

CO-PO mapped syllabi of B.Sc. (H.)Environmental Science and common courses (For new students, w.e.f. 2020-21)

Program Education objectives (PEOs): B.Sc. (H.)Environmental Science

- Investigate the complexities of the natural environment and our relationship with it.
- Explore the problems we face in understanding our natural environment and in living sustainability.
- Develop scientific, interpretive and creative thinking skills.
- Learn to apply quantitative analysis and field research techniques.
- Use computer-based geographical information systems to study environmental change.

Program specific outcomes (PSOs): B.Sc. (H.)Environmental Science

1. B.Sc. (H.)Environmental Science student are able to acquire knowledge, competent professionals with a strong foundation of Environmental Science and application to be suitable for vital positions in the academia, industry and government and non-government institutions as skilled manpower.
2. The learners will be able to become effective scientific communicators/collaborators in multidisciplinary teams providing technical leadership to engage with the challenging environmental problems of local, national and global nature.
3. They can opt for higher studies in plant and animal sciences as the environmental science is multidisciplinary in nature.

POs for UG programs:

B.Sc. (H.) Environmental Science

Program Outcomes (POs)	<ol style="list-style-type: none"> 1. Critical Thinking- Students will demonstrate an understand major concepts of Environment in association with multidisciplinary subjects such as physics, chemistry and mathematics etc. Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in the day-to-day life. 2. Effective Communication- Development of various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively. 3. Social Interaction- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life. 4. Effective Citizenship- Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality. 5. Ethics- Follow the ethical principles and responsibilities to serve the society. 6. Environment and Sustainability- Understand the issues of environmental contexts and sustainable development. 7. Self-directed and Lifelong learning- Students will be capable of self-
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	paced and self-directed learning aimed at personal development and for improving knowledge/skill development.
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Course: Environmental Studies

COURSE CODE: ES101

COURSE OBJECTIVES:

- To study about environment and ecosystems
- To study about different types of natural resource.
- Knowledge and concept of biodiversity and its conservation.
- Basic knowledge and concept of causes, effect and control of different type of environmental pollution.
- To study population growth and its impact on environment

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	Gain knowledge about environment and ecosystem.
CO2	Students will learn about natural resource, its importance and environmental impacts of human activities on natural resource.
CO3	Gain knowledge about the conservation of biodiversity and its importance.
CO4	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.
CO5	Students will learn about increase in population growth and its impact on environment

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Gain knowledge about environment and ecosystem.	3	2	2	2	2	3	2
CO2	Students will learn about natural resource, its importance and environmental impacts of human activities on natural resource.	2	2	2	3	1	3	3
CO3	Gain knowledge about the conservation of biodiversity and its importance.	2	2	2	2	1	3	3
CO4	Aware students about problems of environmental pollution, its impact on human and ecosystem and control measures.	3	2	2	2	2	3	3
CO5	Students will learn about increase in	2	2	2	2	2	3	3

population growth and its impact on environment								
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COURSE: DISASTER ANAGEMENT COURSE

CODE: ES202

COURSE OBJECTIVES:

- To Study the types of Disasters and its profile in India.
- Knowledge of causes and impacts of Disasters, and Case studies of National and Global Disasters.
- To learn about risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters.
- Basic concepts of Disaster Management Cycle and its Risk Reduction Measures.
- To know the National Acts and policies for mitigating disasters. Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.

COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOM (CO)	DESCRIPTION
CO1	Students are able to learn types of disasters and its profile in India
CO2	Students are able to understand the causes and impacts of disasters on environment and related case studies of Global and National disasters
CO3	Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction Measures
CO5	Students to learn the National Acts and policies for mitigating disasters, Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.

CO-PO mapping for a course of “ UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students are able to learn types of disasters and its profile in India	3	3	2	3	2	3	2
CO2	Students are able to understand the causes and impacts of disasters on environment and related case studies of Global and National disasters.	3	2	2	3	1	3	2

CO3	Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.	3	2	2	3	1	3	2
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction Measures.	3	3	2	3	1	3	2
CO5	Students to learn the National Acts and policies for mitigating disasters, Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management.	3	2	2	3	2	3	2

Course: Fundamentals of Environmental Science

COURSE CODE: ES115

COURSE OBJECTIVES:

1. To study an environment and ecosystem.
2. To study natural resources.
3. To study biodiversity and conservation.
4. To study environmental pollution, policies and practices.
5. To study human population and environmental ethics.

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	To study an environment and ecosystem.
CO2	To study natural resources.
CO3	To study biodiversity and conservation.
CO4	To study environmental pollution, policies and practices.
CO5	To study human population and environmental ethics.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To study an environment and ecosystem.	3	3	2	3	2	3	2
CO2	To study natural resources.	3	2	2	3	1	3	2
CO3	To study biodiversity and conservation	3	2	2	3	1	3	2
CO4	To study environmental pollution, policies and practices.	3	3	2	3	1	3	2
CO5	To study human population and environmental ethics.	3	2	2	3	2	3	2

1. Name of the Department: Environmental Science						
2. Course Name	EARTH SURFACE & PROCESSES	L	T	P		
3. Course Code	ES 116	3	1	0		
4. Type of Course (use tick mark)	Core (<input type="checkbox"/>)	DSE (<input type="checkbox"/>)	AEC (<input type="checkbox"/>)	SEC (<input type="checkbox"/>)	OE (<input type="checkbox"/>)	
5. Pre-requisite (if any)	10+2 with Physics, Chemistry &	6. Frequency (use	Even (<input type="checkbox"/>)	Odd (<input type="checkbox"/>)	Either Sem (<input type="checkbox"/>)	Every Sem (<input type="checkbox"/>)
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		Tutorials = 10		Practical = Nil		
8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of Earth Surface and its processes. This will help in enhancing knowledge of Solar System, Earth, Atmosphere, Hydrosphere, Geological timescale and evolution of Earth, Weathering and Erosion, different types of Rocks and Plate Tectonics. After successfully completion of course, the student will able explore subject into their respective dimensions.						
9. COURSE OUTCOMES (CO):						
<i>r the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME	ATTRIBUTES					
CO1	Students will be able to Analyze formation of Solar System, Earth, Atmosphere & Hydrosphere through study of Solar System and history of Earth.					
CO2	Students will be able to Analyze role of Plate Tectonics in Various Earth Surface Processes.					
CO3	Create in student's ability to understand about changes in Earth's history with time.					
CO4	Students will be able to Evaluate the role of different types of Rocks in Rock Cycle and significance of Weathering and Erosion over Earth Surface.					
CO5	Students will Evaluate the role of Atmosphere - Ocean, Atmosphere- Land & Ocean-Land Interface in Earth Surface processes.					
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: 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 of Humans.						
Unit-2	Number of lectures =08	Title of the unit: 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; gravitational and magnetic fields of the earth; origin						
Unit-3	Number of lectures = 08	Title of the unit: Minerals and rocks				
Minerals and important rock forming minerals; rock cycle: lithification and metamorphism; 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.						
Unit-4	Number of lectures = 08	Title of the unit: 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						
Unit-5	Number of lectures =	Title of the unit: Importance of being a mountain				
Formation of Peninsular Indian mountain systems - Western and Eastern Ghats, Vindhyas, Aravallis, etc. Formation of the Himalaya; development of glaciers, perennial river systems and evolution of monsoon in Indian subcontinent;						
11. CO-PO mapping						

Cos	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to Analyze formation of Solar System, Earth, Atmosphere & Hydrosphere through study of Solar System and history of Earth.	3	1	2	1	1	1	2
CO2	Students will be able to Analyze role of Plate Tectonics in Various Earth Surface Processes.	3	1	2	1	1	1	2
CO3	Create in student's ability to understand about changes in Earth's history with time.	3	1	2	2	1	2	3
CO4	Students will be able to Evaluate the role of different types of Rocks in Rock Cycle and significance of Weathering and Erosion over Earth Surface.	3	1	2	1	2	1	2
CO5	Students will Evaluate the role of Atmosphere - Ocean, Atmosphere- Land & Ocean-Land Interface in Earth	3	1	2	1	2	1	2

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self learning / E-learning component

- <https://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-163-surface-processes-and-landscape-evolution-fall-2004/lecture-notes/>
- <https://nptel.ac.in/courses/105104190/>
- <https://www.coursera.org/learn/our-earth#syllabus>

13. Books recommended:

- Bridge, J., & Demicco, R. 2008. Earth Surface Processes, Landforms and Sediment deposits. Cambridge University Press
- Duff, P. M. D., & Duff, D. (Eds.). 1993. Holmes' Principles of Physical Geology. Taylor & Francis.
- 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).
- 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.
- Keller, E.A. 2011. Introduction to Environmental Geology (5th edition). Pearson Prentice Hall.
- Krishnan, M. S. 1982. Geology of India and Burma. CBS Publishers & Distributors.
- Leeder, M., Arlucea, M.P. 2005. Physical Processes in Earth and Environmental Sciences. Blackwell Publishing.
- Pelletier, J.D. 2008. Quantitative Modeling of Earth Surface Processes (Vol.304). Cambridge: Cambridge University Press. Chicago.

Course: Basics of Environmental Biology

Course Code: ES117

Course Objectives:

- To Develop basic knowledge of taxonomy, systematics, morphological and taxonomical studies of flora and fauna.
- To Provide Knowledge of developmental phases of ecology and ecological classification.
- To develop knowledge of population ecology.
- To provide basic knowledge of biotic community and microbiology.

Course Outcomes (CO):

At the end of the course students should:

Course Outcome(CO)	Description
CO1	Have an enhanced knowledge of an ecology.
CO2	Be able to make connections and interrelations between various disciplines in the environment.
CO3	Be able to explain the structure and impact of biogeochemical cycles.
CO4	Be able to Illustrate abiotic/biotic interactions and symbiotic relationships.
CO5	Be able to describe ecological and statistical techniques and approaches used in the study of environmental biology.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Have an enhanced knowledge of an ecology.	3	3	2	3	3	3	3
CO2	Be able to make connections and interrelations between various disciplines in the environment.	3	3	2	3	3	3	3
CO3	Be able to explain the structure and impact of biogeochemical cycles.	3	3	2	2	2	3	2
CO4	Be able to Illustrate abiotic/biotic interactions and symbiotic relationships.	3	2	2	3	2	3	2
CO5	Be able to describe ecological and statistical techniques and approaches used in the study of environmental biology.	2	1	1	1	2	1	1

Course: Introduction to Environmental Chemistry

Course Code: ES118

Faculty Name: Dr. Rahila Rahman Khan

Course Objectives:

- Recognize Important chemical reactions in the atmosphere and in water.
- Assess the important chemical reactions in connection with smog formation, ozone chemistry and acid rain chemistry.
- Recognize the importance of pesticides.
- Recognize the importance of chemical reactions in soil.

Course Outcomes (CO):

Course Outcome(CO)	Description
CO1	To impart students a broad outline of the methodology of

	science in general and Chemistry in particular
CO2	The students will learn the important analytical and instrumental tools used for practicing chemistry.
CO3	Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.
CO4	Students will learn how environmental chemicals effect organisms
CO5	Analyze the causes of pollution in our environment

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To impart students a broad outline of the methodology of science in general and Chemistry in particular.	3	3	3	2	2	3	3
CO2	The students will learn the important analytical and instrumental tools used for practicing environmental chemistry.	3	1	3	1	1	3	3
CO3	Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.	3	3	3	3	3	2	2
CO4	Students will learn how environmental chemicals effect organisms	3	2	3	2	2	3	3
CO5	Analyze the causes of pollution in our environment	3	2	3	2	3	3	3

Soil and Water Chemistry Lab, Subject Code: ES-119

Course Objectives:

- To understand about various Water Quality Parameters
- To understand about measurement of Soil Parameters.
- To understand about Identification of Minerals
- To understand about Identification of Rocks
- To learn about Documentation and Preparation of Herbarium

Course Outcomes (CO):

Course Outcome(Co)	Description
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CO1	Develop in depth knowledge about estimation of various Water Quality Parameters
CO2	Develop practical knowledge on Measurement of soil parameters.
CO3	Gain knowledge about Identification of Minerals
CO4	Gain knowledge about Identification of Rocks
CO5	Develop knowledge on Preparation of Herbarium and its Documentation.

CO-PO mapping								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Develop in depth knowledge about estimation of various Water Quality Parameters	3	2	2	1	1	3	3
CO2	Develop practical knowledge on Measurement of soil parameters.	3	2	2	1	1	3	3
CO3	Gain knowledge about Identification of Minerals	3	2	2	1	1	3	3
CO4	Gain knowledge about Identification of Rocks	3	2	2	1	1	3	3
CO5	Develop knowledge on Preparation of Herbarium and its Documentation.	3	2	3	1	1	3	3

Course: Elements of Ecology
Course Code: ES120

Course Objectives:

- To develop behavioral and physiological mechanisms by which organisms interact with other organisms interact with other organisms and with their physical environment.
- To provide knowledge of the different types of Ecology
- To understand the inter-relationship between organism in population and communities
- To provide basic knowledge of the problems of niche segregation, and speciation.

Course Outcomes (CO):

At the end of the course students should:

Course Outcome(CO)	Description
CO1	Student will recognize evolutionary processes and adaptations of plant and animal species
CO2	Become familiar with the cyclical flow of energy, water and nutrient through ecosystems
CO3	Student will be able to differentiate between exponential and logistic models of population growth
CO4	Student will be able to determine population density using various sampling methods
CO5	Student will be able to construct a life table to determine survivorship and mortality of a population

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will recognize evolutionary processes and adaptations of plant and animal species	3	2	3	2	2	3	2
CO2	Become familiar with the cyclical flow of energy, water and nutrient through ecosystems	3	1	2	2	2	3	1
CO3	Student will be able to differentiate between exponential and logistic models of population growth	3	2	2	2	1	3	1
CO4	Student will be able to determine population density using various sampling methods	3	1	2	1	2	3	2
CO5	Student will be able to construct a life table to determine survivorship and mortality of a population	3	1	3	1	2	3	1

Course: Ecosystem Dynamics
Course Code: ES121
Course Objectives:

- To develop Basic knowledge of Ecosystem.
- To provide knowledge of bio-geochemical and sedimentary cycles and its importance
- To develop knowledge of major Biomes of the world.
- To provide Knowledge of Ecosystem Energetic.
- To recognize knowledge of effects of disturbances, adaptation and development in ecosystem.

Course Outcomes (CO):

After completion of the course, a student will be able to

Course Outcome(CO)	Description
CO1	Have an enhanced knowledge of an ecosystem.
CO2	Be able to make connections and interrelations of bio-geochemical and sedimentary cycles and its importance.
CO3	Be able to explain the major Biomes of the world.
CO4	Be able to Illustrate the Ecosystem Energetic.
CO5	Be able to describe effects of disturbances, adaptation and development in ecosystem.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Have an enhanced knowledge of an ecosystem.	2	3	3	3	3	3	2
CO2	Be able to make connections and interrelations of bio-geochemical and sedimentary cycles and its importance.	1	3	2	2	2	2	2
CO3	Be able to explain the major Biomes of the world.	2	2	2	2	3	2	2
CO4	Be able to Illustrate the Ecosystem Energetic.	3	2	2	1	1	2	2
CO5	Be able to describe effects of disturbances, adaptation and development in ecosystem.	1	3	3	3	3	3	1

1. Name of the Department: Environmental Science

2. Course Name	Atmosphere and Global Climate Change	L	T	P	
3. Course Code	ES 122	3	1	0	
4. Type of Course (use tick mark)	Core (☐)	DSE ()	AEC ()	SEC ()	OE ()
5. Pre-requisite (if any)	10+2 with Physics, Chemistry &	6. Frequency (use	Even (☐) Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals					
Lectures = 30		Tutorials = 10		Practical = Nil	

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of Atmosphere and Global Climate Change. This will help in enhancing knowledge of Influence of Meteorological Parameters and Atmospheric Circulation on Climate, contribution of Green Houses Gases in Global warming, remedial measures against Global warming and Climate Change and policies, Global and National Action Plan related to Climate Change mitigation. After successfully completion of course, the student will able explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

At the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will be able to Analyse Impact of Atmospheric Circulation on World Climate and Influence of Meteorological Parameters & Atmospheric Stability in shaping of Climate.
CO2	Students will be able to Evaluate the role of Remedial Measures in Combating Global Warming and Climate Change.
CO3	Students will be able to Evaluate Various Policies related to Climate Change mitigation Strategies and Create a knowledge base for Global and National Action Plan.
CO4	Students will be able to Evaluate contribution of Green Houses Gases in Global warming and thereby bringing Change in Climate.
CO5	Students will Analyse the role of Ozone Depleting Substances in Ozone layer Depletion and efforts for mitigation of Ozone hole Problem.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: Atmospheric circulation
Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; tropical cyclone; Indian monsoon and its development, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture and Indus valley civilization; effect of urbanization on climate.		
Unit-2	Number of lectures =08	Title of the unit: Meteorology and atmospheric stability
Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.		
Unit-3	Number of lectures = 08	Title of the unit: Global warming and climate change
Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different green house gases (GHGs) causing the climate change; atmospheric windows; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.		
Unit-4	Number of lectures = 08	Title of the unit: Ozone layer depletion
Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures.		
Unit-5	Number of lectures = 08	Title of the unit: Climate change and policy
Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.		

11. CO-PO mapping

Cos	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to Analyse Impact of Atmospheric Circulation on World Climate and Influence of Meteorological Parameters & Atmospheric Stability in shaping of Climate.	3	1	3	1	2	2	3

CO2	Students will be able to Evaluate the role of Remedial Measures in Combating Global Warming and Climate Change.	3	1	3	2	2	3	3
CO3	Students will be able to Evaluate Various Policies related to Climate Change mitigation Strategies and Create a knowledge base for Global and National Action Plans to combat Climate	3	1	2	2	2	3	2
CO4	Students will be able to Evaluate contribution of Green Houses Gases in Global warming and thereby bringing Change in Climate.	3	1	2	1	2	1	2
CO5	Students will Analyse the role of Ozone Depleting Substances in Ozone layer Depletion and efforts for mitigation of Ozone	3	1	2	2	2	2	2

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self learning / E-learning component

1. <https://www.edx.org/learn/climate-change>
2. <https://www.coursera.org/learn/global-warming#syllabus>
3. <https://www.plt.org/educator-tips/videos-climate-change-middle-school>

13. Books recommended:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
3. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
4. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
5. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
6. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. & Sen, K. 2004. Climate Change and India. Universities Press, India
7. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.

Ecosystem Lab

Course Code: ES123

Course Objectives: □

- To provide basic knowledge about ecological tools that allows one to quantify the relative abundance of plant species in an area and to track their change overtime.
- To develop a basic knowledge towards economically important insects.
- To provide basic understanding regarding spatial distribution of different climates on the basis of rainfall ad temperature.
- To enhance knowledge of students towards Wildlife Sanctuaries and National Parks.
- To provide basic knowledge about ETP and STP

Course Outcomes (CO):

At the end of the course students should:

Course Outcome(CO)	Description
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CO1	To provide basic knowledge about ecological tools that allows one to quantify the relative abundance of plant species in an area and to track their change overtime.
CO2	To develop a basic knowledge towards economically important insects.
CO3	To provide basic understanding regarding spatial distribution of different climates on the basis of rainfall ad temperature.
CO4	To enhance knowledge of students towards Wildlife Sanctuaries and National Parks.
CO5	To provide basic knowledge about ETP and STP

CO-PO mapping for a course of “ UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To provide basic knowledge about ecological tools that allows one to quantify the relative abundance of plant species in an area and to track their change overtime.	2	3	1	1	3	2	3
CO2	To develop a basic knowledge towards economically important insects.	2	2	2	1	2	3	3
CO3	To provide basic understanding regarding spatial distribution of different climates on the basis of rainfall and temperature.	3	2	1	1	2	2	3
CO4	To enhance knowledge of students towards Wildlife Sanctuaries and National Parks.	3	3	2	2	3	3	3
CO5	To provide basic knowledge about ETP and STP	2	2	1	1	2	3	3

Course: Biodiversity and Conservation

Course Code: ES203

Course Objectives:

1. Assessment of biodiversity.

2. To predict pattern of biodiversity distribution.
3. To preserve all varieties of old and new flora, fauna and microbes.
4. To identify various threats related to biodiversity.
5. Exploration of biodiversity and importance of biodiversity.
6. The sustainable use of biological resources, fair and equitable sharing of the benefits arising from biodiversity.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	In-depth knowledge and critical understanding of the theory and principles of biodiversity and the interrelationships of its levels with the basic effects from infrastructure development in nature conservation areas.
CO2	Knowledge and skills to realize and combine the complexity of the relations and interactions between the ecosystem structures and functions and the human impacts from the one side with the sustainable management aiming at the conservation of species and habitats.
CO3	Describe the threats to biological diversity, that is, direct harvesting, habitat destruction, and introduction of non-native species, among others, and their interactions.
CO4	Describe the threats to biological diversity, that is, direct harvesting, habitat destruction, and introduction of non-native species, among others, and their interactions.
CO5	Approaches for conservation of biodiversity at all level.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	In-depth knowledge and critical understanding of the theory and principles of biodiversity and the interrelationships of its levels with the basic effects from infrastructure development in nature conservation areas.	3	1	2	1	2	2	1
CO2	Knowledge and skills to realize and combine the complexity of the relations and interactions between the ecosystem structures and functions and the human impacts from the one side with the sustainable management	3	2	3	2	2	2	1
CO3	Discuss benefits, services and values harnessed from the biodiversity.	1	1	1	3	2	1	1

CO5	Students are able to encourage conservation of natural resources, the city should work towards ensuring that users are charged for the full local costs of their individual use of water, electricity and sanitary sewers. There should also be educational programs to encourage conservation of natural resources.	3	2	3	2	2	2	2
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Course: Human- Wildlife Conflict & Management

Course Code: ES205

Course Objectives: □

- To study Role of government in wild life conservation and management.
- Evolution of wildlife conservation and policies regarding protected areas in 21th century.
- To study different types of Environmental Act. for wild life conservation.
- Importance of forest produces to tribal population and tribal right in India.
- Impact of human wild life conflict in environment

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To Provided knowledge of government in Biodiversity conservation.
CO2	Be able to explain protected areas and Evolution of wildlife conservation.
CO3	To created knowledge Environmental Act. For wild life conservation.
CO4	To provided knowledge tribal population and tribal right in India.
CO5	To provided knowledge of human wild life conflict.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To Provided knowledge of government in Biodiversity conservation.	3	3	3	3	3	3	2
CO2	Be able to explain protected areas and Evolution of wildlife conservation.	3	3	3	3	3	3	3
CO3	To created knowledge Environmental Act. For wild life conservation.	3	3	2	2	3	2	3
CO4	To provided knowledge tribal population and tribal right in India.	3	2	2	3	2	2	3
CO5	To provided knowledge of human wild life conflict.	3	3	3	3	3	3	3

Course: Environmental Pollution and Human Health

Course Code: ES206**Course Objectives:**

To help the social groups and individuals to acquire knowledge of pollution and environmental degradation.

To help social groups and individuals to acquire a set of values for environmental protection.

Environmental pollution also aims at producing scientists with technical and analytical skills, environmental policy makers and researchers.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Explain the effects of water, land and air pollution on environment and suggest ways to reduce them.
CO2	To have experience in real-world problem solving through a research project for an external client
CO3	Develop improved understanding of the principles and application of environmental management tools including legislation and regulation
CO4	evaluate the relations among environment, human, and health.
CO5	Define the concepts acid rain, greenhouse gases and global warming

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Explain the effects of water, land and air pollution on environment and suggest ways to reduce them.	3	2	3	3	3	3	2
CO2	Have experience in real-world problem solving through a research project for an external client	3	1	2	2	1	3	3
CO3	Develop improved understanding of the principles and application of environmental management tools including legislation and regulation	3	2	3	3	3	3	3
CO4	evaluate the relations among environment, human, and health.	3	2	3	3	3	3	3
CO5	Define the concepts acid rain, greenhouse gases and global warming	3	1	2	1	1	3	3

1. Name of the Department: Environmental Science

2. Course Name	Environmental Impact and Risk	L	T	P	
3. Course Code	ES 207	3	1	0	
4. Type of Course (use tick mark)	Core ()	DSE (□)	AEC ()	SEC ()	OE ()

5. Pre-requisite (if any)	10+2 with Physics, Chemistry &	6. Frequency (use	Even ()	Odd (□)	Either Sem ()	Every Sem ()				
7. Total Number of Lectures, Tutorials, Practicals										
Lectures = 30		Tutorials = 10		Practical = Nil						
8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of Environmental Impact and Risk Assessment. This will help in enhancing knowledge of Environmental Impact assessment Process, methodologies of Environmental Impact assessment and Risk assessment. After successfully completion of course, the student will be able to explore subject into their respective dimensions.										
9. COURSE OUTCOMES (CO): <i>After the successful course completion, learners will develop following attributes:</i>										
COURSE OUTCOME		ATTRIBUTES								
CO1	Students will be able to Analyse Impact of Atmospheric Circulation on World Climate and Influence of Meteorological Parameters & Atmospheric Stability in shaping of									
CO2	Students will be able to Evaluate the role of Remedial Measures in Combating Global Warming and Climate Change.									
CO3	Students will be able to Evaluate Various Policies related to Climate Change mitigation Strategies and Create a knowledge base for Global and National Action									
CO4	Students will be able to Evaluate contribution of Green Houses Gases in Global warming and thereby bringing Change in Climate.									
CO5	Students will Analyse the role of Ozone Depleting Substances in Ozone layer Depletion and efforts for mitigation of Ozone hole Problem.									
10. Unit wise detailed content										
Unit-1	Number of lectures = 08	Title of the unit: Atmospheric circulation								
Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; tropical cyclone; Indian monsoon and its development, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture and Indus valley civilization; effect of urbanization on										
Unit-2	Number of lectures = 08	Title of the unit: Meteorology and atmospheric stability								
Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model.										
Unit-3	Number of lectures = 08	Title of the unit: Global warming and climate change								
Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different green house gases (GHGs) causing the climate change; atmospheric windows; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.										
Unit-4	Number of lectures = 08	Title of the unit: Ozone layer depletion								
Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion;										
Unit-5	Number of lectures =	Title of the unit: Climate change and policy								
Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.										
11. CO-PO mapping										
Cos	Attributes			PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	Students will be able to Analyse Impact of Atmospheric Circulation on World Climate and Influence of Meteorological Parameters & Atmospheric Stability in shaping of Climate.	3	1	3	1	2	2	3
CO2	Students will be able to Evaluate the role of Remedial Measures in Combating Global Warming and Climate Change.	3	1	3	2	2	3	3
CO3	Students will be able to Evaluate Various Policies related to Climate Change mitigation Strategies and Create a knowledge base for Global and National Action Plans to combat Climate	3	1	2	2	2	3	2
CO4	Students will be able to Evaluate contribution of Green Houses Gases in Global warming and thereby bringing Change in Climate.	3	1	2	1	2	1	2
CO5	Students will Analyse the role of Ozone Depleting Substances in Ozone layer Depletion and efforts for mitigation of Ozone	3	1	2	2	2	2	2

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self learning / E-learning component

1. <http://www.fao.org/3/i2802e/i2802e.pdf>
2. <http://www.environmentwb.gov.in/pdf/EIA%20Notification,%202006.pdf>
3. <http://extwprlegs1.fao.org/docs/pdf/ind4656.pdf>
4. http://awsassets.wwfindia.org/downloads/session_13_1.pdf

13. Books recommended:

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
3. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
4. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
5. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
6. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. & Sen, K. 2004. Climate Change and India. Universities Press, India
7. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.

Course: Biodiversity and Environmental Lab

Course Code: ES209

Course Objectives: □

To help students to acquire a knowledge of qualitative structure of plant community

To help students to acquire a set of values for environmental protection.

Biodiversity and Environment also aims at producing scientists with technical and analytical skills, environmental policy makers and researchers.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Explain the qualitative structure of plant community in a given area and also able to explain the medicinal properties of plants
CO2	Able to explain air pollutants and soil erosion and their impacts on the organisms

CO3	Able to explain watershed management technique and impact of abiotic stresses on plants
CO4	Able explain Conversion of organic or domestic waste into vermi compost and also able to discuss why man wild life conflict arises
CO5	Able to define Bishnoi Tribe efforts to conserve Biodiversity and About the collection of forest products.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Explain the qualitative structure of plant community in a given area and also able to explain the medicinal properties of plants	3	2	3	3	3	3	2
CO2	Able to explain air pollutants and soil erosion and their impacts on the organisms	3	1	2	2	1	3	3
CO3	Able to explain watershed management technique and impact of abiotic stresses on plants	3	2	3	3	3	3	3
CO4	Able explain Conversion of organic or domestic waste into vermicompost and also able to discuss why man wild life conflict arises	3	2	3	3	3	3	3
CO5	Able to define Bishnoi Tribe efforts to conserve Biodiversity and About the collection of forest products.	3	1	2	1	1	3	3

Course: Environmental Legislation and policy

Course Code: ES210

Course Objectives:

- To protect the man’s fundamental rights of freedom, equality and adequate conditions of life in an environment of quality that permits a life of dignity and wellbeing.
- To balance Inter-generational Equity
- Integration of Environmental Concerns in Economic and Social Development
- To apply principles of Environmental Governance
- Efficiency in Environmental Resource Use.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To create knowledge of laws and policies related to environment
CO2	To understand judicious use of environmental resources to meet the need of present and future generation.

CO3	To provide knowledge regarding good governance
CO4	To understand environmental conservation through mutually beneficial multi stakeholder partnerships between local communities
CO5	To ensure efficient use of environmental resources in the sense of reduction in their use per unit of economic output, to minimize adverse environmental impacts.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To create knowledge of laws and policies related to environment	3	3	3	3	3	3	2
CO2	To understand judicious use of environmental resources to meet the need of present and future generation.	3	3	3	3	3	3	3
CO3	To provide knowledge regarding good governance	3	3	2	2	3	2	3
CO4	To understand environmental conservation through mutually beneficial multi stakeholder partnerships between local communities	3	2	2	3	2	2	3
CO5	To ensure efficient use of environmental resources in the sense of reduction in their use per unit of economic output, to minimize adverse environmental impacts	3	3	3	3	3	3	3

Course: Environmental Health Accounting and Auditing

Course Code: ES211

Course Objectives:

1. Imparting basic knowledge of concept of health and disease, and its allied problems.
2. To understand types of diseases and spread of disease.
3. Motivating public to participate in awareness for health and education and communication of disease.
4. Acquiring knowledge for Environmental accounting.
5. To get knowledge of environmental audit.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To developed basic knowledge of concept of health and disease, and its allied problems.
CO2	To provided knowledge of types of diseases and spread of disease.
CO3	To developed awareness for health and education and communication of disease.

CO4	Acquired knowledge for Environmental accounting.
CO5	Got knowledge of environmental audit.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To developed basic knowledge of concept of health and disease, and its allied problems.	2	2	2	2	2	2	3
CO2	To provided knowledge of types of diseases and spread of disease.	2	2	2	2	2	2	3
CO3	To developed awareness for health and education and communication of disease.	2	3	3	2	3	2	2
CO4	Acquired knowledge for Environmental accounting.	2	2	2	2	2	2	2
CO5	Got knowledge of environmental audit.	2	2	2	2	2	2	3

Course: Environmental Methods and Analytical Techniques

Course Code: ES212

Course Objectives:

- To introduce concepts of various analytical techniques.
- To give an introduction to modern methods of analysis that is used in environmental and process analysis.
- To understand the basic design and operating principles of some modern instruments used in chemical analysis.
- To understand the basics of experimental design.

Course Outcomes (CO):

At the end of the course students should:

Course Outcome(CO)	Description
CO1	Student gained insight into advanced theoretical knowledge in methodologies in environmental management.
CO2	Demonstrate extensive knowledge of the area, relevant technologies, methods and theories.
CO3	Students can describe the most common methods of chemical analysis that are used in environmental analysis.

CO4	Students will be able to explain the general principles governing chromatographic separations based on the interactions between analytes and stationary phase.
CO5	Students will be able to explain the advantages of mass spectrometry over other techniques for the identification and quantification of analytes

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student gained insight into advanced theoretical knowledge in methodologies in environmental management.	3	2	3	2	2	3	2
CO2	Demonstrate extensive knowledge of the area, relevant technologies, methods and theories.	3	1	2	2	2	3	1
CO3	Students can describe the most common methods of chemical analysis that are used in environmental analysis.	3	2	2	2	1	3	1
CO4	Students will be able to explain the general principles governing chromatographic separations based on the interactions between analytes and stationary phase.	3	1	2	1	2	3	2
CO5	Students will be able to explain the advantages of mass spectrometry over other techniques for the identification and quantification of analytes	3	1	3	1	2	3	1

Course: Introduction to Environmental Biotechnology

Course Code: ES213

Course Objectives:

To develop the student's interest in the field of environment biotechnology that may provide better understanding and solution to mitigate the pollutants.

To inculcate the knowledge towards the application and future prospects of biotechnology.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To explain the basic concepts of biotechnology
CO2	To define the principles of Genetic Engineering
CO3	To understand the techniques involve in Genetic Engineering
CO4	To know the application of biotechnology
CO5	To study the future and scope of biotechnology

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To explain the basic concepts of biotechnology	2	2	1	3	3	3	2
CO2	To define the principles of Genetic Engineering	2	1	2	2	1	3	3
CO3	To understand the techniques involve in Genetic Engineering	3	2	3	2	3	3	2
CO4	To know the application of biotechnology	3	2	3	3	3	3	3
CO5	To study the future and scope of biotechnology	2	1	2	2	1	3	3

Course: Natural Hazards and Disaster Management

Course Code: ES215

Course Objectives:

1. Imparting basic knowledge of concept of Hazard, risk and vulnerability.
2. To understand types of hazards, its causes and impact.
3. Assessment of risk and vulnerability.
4. Acquiring knowledge about mitigation and preparedness to combat disaster.
5. To aware about role of Role of government bodies in disaster management.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To developed basic knowledge of concept of Hazard, risk and vulnerability.
CO2	To provided knowledge of of hazards, its causes and impact.
CO3	Acquired knowledge for Assessment of risk and vulnerability related to disaster.
CO4	Acquired knowledge about mitigation and preparedness to combat disaster.
CO5	Got knowledge about role of Role of government bodies in disaster management.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To developed basic knowledge of concept of Hazard, risk and vulnerability.	2	2	2	2	2	2	3
CO2	To provided knowledge of of hazards, its causes and impact.	2	2	2	2	2	2	3
CO3	Acquired knowledge for Assessment of risk and vulnerability related to	2	3	3	2	3	2	2

	disaster.							
CO4	Acquired knowledge about mitigation and preparedness to combat disaster.	2	2	2	2	2	2	2
CO5	Got knowledge about role of Role of government bodies in disaster management.	2	2	2	2	2	2	3

Course: Green Technology Lab

Course Code: ES216

Course Objectives: □

- To help students to acquire the significance of composting method and analytical techniques.
- To enable students to acquire knowledge about natural disaster and waste water treatment plant.
- To aims at producing students with technical and analytical skills, collection and analysis of soil sample from different zones affected by anthropogenic activities.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To help students to acquire the significance of composting method and analytical techniques
CO2	To enable students to acquire knowledge about natural disaster and waste water treatment plant
CO3	To aims at producing students with technical and analytical skills.
CO4	Collection and analysis of soil sample from different zones affected by anthropogenic activities.
CO5	To help students in the survey of air pollution control equipments.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To help students to acquire the significance of composting method and analytical techniques	3	2	2	3	3	2	2
CO2	To enable students to acquire knowledge about natural disaster and waste water treatment plant.	3	1	2	2	2	3	3
CO3	To aims at producing students with technical and analytical skills.	2	3	3	3	3	2	2
CO4	Collection and analysis of soil sample from different zones affected by anthropogenic activities	2	2	3	3	3	3	3
CO5	To help students in the survey of air pollution control equipments.	2	1	3	1	1	3	2

Course: Basics of Remote Sensing, Geographic information system**Course Code: ES301****Course Objectives:**

- To study of remote sensing component and different types of platform.
- Measurement of biodiversity interaction with environment by satellite, sensors and aerial photography.
- Geographical analysis by Raster and vector data.
- Statistical analysis of geographical data structure.
- To monitoring forest diversity and urban sprawl analysis by Remote Sensing and GIS Technology.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To develop basic knowledge of remote sensing and GIS.
CO2	To provided knowledge of monitoring biodiversity by satellite, sensors and aerial photography.
CO3	To provided knowledge of Geographical analysis by Raster and vector data.
CO4	To created knowledge of Statically analysis of geographical data structure.
CO5	Be able to describe application of Remote Sensing and GIS Technology.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To develop basic knowledge of remote sensing and GIS.	3	3	3	3	3	3	2
CO2	To provided knowledge of monitoring biodiversity by satellite, sensors and aerial photography.	3	3	3	3	3	3	3
CO3	To provided knowledge of Geographical analysis by Raster and vector data.	3	3	2	2	3	2	3
CO4	To created knowledge of Statically analysis of geographical data structure.	3	2	2	3	2	2	3
CO5	Be able to describe application of Remote Sensing and GIS Technology.	3	3	3	3	3	3	3

Course Code: ES302**Course Objectives:**

- To develop the scientific attitude among the students for land and soil conservation.
- To develop attitude towards the fundamental education of soil among the students.
- To develop clear thinking about land use pattern awareness among the students.
- To develop attitude towards soil pollution, its degradation among the students.
- To provide knowledge to students about rational and scientific thinking about the measures to abate soil degradation.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Students can enhance their knowledge about of soil erosion and conservation.
CO2	Students can increase their knowledge about agricultural productivity in sustained manner without deteriorating the soil health.
CO3	Students can get efficient prospect to know about rainfall with development of water harvesting structures such as farm Ponds and Check Dams.
CO4	Restoration of ecological balance by harnessing, conserving and developing natural resources.
CO5	To minimize flood hazards in the valley bottom areas and farm lands by way of preventing silt deposition in the riverbed.

Course: Agro ecology and Agro forestry**Course Code: ES303****Course Objectives:**

Provide general introduction about Agroecology and Agroforestry

To learn about fundamentals, concepts and principles of Agroforestry

To develop silvicultural systems in Agroforestry and their management with its formulation and objectives

To learn about concept and principle of Agroecology with its Agroecological practices

To provide knowledge about Agro-ecological basis for the conversion to organic movements

Course Outcome(Co)	Description
CO1	Knowledge of Agroecology and Agroforestry
CO2	Knowledge about scope of global and national needs for Agroforestry with its practices
CO3	To understand silvicultural systems in Agroforestry and selection of tree species for Agroforestry
CO4	To understand the principle of Agroecology and its role in ecological agriculture
CO5	To learn the conversion of organic movements for crop rotation, crop diversity and enhance soil health

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Knowledge of Agroecology and Agroforestry	3	3	3	3	3	3	2
CO2	Knowledge about scope of global and national needs for Agroforestry with its practices	3	3	3	3	3	3	3
CO3	To understand silvicultural systems in Agroforestry and selection of tree species for Agroforestry	3	3	2	2	3	2	3
CO4	To understand the principle of Agroecology and its role in ecological agriculture	3	2	2	3	2	2	3
CO5	To learn the conversion of organic movements for crop rotation, crop diversity and enhance soil health	3	3	3	3	3	3	3

Course: Solid Waste management
Course Code:
 ES304

Course Objectives:

- To select the most suitable solid waste management options in a specific local context
- To conceptually design waste conversion/treatment processes
- Assess the environmental impact of solid waste management options and criticize the results
- Assess the economic impact of solid waste management options and criticize the results
- Develop innovative solutions of solid waste management in urban areas

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Deep knowledge of disposal of solid waste.
CO2	To create awareness among the people about the impact of waste

CO3	Knowledge for the protection of environment through effective waste management techniques.
CO4	Knowledge to reduce and reuse of waste
CO5	Understanding of green techniques for solid waste disposal

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Deep knowledge of disposal of solid waste.	3	3	3	3	2	3	2
CO2	To create awareness among the people about the impact of waste	3	3	3	3	3	3	2
CO3	Knowledge for the protection of environment through effective waste management techniques.	3	3	3	3	3	3	3
CO4	Knowledge to reduce and reuse of waste local communities	3	3	3	3	3	3	3
CO5	Knowledge to reduce and reuse of waste	3	3	3	2	2	3	3

Course: Urban Ecosystems Course
Code: ES306 Course

Objectives:

- Comprehend basic ecological and environmental concepts and principles related to urban ecosystems.
- Understand major arguments in and the critical concerns of urban political ecology; Describe and appreciate the complex and diverse relationships between cities and ecology, and between human and the built environment.
- Apply principles and concepts of urban ecosystems to analyze our surrounding urban habitats.
- Critically discuss contemporary socio-economic issues of urban ecology in different urban contexts.
- Make policy recommendation for a more sustainable urban future.

Course Outcomes (CO):

Upon the successful completion of this course, students should be able to:

Course Outcome(Co)	Description
CO1	Able to Identify key issues in urban ecosystem management, and its linkage to urban sustainability and resilience.
CO2	Able to raise attention and public awareness of the importance of urban ecosystem management among scientists, policy makers, and general public.
CO3	Understand Urban Planning
CO4	Advanced knowledge and guidance for better urban ecosystem management.

CO-PO mapping for a course of “UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Able to Identify key issues in urban ecosystem management, and its linkage to urban sustainability and	3	2	3	2	2	2	2

	resilience.							
CO2	Able to raise attention and public awareness of the importance of urban ecosystem management among scientists, policy makers, and general public.	2	3	3	2	3	2	2
CO3	Understand Urban Planning.	3	2	3	3	2	1	2
CO4	Advanced knowledge and guidance for better urban ecosystem management	3	2	3	3	2	1	2

Course: Environmental Management Lab

Course Code: ES307

Course Objectives:

To help students to acquire a knowledge of solid waste disposal methods.

Basic knowledge and concept of causes, effect and control of different type of environmental pollution.

To help students to Basic knowledge and values for Remote Sensing and GIS.

Biodiversity and Environment also aims at producing scientists with technical and analytical skills.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Explain the qualitative structure of analysis of solid waste disposal methods.
CO2	Able to explain Knowledge of Remote Sensing and Geographical Information System.
CO3	Able to explain Nursery techniques for agro-forestry and analysis of soil samples.
CO4	Able explain Model making of a green building and its importance.
CO5	Able to define Visit to Solid waste Treatment Plant and Agro-forestry plantation.

CO-PO mapping for a course of “UG program”

S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Explain the qualitative structure of analysis of solid waste disposal methods.	3	2	3	3	3	3	2
CO2	Able to explain Knowledge of Remote Sensing and Geographical Information System.	3	1	2	2	1	3	3
CO3	Able to explain Nursery techniques for agro-forestry and analysis of soil samples.	3	2	3	3	3	3	3
CO4	Able explain Model making of a green building and its importance.	3	2	3	3	3	3	3
CO5	Able to define Visit to Solid waste Treatment Plant and Agro-forestry plantation.	3	2	2	1	1	3	3

1. Name of the Department: Environmental Science						
2. Course Name	Environmental Economics			L	T	P
3. Course Code	ES 308			3	1	0
4. Type of Course (use tick mark)		Core (<input type="checkbox"/>)	DSE ()	AEC ()	SEC ()	OE ()
5. Pre-requisite (if any)	10+2 with Physics, Chemistry &	6. Frequency (use	Even (<input type="checkbox"/>)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		Tutorials = 10		Practical = Nil		
8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of scope and importance of Ecological economics. This will help in enhancing knowledge of Cost & Benefit analysis, economics in Sustainability, global sustainability and economic solutions to environmental problems. After successfully completion of course, the student will able explore subject into their respective dimensions.						
9. COURSE OUTCOMES (CO): <i>r the successful course completion, learners will develop following attributes:</i>						
COURSE OUTCOME		ATTRIBUTES				
CO1		Students will be able to Analyse the role of ecological economics in influencing demand and Supply in Markets and environmental policy.				
CO2		Students will be able to Evaluate costs and benefits of pollution control by adopting market based instruments for controlling Environmental pollution.				
CO3		Create an Understanding among Students about how guiding principles of Sustainable developmental help in facing global challenges of Sustainable Development				
CO4		Students will be able to Analyse importance of strategies of global sustainability in developing instruments for implementing Sustainability.				
10. Unit wise detailed content						
Unit-1	Number of lectures = 08	Title of the unit: Introduction to Ecological Economics				
Scope and Importance of Ecological Economics, Economics and Environmental Policy, the market mechanisms and choices, benefits of Environmental protection: Demand and supply, market Price and Quality: Environmental Externalities and the problem of Social cost. Valuation of Ecosystem services, Value Addition in Agriculture Crops,						
Unit-2	Number of lectures =08	Title of the unit: Ecological Cost Benefits and Environmental				
Economic Analysis of Climate change, Benefits of controlling of Green House Gasses, Cost of Controlling Green House Gasses, Carbon Trading and CDM mechanisms. Measuring the Cost and Benefits of Pollution control, Overview of Cost Benefit Analysis, Economic Principles of Cost Benefit Analysis, Measurement of Economic Value of Environment, contingent valuation method, Travel Cost Methods, Hedonic Market Methods, Market Based Instruments for Pollution Control, Systems of Integrated Environmental accounting, Green Accounting.						
Unit-3	Number of lectures = 08	Title of the unit: Economic Sustainability				
Definition and Dimensions of Sustainability, Global Challenges of Sustainable Development, The Ecological Foot Print, Global Environmental Monitoring and Assessment, Guiding Principles of Sustainable Development, National Sustainable Development Strategies, Sustainability Indicators, Models of Sustainability, Environmental Sustainability Index, Global Action and Sustainable Development, Education for Sustainability.						
Unit-4	Number of lectures = 08	Title of the unit: Strategies of Global Sustainability				

An Economic perspective to Sustainability, Strategies for Global Sustainability, Instruments for implementing Sustainability-Finding Right Prices, the Hardwick - Sorrow rule, Critical Rental Capital, Safe minimum Standard, Steady State Principles. Policy Implications for implementing Sustainability.

Unit-5 | **Number of lectures =** | **Title of the unit: Economic Solutions to Environmental**
 Social Cost and Benefits of Environmental Programmes, Marginal Social benefit of Abatement, Marginal Social Cost of Abatement, pollution control, Policies for Controlling Air and Water Pollution, Disposal of Toxic and Hazardous Waste –Standards vs. emission charges, environmental subsidies, modelling and emission charges, polluter pays principle, pollution permit Trading system.

11. CO-PO mapping

Cos	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to Analyse the role of ecological economics in influencing demand and Supply in Markets and environmental policy.	3	1	2	1	1	1	3
CO2	Students will be able to Evaluate costs and benefits of pollution control by adopting market based instruments for controlling Environmental pollution.	3	1	2	1	2	3	3
CO3	Create an Understanding among Students about how guiding principles of Sustainable developmental help in facing global challenges of Sustainable Development	3	1	2	1	2	3	3
CO4	Students will be able to Analyse importance of strategies of global sustainability in developing instruments for implementing Sustainability.	3	1	2	1	3	3	3

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self learning / E-learning component

- https://www.soas.ac.uk/cedep-demos/000_P570_IIEP_K3736-Demo/module/pdfs/p570_unit_01.pdf
- https://www.sfu.ca/~wainwig/Econ400/documents/Econ_460_Lecture-Notes-part_One-10-3.pdf
- <https://ocw.mit.edu/courses/economics/14-42-environmental-policy-and-economics-spring-2011/lecture-notes/>
- <https://nptel.ac.in/courses/109107171/>

13. Books recommended:

- Bhattacharya, R.N. 2001. An Economic perspective , Oxford University Press.
- Environmental Economics and Sustainability, Jose G Varghas- Hernandez, Monowar Alam Khalid. Pawan Kumar Bharti, 2018. Discovery Publishing House Pvt. Ltd. ISBN 978-93-86841-37-7 Pg 202.
- Brundtland G. H. 1987, Our Common Future: The World Commission on Environmental and Development. Oxford, UK: Oxford University Press.
- Garrod, G and Willis K.G. 1999. Economic Valuation of the Environment: Methods and Case Studies, Edward Elgar, UK.
- Hanley, Nick and Roberts C.J. 2002, Issues in Environmental Economics, Black well Publishers, U.K.
- Kalof, L and Satter Field T 2005. Environmental Values, Earthscan, London.
- Krishna, B Ghimire and Mitchel P. Pimbert, 2006. Social Change and Conservation, Earthscan, London.
- Marshall and Graham R. 2005. Economics for Collaborative Environmental management, Earth: London.
- MEA (Millennium Ecosystem Assessment) 2005 a. Ecosystems and Human Well Being, World Resource Institute, Washington, D.C. www.wri.org.
- Ninan, K.N. 2007, The Economics of Biodiversity Conservation, Earthscan, London.
- Singh, J.S., Singh S.P. and Gupta S. R. 2006, Ecology, Environment and Resource Conservation, Anand Publishers, New Delhi.
- Ward F. A. 2006, Environmental and Natural Resource Economics, Pearson Prentice Hall, New Jersey.
- Sanskar, U. 2001, Environmental Economics, Oxford University Press.

Course Code:**ES309 Course****Objectives:**

- To develop the social and cultural attitude towards the environment.
- To develop attitude among students on the issues arising from anthropogenic activities.
- To develop clear thinking about inequalities of class, gender, race and the rehabilitation of the project affected people.
- To develop attitude towards the issues arising from the development of urbanization and technological development and its impact on environment.
- To enable students to participate as a volunteer on various environmental issues.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	To develop the social and cultural attitude towards the environment
CO2	To develop attitude among students on the issues arising from anthropogenic activities.
CO3	To develop clear thinking about inequalities of class, gender, race and the rehabilitation of the project affected people.
CO4	To develop attitude towards the issues arising from the development of urbanization and technological development and its impact on environment.
CO5	To enable students to participate as a volunteer on various environmental issues.

CO-PO mapping for a course of “ UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To develop the social and cultural attitude towards the environment.	2	1	3	1	2	1	3
CO2	To develop attitude among students on the issues arising from anthropogenic activities.	3	2	1	2	2	1	2
CO3	To develop clear thinking about inequalities of class, gender, race and the rehabilitation of the project affected people	3	1	2	1	2	1	1
CO4	To develop attitude towards the issues arising from the development of urbanization and technological development and its impact on environment	3	1	2	1	1	2	2
CO5	To enable students to participate as a volunteer on various environmental issues.	2	1	2	1	1	1	2

Course: Energy and Environment**Course code: ES311****Course Objectives:**

- To understand the Introduction and history related to different forms of energy.
- To provide knowledge of Energy resources and its demand as respect to historical and current perspectives.
- To develop knowledge of Energy consumption and its impact on environment.
- To provide knowledge of Policies for uses of energy.
- To provide deep knowledge of sustainable use of energy.

Course Outcomes (CO):

Course Outcome(Co)	Description
CO1	Be able to describe history related to different forms of energy.
CO2	Be able to Illustrate Energy resources and its demand as respect to historical and current perspectives.
CO3	Be able to explain Energy consumption and its impact on environment.
CO4	Be able to make connections of Policies for uses of energy.
CO5	Have an enhanced knowledge of sustainable use of energy.

CO-PO mapping for a course of “ UG program”								
S.No.	CO description	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Be able to describe history related to different forms of energy.	3	3	2	2	2	1	1
CO2	Be able to Illustrate Energy resources and its demand as respect to historical and current perspectives.	3	3	2	2	2	1	1
CO3	Be able to explain Energy consumption and its impact on environment.	3	3	2	2	3	2	1
CO4	Be able to make connections of Policies for uses of energy.	2	3	2	2	2	1	1
CO5	Have an enhanced knowledge of sustainable use of energy.	3	3	2	2	3	3	1