plastics.	14
IV	Biotechnology: Scope and Importance of Biotechnology; Development of genetically engineered microorganisms (GEMs); Biotechnology and its application- Biofertilizer, Vermiculture Technology, Microbial enhanced oil recovery (MEOR), Biomining, Biosensors.	12
V	Bioethics, Biosafety and IPR: Ethics of Genetically modified (GM) plants, animals, microbes; GM food and Bio warfare; Biosafety guidelines in India; Intellectual Property Right.	10

Suggested Books:

1. Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J., 3rd edition, Academia Press, Elsevier.
2. Textbook of Environmental Microbiology, Mohapatra, P. K., I. K. International (P) Ltd.
3. Basic Biotechnology, Ratledge, C. and Kristiansen, B., 2nd edition, Cambridge University Press.
4. Environmental Biotechnology, Theory and Application, Gareth M. Evans and Judith C. Furlong. John Wiley & Sons.
5. Bioethics and Biosafety in Biotechnology, Sree Krishna. V., New Age International Publishers.

Programme: Degree	Year: Third	Semester: Fifth
Course Code: BSES-504A	Course Title: Gender and Environment	
<p>Course Outcomes: After completing the course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Expose the concept of gender in society and its relevance in the environmental context. 2. Examine environmental issues from a gender-sensitized perspective. 		

Unit	Topic	No. of Lectures (45)
I	Gender and society: The socially constructed 'gender' concept; Gender existence in society; gender: matriarchy and patriarchy as means of social exclusion (case studies in an Indian context); gender equity issues in rural and urban settings.	11
II	Gender and the environment: Relevance of the concept in an environmental context; evolution of gender hierarchies in historical and contemporary perspective; gender division of roles in cultural, social and economic perspective; gender inequalities.	11

III	Gender,resourcesandtheenvironment:Knowledge about the environment among men and women; differential dependencies on environmentalresources;implications ofgenderedresponsestoenvironmentaldegradation.	11
IV	Gender,environmentalmanagementandfuture:Women’s participation in environmental movements and conservation; historical andcontemporarycasestudies;roleofwomeninenvironmentaleducation,awar enessandsustainable development.Need for gender equity; Instruments for change: education, media, action groups, policy andmanagement;equity inresourceavailability andconsumption forasustainablefuture.	12
	<p><u>TextBooks:</u></p> <ul style="list-style-type: none"> - Miller,B.1993.<i>SexandGenderHierarchies</i>.CambridgeUniversityPress <p><u>ReferenceBooks:</u></p> <ul style="list-style-type: none"> - Agarwal,B.1992. <i>TheGenderandEnvironmentDebate:LessonsfromIndia</i>.Feminist Studies(Minnesota). - Agarwal,B.1997.Gender,EnvironmentandPovertyInterlinks:RegionalVariationsandTemporalShiftsin Rural India: 1971-1991.<i>World Development</i> 25: 1-42. - Agarwal,B.2001.Participatoryexclusions,communityforestry,and gender:AnanalysisforSouthAsiaand aconceptual framework.<i>World Development</i> 29: 1623-1648. - Jackson,C.1993.Doingwhatcomesnaturally?Womenandenvironmentindevelopment <i>WorldDevelopment</i> 21:1947-63. - Krishna,S.2004.<i>LivelihoodandGender</i>.NewDelhi,Sage. - Leach,M.2007.EarthMothermythsandotherecofeministfables:Howastrategicnotion roseand fell. <i>Developmentand Change</i>38: 67-85. - Stein, R. (ed.). 2004. <i>New Perspectives on Environmental Justice: Gender, Sexuality, andActivism</i>.RutgersUniversityPress. - Steingraber,S.1998.<i>LivingDownstream:AScientist’sPersonalInvestigationofCancerandtheEnvironment</i>.New York:VintageBooks. - Zwarteveen, M.Z.1995.<i>Linkingwomentothemaincanal:Genderandirrigationmanagement</i>.GatekeeperSeries 54, IIED. 	

Programme: Degree	Year: Third	Semester: Fifth
CourseCode: BSES-504B	CourseTitle: Green Technologies	
Course Outcomes: Aftercompletingthecourse,the studentwillbeable to:		

3. Expose the concept of gender in society and its relevance in the environmental context.
4. Examine environmental issues from a gender-sensitized perspective.

Unit	Topic	No. of Lectures (45)
	<p>Course Outcomes</p> <p>CO1: Understand the fundamental concepts of green technologies and their role in sustainable development.</p> <p>CO2: Learn about environmentally friendly energy sources, materials, and processes that reduce pollution and resource depletion.</p> <p>CO3: Gain knowledge of green innovations used in waste management, water conservation, and clean energy systems.</p> <p>CO4: Understand the social, economic, and environmental benefits of adopting green technologies in various sectors.</p>	
I	<p>Green technologies: concept: Definition and concepts: green technology, green energy, green economy, and green chemistry; sustainable consumption of resources; individual and community level participation, energy conservation; encouraged use of public transport instead of private transport. successful green technologies: wind turbines, solar panels; 3 R's of green technology: recycle, renew and reduce; paradigm shift from 'cradle to grave' approach. Agenda of green development; reduction of ecological footprint; role of green technologies towards a sustainable future; major challenges and their resolution for implementation of green technologies.</p>	11
II	<p>Green infrastructure, planning and economy: Green buildings; history of green buildings, need and relevance of green buildings over conventional buildings, outlined examples of green buildings; LEED certified building; Eco-mark certification, Green planning: role of governmental bodies, land use planning, concept of green cities, waste reduction and recycling in cities, public transportation for sustainable development, green belts.; Introduction to UNEP's green economy initiative, inclusive economic growth of the society, REDD+ initiative, and cap and trade concept; green banking.</p>	11
III	<p>Applications of green technologies: Increase in energy efficiency: cogeneration, motor system optimization, oxy-fuel firing, isothermal melting process, energy efficient fume hoods. Green House Gas (GHG) emissions reduction: carbon capture and storage (CCS) technologies, purchase and use of carbon offsets, methane emissions reduction and/or reuse. Pollution reduction and removal (Flue Gas Desulfurization (FGD) methods, catalytic or thermal destruction of NO_x, Fluidized Bed Combustion, Dioxins reduction and removal methods, Thermal Oxidizers or Wet Scrubbers to neutralize chemicals or heavy metals, solvent recovery systems, Low Volatile</p>	12

	Organic Compound (VOC) paints and sealers).	
IV	Green chemistry and future: Introduction to green chemistry; principles and recognition of green criteria in chemistry; biodegradable and bio-accumulative products in environment; green nanotechnology; reagents, reactions and technologies that should be and realistically could be replaced by green alternatives; photodegradable plastic bags, green practices to conserve natural resources (organic agriculture, agroforestry, reducing paper usage and consumption, etc.); emphasis on waste reduction instead of recycling, emphasis on innovation for green future; role of advancement in science in developing environmental friendly technologies.	11
	<p>Text Books:</p> <ul style="list-style-type: none"> - Anastas, P. T. & Warner, J. C. 1998. <i>Green Chemistry: Theory & Practice</i>. Oxford University Press. - Arceivala, S. L. 2014. <i>Green Technologies: For a Better Future</i>. Mc-Graw Hill Publications. <p>Reference Books:</p> <ul style="list-style-type: none"> - Baker, S. 2006. <i>Sustainable Development</i>. Routledge Press. - Hrubovcak, J., Vasavada, U. & Aldy, J. E. 1999. <i>Green technologies for a more sustainable agriculture</i> (No. 33721). United States Department of Agriculture, Economic Research Service. - Thangavel, P. & Sridevi, G. 2015. <i>Environmental Sustainability: Role of Green Technologies</i>. Springer Publications. - Woolley, T. & Kimmins, S. 2002. <i>Green Building Handbook</i> (Volume 1 and 2). Spon Press. 	

DETAILED SYLLABUS VI SEMESTER

Programme/Class: Degree	Year: Third	Semester: Sixth
Course Code: BSES-601	Course Title: Water Pollution and Control Technologies	
<p>Course outcomes: After completing the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Acquire the knowledge of basic rationale of water quality management. 2. Characterize the typical inorganic and organic pollutants from a variety of sources entering into water bodies. 3. Design and develop water purification techniques for safe drinking water and wastewater treatment technologies for abatement of water pollution. 4. Apply the knowledge of various methods for water resource management. 		
Credits: 4	Compulsory	

Max.Marks:100		Min.Passing Marks: 40
Uni t	Topic	No. ofLectur es
I	DRINKING WATER CHARACTERISTICS AND PURIFICATION TECHNIQUES Water Sources – Availability and quality of Surface water and Groundwater, Water Requirements for Domestic Consumption (Population forecasting), Drinking water standards (physical, chemical & bacteriological), Water Treatment process – Principal, process design and applications (Aeration, flocculation, Sedimentation, Filtration, Disinfections (Chlorination, UV, Ozonation), water softening.	12
II	WATER POLLUTION Sources, types, Causes and consequences of water pollution, water pollutants (organic, inorganic, biological and radioactive pollutants), Marine pollution, Thermal pollution, Oil pollution, Classification of wastewater, Bioindicators. Characteristics of water and wastewater, Sampling of water and wastewater, collection and storage, physical chemical and biological analysis of water and wastewater.	12
III	WASTEWATER TREATMENT -I Wastewater generation, objectives of waste water treatment, Primary, secondary, Tertiary treatment: sedimentation, coagulation and flocculation, filtration, disinfection, activated sludge process, trickling filters, and anaerobic (UASB) processes,	12
IV	WASTEWATER TREATMENT-II Suspended, attached and hybrid reactors. Sludge treatment – Preliminary operation, Thickening, Conditioning, Dewatering, Filtration, Digestion and Drying of sludge, Sludge disposal. An introduction to common ETPs and STPs. wastewater treatment for small communities – Oxidation ditch, SBR, aerated lagoon.	12
V	WATER RESOURCE MANAGEMENT Eutrophication, Recovery of eutrophicated lakes, rehabilitation of polluted rivers-Ganga Action Plan, Yamuna Action Plan and new Plans introduced by Govt. of India.	12
SuggestedBooks: <ol style="list-style-type: none"> 1. Wastewater Engineering: Treatment, disposal, Reuse – Metcalf & Eddy Inc.4th ed. TMGHI, New Delhi, 2003. 2. Environmental Engineering- Peavy, HS, Donald RR & G. Tchobanoglous, MGH Int. Ed. New York, 1985. 3. Edzwald, James K. (ed.) Water quality & treatment: A handbook on drinking water 4. Ujang, Zaini (Ed.) Municipal wastewater management in developing countries: Principles and Engineering. 5. Natural Resources conservation-Oliver S Owen & Chiras 6. Natural Resource Conservation-Owen & Chiras 7. Living in the Environment –T.J.Miller 		

Programme/Class:Degree		Year:Third	Semester:Sixth
CourseCode:BSES-602		CourseTitle:Ecology and Biodiversity	
Courseoutcomes: Aftercompletingthecoursethe studentwillbeable to:			
<ol style="list-style-type: none"> 1. Demonstrate knowledge of ecological principles operating at different levels of organization. 2. Understand the concepts of ecosystems and compare them with real life processes. 3. Analyze components of population and community ecology. 4. Interpret ecological and social phenomena from a biodiversity view point and develop new conservation measures on new or endangered species in a given habitat. 			
Credits:4		Compulsory	
Max.Marks:100		Min.Passing Marks: 40	
Uni t	Topic	No. ofLectur es	
I	INTRODUCTION TO ECOLOGY Definition, subdivisions and scope, basic concepts of ecology, Autecology and Synecology, biological levels of organization-genes to biosphere, Interaction of ecological factors - Light, temperature, precipitation, humidity. Atmospheric gases, wind and fire, topographic and edaphic factors, adaptation, Ecological concepts of species (Liebig's law of minimum, Shelford's law of Tolerance, Combined concept of limiting Factors).	14	
II	POPULATION AND COMMUNITY ECOLOGY Population characteristics, population interaction, prey-predator relations, competition, exploitation, mutualism, parasitism, allelopathy, Population growth and regulation. Community structure and organization, Concept of metapopulation, demes and dispersal, Habitat, niche- concept and types, keystone species, Flagship species and umbrella species; dominant species, ecotone, edge effect, ecotypes, plant indicators, ecological succession - types and mechanism.	10	
III	ECOSYSTEM DYNAMICS Introduction, kinds of ecosystem, structure and function of ecosystem, food chain, food web, trophic level, ecological pyramids, energy flow models, ecosystem productivity, methods of measuring primary productivity, Ecosystem stability and regulation, biogeochemical cycles- cycling of water and nutrients, Structure of some typical ecosystems - forest, desert, grassland, pond, marine, wetland, estuaries, cropland.	14	
IV	BIODIVERSITY Definition, levels of biodiversity, measuring biodiversity, values of biodiversity, Hotspots of biodiversity, Biodiversity hotspots of India, threats to biodiversity. Biological Invasion: concept; pathways, process, mechanism, impacts, examples of major invasive species in India.	12	
V	Endangered and threatened species, IUCN Categories of threatened species, Red data book, List of threatened flora and fauna in India. Biodiversity	10	

conservation; National and international efforts for wildlife and forest conservation, wetland conservation, Convention on Biodiversity.
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. Brewer, R. The Science of Ecology, Sanders College Publishing Co., Tokyo, 1994. 2. Odum, E.P. Basic Ecology, W.B. Saunders, Philadelphia, 1983. 3. Fatik B. Mandal and Nepal C. Nandi. Biodiversity: Concepts, Conservation and Biofuture, 4. Asian Books, 2013. 5. Jorgensen, Sven Erik. Encyclopedia of Ecology. Vol 1-5. Elsevier Publishers. Netherlands, 2008. 6. Joshi, B.D., Tripathi, C.P.M and Joshi, P.C. Biodiversity and Environmental Management. 7. APH, New Delhi, 2009. 8. Joshi, P.C. and Joshi, N. Biodiversity and conservation. APH Publishing Co-operation, New Delhi, 2009. 9. Kohli, R. K., Jose, S., Singh, H. P. and Batish, D. R. Invasive Plants and Forest Ecosystems. CRC Press / Taylor and Francis, 2009. 10. Odum, E.P., Barrick, M. and Barrett, G.W. Fundamentals of Ecology (5th Ed). Thomson Brooks/Cole Publisher, California, 2005. 11. Rana, S.V.S. Essentials of Ecology and Environmental Science (5th Ed), PHI Learning Pvt. Ltd, 2013. 12. Sharma, P.D. Ecology and Environment. Rastogi Publications. New Delhi, 2016. 13. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York. 14. Smith, T.M and Smith, R.L. Elements of Ecology (8th Ed), Benjamin Cummings, 2012. 15. Vandermeer, John H., Riddle, B.R. and Brown, J.H. Population Ecology: First principle (2nd Ed). Princeton University Press, 2013. 17. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). Ecology, Environment and Resource Conservation, S. Chand Publishing, New Delhi.

Programme/Class: Degree	Year: Third	Semester: Sixth
Course Code: BSES-603	Course Title: Environmental Geosciences	
<p>Course outcomes: After completing the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand the basics of the Earth's structure, composition and evolution of landforms CO₂: Analyze the effects of meteorological parameters on the dispersion of pollutants. 2. Understand and apply the basic concepts of meteorology, climatology and oceanography for solving relevant environmental issues. 3. Identify the issues related to climate change, understand reasons and recommend remedial measures 		
Credits: 4	Compulsory	
Max. Marks: 100	Min. Passing Marks: 40	
Unit	Topic	No. of Lectures

I	EARTH PROCESSES Earth Structure and Materials of the Earth; Minerals and Rocks; Weathering and Erosion. Plate tectonics; Volcanicity; Seismicity; Geological Time Scale.	10
II	METEOROLOGY Fundamentals of meteorology, Scales of meteorology, Parameters of meteorology- pressure, wind, temperature, humidity, radiation; Radiation laws, shortwave and long wave radiations, Albedo, Emissivity, Inversion;	10
III	The boundary layer; Radiation balance of the Earth; Heating of Earth' surface and its atmosphere; Rotation of the Earth- Coriolis acceleration; Circulation of water and energy in atmosphere, El Nino, La Nina	14
IV	CLIMATOLOGY Seasons and monsoons, Precipitation, Cloud classification and formation Local microclimate Weather and Climate in India, Climatic classification schemes, Climate change - Emissions and Global warming.	12
V	OCEANOGRAPHY Sea water properties, Chemistry of seawater, Waves, Tides and Currents, Upwelling and El Nino, Marine Resources, Marine Pollution, Global Warming and Oceans - Greenhouse effect, Ocean warming, Sea level rise, Acidification, Carbon sequestration.	14
<p>Suggested Books:</p> <ol style="list-style-type: none"> 1. Bell F. G., (1998). <i>Environmental Geology: Principles and Practice</i>. Blackwell Science Publisher, USA. 2. Critchfield H. J. (2009). <i>General Climatology</i>, PHI Learning, New Delhi. 3. Kale, V. S. and Gupta, A. (2001). <i>Introduction to Geomorphology</i>. Orient Longman, Bangalore. 4. Singh, S. (2011), <i>Physical Geography</i>, Prayag Pustak Bhavan, Allahabad. 5. Strahler, A.N. and Strahler (1996). <i>An Introduction to Physical Geography</i>. John Wiley & Sons, UK. 6. D.S. Lal (2011). <i>Climatology</i>, Sharda Pustak. 7. Frank Press, Raymond Siever, John Grotzinger, <i>Understanding Earth</i>. Editors Thomas 8. H. Jordan, Tom Jordan W. H. Freeman & Co Ltd ISBN-10: 1464138745; ISBN-13: 978-1464138744 9. Frederick K. Lutgens Edward J. Tarbuck Pearson Education, <i>The Atmosphere An Introduction to Meteorology</i> Inc. ISBN-10 0-32-158733-2 ISBN-13 978-0-321-58733-6 10. Tom Garrison <i>Essentials of Oceanography</i> ISBN-13: 978-0-495-55531-5 ISBN-10: 0-495-55531-Brooks/Cole Cengage Learning 10 Davis Drive Belmont, CA 94002-3098 USA 		

Programme/Class:Degree	Year:Third	Semester:Sixth
CourseCode:BSSES-605A	CourseTitle:ATMOSPHEREANDGLOBALCLIMATECHANGE	
<p>Course Outcomes: After completing the course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand dynamics of atmospheric processes, which include its composition, meteorological phenomena and atmospheric chemistry. 		

2. Highlight the anthropogenic intervention in 'anthropocene', which has led to global climate change.
3. Explore the effects of global changes on human communities and initiatives taken at global and regional levels to combat them.

Credits:3		Compulsory	
Maximum Marks: 100		Minimum Passing Marks: 45	
Unit	Topic		
I	Atmospheric circulation and energy balance: Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; <i>El Nino</i> and <i>La Nina</i> ; 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; greenhouse gases (GHGs); greenhouse effect; global conveyor belt.		
II	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.		
III	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, CO ₂ fertilization and agriculture; impact on economy and spread of human diseases.		
IV	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. Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.		

TextBooks:

- Hardy, J.T. 2003. *Climate Change: Causes, Effects and Solutions*. John Wiley & Sons.
- Harvey, D. 2000. *Climate and Global Climate Change*. Prentice Hall.

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.
- 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.

Programme: Degree		Year: Third	Semester: Sixth
Course Code: BSES-605B		Course Title: Environmental Pollution and Human Health	
<p>Course Outcomes: After completing the course the student will be able to:</p> <ol style="list-style-type: none"> 1. deals with different aspects of environmental contamination, which have adverse effects on human health. 2. Understand mechanisms of pollutants impacting human health by developing an understanding of different types of pollutants, their sources and mitigation measures. 3. Introduced to the concept of permissible limits. 			
Credits: 3		Compulsory	
Maximum Marks: 30+70= 100		Minimum Passing Marks: 40	
Unit	Topic	No. of Lectures (45)	
I	Chemistry of environmental pollutants: Definition of pollution; pollutants; classification of pollutants; solubility of pollutants (hydrophilic and lipophilic pollutants), transfer of pollutants within different mediums, role of chelating agents in transferring pollutants, concept of biotransformation and bioaccumulation, concept of radioactivity, radioactive decay and half-life of pollutants, organometallic compounds, acid mine drainage.	11	
II	Air pollution: Ambient air quality: monitoring and standards (National Ambient Air Quality Standards of India); air quality index; sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on human health and control measures; indoor/outdoor air pollution: sources and effects on human health, emission inventory and its application, urban air quality.	11	
III	Freshwater, marine and soil pollution: Sources of surface and ground water pollution; water quality parameters and standards; eutrophication; COD, BOD, DO; effect of water contaminants on human health; water	11	

	bornediseases; Marine resources and their importance; sources of marine pollution; oil spill and itseffects; coral reefs and their demise; coastal area management; Causes of soil pollution anddegradation; effect of soil pollution on environment, vegetation and other life forms; controlstrategies.	
IV	Noisepollution, Radioactive/Thermalpollutionandpollutioncontrol: Noise pollution – sources; frequency, intensity and permissible ambient noise levels;effect on communication, impacts on life forms and humans; control measures. Radioactivematerial and sources of radioactive pollution; effect of radiation on human health (somatic andgenetic effects); thermal pollution and its effects. Activated Sludge Process (ASP) – TricklingFilters – oxidation ponds, fluidized bed reactors, membrane bioreactor neutralization, up flowanaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors,bioscrubbers,biotricklingfilters.	12
TextBooks: <ul style="list-style-type: none"> - Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006. <i>Environmental and Pollution Science</i>. Elsevier Academic Press. - Purohit, S.S. & Ranjan, R. 2007. <i>Ecology, Environment & Pollution</i>. Agrobios Publications. ReferenceBooks: <ul style="list-style-type: none"> - Gurjar, B.R., Molina, L.T. & Ojha C.S.P. 2010. <i>Air Pollution: Health and Environmental Impacts</i>. CRC Press, Taylor & Francis. - Hester, R.E. & Harrison, R.M. 1998. <i>Air Pollution and Health</i>. The Royal Society of Chemistry, UK. - Park, K. 2015. <i>Park's Textbook of Preventive and Social Medicine</i> (23rd edition). Banarsidas Bhanot Publishers. 		

IV YEAR

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Environmental Science													
Batch:2025 -26			SEM:VII										
S. No.	Course Type	Course Code	Course	Teaching Load			Credits	Attendance (5)	Internal Assessment		External Assessment	Total	Remark
				L	T	P			quiz/ PPT/ Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS													
1	Major 13	BSES-701	Instrumental Techniques for Environmental Analysis	4	0	0	4	5	10	15	70	100	
2	Practical VII (Based on Major (13+14)	BSES-701P	Instrumental Techniques for Environmental and Environmental Law Lab	0	0	4	2	5	10	15	70	100	
3	Major 14	BSES-702	Environmental Laws	4	0	0	4	5	10	15	70	100	
4	Practical VIII (Based on Major 15)	BSES-703P	Computational biology and bioinformatics in research Lab	0	0	4	2	5	10	15	70	100	
5	Major 15	BSES-703	Environmental Priorities and Research Tools	4	0	0	4	5	10	15	70	100	
6	Minor 9		To be chosen	3	0	0	4	5	10	15	70	100	
TOTAL CREDITS / ASSESSMENT							20	30	60	90	420	600	

SWAMI VIVEKANAD SUBHARTI UNIVERSITY MEERUT													
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE													
Department of Life Science													
Course Name - B.Sc. Environmental Science													
Batch:2025-26				SEM:VIII									
S. No.	Course Type	Course Code	Course	Teaching Load			CREDITS	Internal Assessment			External Assessment	Total	Remark
				L	T	P		Attendance (5)	Quiz/PPT/Assignment (10)	Mid Sem Test (15)			
THEORY and PRACTICAL SUBJECTS				L	T	P							
1	Major 16	BSES-801	Research Methodology in Environmental Science	4	0	0	4	5	10	15	70	100	
2	Minor 10		To be chosen	3	0	0	4	5	10	15	70	100	
4	Research Project / Dissertation	BSES-803R	Research Project / Dissertation	2	0	0	12				300	300	
TOTAL CREDITS / ASSESSMENT							20	60			440	500	

K. V. Subharti College of Science
S V Subharti University
NH-58 Bypass Road, Meerut

DETAILED SYLLABUS VII SEMESTER

Programme/Class: Degree		Year: Fourth		Semester: Seventh	
Course Code: BSES-701			Course Title: Instrumental Techniques For Environmental Analysis		
Course outcomes: After completing the course the student will be able to:					
<ul style="list-style-type: none"> • Understand the problem and identify suitable techniques to analyze the environmental samples. • Explain and use suitable sampling methods for collection of different samples to perform physical, chemical and biological characterization of environmental pollutants. • Appraise the principles, working and applications of the instrumental techniques used for analysis of physical, chemical and biological entities. • Differentiate between the various analytical methods and capable to design method required for quantitative and qualitative analysis of environmental components. 					
Credits: 4			Compulsory		
Max. Marks: 100			Min. Passing Marks: 40		
Unit	Topic				No. of Lectures
I	BASICS OF ANALYTICAL APPROACH <i>Analytical Approach:</i> Defining of Problem and Designing of Analytical Method; Sampling: Types and Methods for Solid, Liquid and Gaseous Matrix; Sample Storage; Sample Preparation; Measurement and Assessing of Data; Method Validation and Documentation; <i>Wet Chemical Methods:</i> Titrimetry; Gravimetry				14
II	ANALYTICAL TECHNIQUES UV- Visible spectrophotometer, Flame photometry, atomic absorption spectrophotometry; Plasma Emission				10
III	Spectroscopy; X-Ray Spectroscopy (X-Ray Fluorescence, X-Ray Diffraction); Fourier- transform Infrared Spectroscopy (FTIR); Nephelometry and Turbidimetry				10
IV	CHROMATOGRAPHIC TECHNIQUES Chromatographic Techniques (Paper Chromatography, Thin Layer Chromatography, Gas Liquid Chromatography, High Performance Liquid Chromatography, Ion-exchange Chromatography); Electrophoresis				14
V	MICROSCOPY TECHNIQUES Optical Microscopy (Brightfield and Darkfield, Phase Contrast, Fluorescence, Confocal); Electron Microscopy (Scanning and Transmission Electron Microscopy)				12
Suggested Books:					
<ol style="list-style-type: none"> 1. Hussain, C. M., & Kecili, R. (2019). Modern Environmental Analysis Techniques for Pollutants. Elsevier. 2. Khopkar, S.M. (2015). Basic Concepts of Analytical Chemistry. Wiley Eastern Ltd., New Delhi. 3. Mitra, S., & Keccakus, B. B. (2018). Environmental Chemical Analysis. CRC Press. 4. Robinson, J. W., Frame, E. M. S., & Frame, G. M. (2014). Undergraduate 					

Instrumental Analysis. CRC Press, New York

5. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). Principles of Instrumental Analysis. Cengage learning.
6. Willard, H.H., Merritt, L.L, Deen, J.A. and Settle, F.A. (2015). Instrumental Methods of Analysis. CBS Publishers and Distributers, New Dehi.
7. Patnaik, P. (2017). Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes. CRC Press.

Programme/Class: Hon's Degree		Year:Fourth	Semester:Seventh
CourseCode:		CourseTitle:Environmental Laws	
Courseoutcomes: Aftercompletingthecoursethe studentwillbeable to: <ol style="list-style-type: none"> 1. Become aware about the rights of nature and natural resources. 2. To understand the various environmental laws, thereby become aware about environmental protection. 			
Credits: 4		Compulsory	
Max.Marks:100		Min.Passing Marks: 40	
Unit	Topic	No. ofLectures	
I	Scheme of labelling of environmentally friendly products (ecomark). Public liability Insurance Act. 1991. Provision of constitution of India regarding environment (article 48 A & 58A).	12	
II	Environmental policy resolution, legislation, public policy strategies in pollution control. Wild life protection act, 1972 amended 2002. Forest conservation act, 1980. Indian forest act 1927.	12	
III	Air (prevention & control of pollution) Act 1981 as amended by amendment 1987 & rule 1982. Motor vehicle act, 1988, The environment (protection) Act, 1986, rules 1986.	12	
IV	The water (prevention & control of pollution) Act, 1974 as amended by amendment 1978 & rules 1975.	12	
V	Environment protection issues & problems, international & national efforts for environment protection.	12	
SuggestedBooks: <ol style="list-style-type: none"> 1. Environmental administration & law - Paras Diwaa. 2. Environmental planning, policies & programs in India - K.D. Saxena. 			

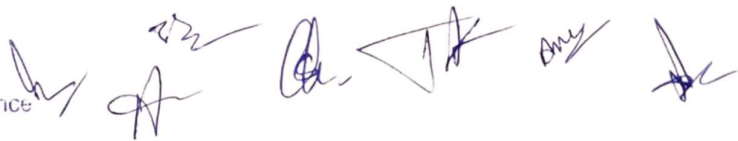
Programme/Class:Degree		Year:Fourth	Semester:Seventh
CourseCode:BSSES-703		CourseTitle:EnvironmentalPrioritiesandResearchTools	
Courseoutcomes: Aftercompletingthecoursethestudentwillbeable to: <ul style="list-style-type: none"> • Learnaboutgeneralnationalenvironmentalmovements. • Abletounderstandthe environmentalprioritiesinIndia. • Developunderstandingaboutdifferentenvironmentaldisastersandtheirmanagement. • Gainknowledgeonbasicofstatistics andinstrumentation. 			
Credits: 4		Compulsory	
Max.Marks:100		Min.Passing Marks: 40	
Uni t	Topic		No. ofLectures
I	National Environmental movement: Silent valley movement, Chipko movement, Narmada movement, Green Revolution, Appiko movement, Tehri Dam movement; Namami Gange and Yamuna Action Plan; International Solar Alliance.		12
II	Environmental Priorities in India: Sustainable Development; Urban and Rural planning, Power generation; Human Population Explosion; Environment and human health; Sanitation and health education; Role of information technology in environment and human health.		10
III	Environmental Disaster & Toxicology: Natural hazards; earthquake, flood, cyclones, landslides, desertification and fire; Resettlement and rehabilitation process; NDRF/SDRF; NDMA; Introduction and nature of toxicity (acute and chronic), Dose and time response relationship, Teratogenicity, Carcinogenicity and mutagenicity.		14
IV	Biostatistics: Introduction and historical perspective; definition; characteristics and application of biostatistics; statistical terms and symbols; mean, mode and median; variance and standard deviation.		14
V	Instrumentation: Introduction to Techniques, Basic principles, and applications- Centrifuge; colorimetric, volumetric, titration, Conductometry; Nephelometry; Gravimetry; Microscopy; Ultraviolet-visible (UV- VIS) Spectroscopy.		12
Suggested Books: <ol style="list-style-type: none"> 1. Ecology and Environment: P.D. Sharma., Rastogi Publication. 2. Disaster Management, Singh, S. and Singh, J., Pravalika Publications, Allahabad. 3. Elements of Biostatistics, Prasad, S., Rastogi Publications, Meerut. 4. Vogel's Text Book of Quantitative Inorganic Analysis, Barnes, J.D. J., Denney, R.C., Jeffery, G.H. and Mendham, J., 6th Edition, Pearson Education Ltd., U.K. 5. Instrumental Methods of Chemical Analysis, Sharma, B.K. (2005), Goel Publishing 			

House, Meerut, India.
 6. Instrumental methods of analysis, Malathi, S., Patil, P.M., Kumar, S. (2020). Thakur publications (pvt.) Ltd, Lucknow, India.

Programme/Class: Degree		Year: Fourth	Semester: Seventh
Course Code: BSES-704		Course Title: Energy and Environment, Minor	
Course outcomes: After completing the course the student will be able to: 1. Understand the existing energy resources, issues related to energy and the environment, challenges and possible paths to sustainable energy generation and use.			
Credits: 4		Compulsory	
Maximum Marks: 100		Minimum Passing Marks: 40	
Unit	Topic	No. of Lectures (45)	
I	Introduction: Defining energy; forms and importance; energy use from a historical perspective: discovery of fire, discovery of locomotive engine and fossil fuels, electrification of cities, oil wars in the Middle East, advent of nuclear energy; sources and sinks of energy; energy over-consumption in urban setting	10	
II	Energy resources: Global energy resources; renewable and non-renewable resources: distribution and availability; past, present, and future technologies for capturing and integrating these resources into our energy infrastructure; energy-use scenarios in rural and urban setups; energy conservation.	10	
III	Energy demand: Global energy demand: historical and current perspective; energy demand and use in domestic, industrial, agriculture and transportation sector; generation and utilization in rural and urban environments; changes in demand in major world economies; energy subsidies and environmental costs.	12	
IV	Energy, environment and society: Nature, scope and analysis of local and global impacts of energy use on the environment; fossil fuel burning and related issues of air pollution, greenhouse effect, global warming and, urban heat island effect; nuclear energy and related issues such as radioactive waste, spent fuel; social inequalities related to energy production, distribution, and use.	13	
Suggested Books: 1. McKibben, B. 2012. Global Warming's Terrifying New Math, Rolling Stone Magazine. 2. Craig, J.R., Vaughan, D.J., Skinner, B.J. 1996. Resources of the Earth: Origin, use, and environmental impact (2nd edition). Prentice Hall, New Jersey. 3. Elliott, D. 1997. Sustainable Technology. Energy, Society and Environment (Chapter 3). New York, Routledge Press. 4. Rowlands, I.H. 2009. Renewable Electricity: The Prospects for Innovation and			

Integration in Provincial Policies in Debora L. Van Nijnatten and Robert Boardman (eds), Canadian Environmental Policy and Politics: Prospects for Leadership and Innovation, Third Edition. Oxford University Press, pp. 167-82.

5. Oliver, J. 2013. Dispelling the Myths about Canada's Energy Future, Policy: Canadian Politics and Public Policy, June-July.

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DETAILED SYLLABUS VIII SEMESTER

Programme/Class: Degree	Year: Fourth	Semester: Eight
Course Code: BSES-801	Course Title: Research Methodology in Environmental Science	
Course Outcomes		
<ol style="list-style-type: none"> 1. Understand the fundamental principles of scientific research and its relevance in environmental science. 2. Formulate appropriate research problems, hypotheses, and research designs for environmental investigations. 3. Utilize environmental field and laboratory tools, including GIS and remote sensing, for scientific data collection. 4. Analyze and interpret environmental data using statistical methods and scientific software. 5. Prepare and communicate scientific reports, research papers, and project proposals in the domain of environmental science. 		
Credits: 4	Compulsory	
Max. Marks: 100	Min. Passing Marks: 40	
Unit	Topic	No. of Lectures
I	Introduction to Research and Environmental Science Definition and objectives of research, Types of research: Basic, Applied, Descriptive, Analytical, Experimental Scientific method in environmental research Interdisciplinary nature of environmental science research Formulation of research problems Review of literature and identification of knowledge gaps.	12
II	Research Design and Data Collection Research design: Exploratory, Descriptive, Experimental, and Case Study Hypothesis: Characteristics, types, and formulation Sampling methods: Random, stratified, cluster, systematic Methods of data collection: Primary data: Surveys, interviews, field studies, questionnaires Secondary data: Literature, satellite data, government/environmental reports Ethical issues in environmental research.	10
III	Tools and Techniques in Environmental Research Measurement scales: Nominal, Ordinal, Interval, Ratio Environmental monitoring techniques: Air, water, soil, and noise pollution sampling and analysis Use of sensors and probes, Laboratory methods: Chromatography, Spectrophotometry, Microscopy, Remote sensing and GIS applications Field instrumentation and data logging.	12
IV	Data Analysis and Interpretation Descriptive statistics: Mean, median, mode, standard deviation Inferential statistics: t-test, chi-square test, ANOVA, regression analysis Use of software: Excel, SPSS, R, MATLAB (basic introduction)	14

	Data visualization: Graphs, charts, maps, histograms Interpretation and significance of environmental data Error analysis and uncertainty in measurements	
V	Scientific Communication and Reporting Structure of scientific papers and reports, Referencing styles: APA, MLA, Chicago, etc. Plagiarism and how to avoid it, Proposal writing for research grants <ul style="list-style-type: none"> Presenting research: Posters, oral presentations, conference participation Publication process: Peer review, impact factor, open-access journals.	12
Suggested Books: <ol style="list-style-type: none"> Kothari, C.R., & Garg, G. (2019). <i>Research Methodology: Methods and Techniques</i> (4th ed.). New Age International Publishers. Aery, N.C. (2009). <i>Methods in Environmental Science</i>. Ane Books Pvt. Ltd. Ghosh, M.K. (2012). <i>Research Methodology for Environmental Sciences</i>. Dominant Publishers and Distributors. 		

Programme/Class: Hon's Degree		Year: Fourth	Semester: Eight
Subject: Environmental Sciences			
Course Code: BSES-802		Course Title: Application of Biostatistics and Computer in Environmental Science, Minor	
Course outcomes: After completing the course the student will be able to: <ul style="list-style-type: none"> Understand the need of statistics Understand the arrangement of data for the application of statistics Apply the various statistical tools. In the Interpretation of obtained value of statistical measures. 			
Credits: 3		Compulsory	
Maximum Marks: 100		Minimum Passing Marks: 40	
Unit	Topic	No. of Lectures (45)	
I	Data Collection and Analysis <ul style="list-style-type: none"> Sampling types, Data: sources, structures, types and collection. Measurements of central tendency Statistical Methods: Standard deviation and variance. Basic concepts: Measures of central tendency and deviations 	15	
II	Application of Biostatistics in Analyses of Data <ul style="list-style-type: none"> Types of Probability, Normal and Binomial Distribution. Hypothesis testing, significance and correlations: Linear models and regressions. 	15	

	<ul style="list-style-type: none"> ▪ Multiple regressions. Difference among means: F-test: 1 way ANOVA; F-test: 2 way ANOVA., T-test ▪ FUZZI technology, Analytical Hierarchy Process 	
III	<p>Computer application & Web designing</p> <ul style="list-style-type: none"> ▪ Computer-based modeling: Linear, regression, validation and forecasting. ▪ Computer-based modeling for population and population studies. ▪ Computer application for environmental : Linear, regression, validation and forecasting ▪ Introduction to database , networking, LAN,WAN , Website design 	15
<p>SuggestedBooks:</p> <ol style="list-style-type: none"> 1. Robert S. and Rohlf J.(1997). Biometry, Freeman Press, New York, U.S. 2. Walpole, R. and Myers R. (1993). Statistics for Engineers and Scientists, 5thedn. MacMillan, New York, U.S. 3. Ott W.R. (1995). Environmental Statistics and Data Analysis, CRC Press. 4. Manly (2001) Statistics for environmental science and management, Chapman and Hall / CRC Press 5. Ramsay F. and Schafer D. (1997). The Statistical Sleuth, Duxbury Press 6. Smith J. and Smith P.(2007) Environmental modeling and introduction.OxfordUniversity Press,UK, . 7. Jerrold H. Z.(1998). Biostatistical Analysis. Prentice Hall, New jersey, U.S. 		