Course title: Ecosystems and Climate Change			
Course code: NRC 151	**No. of credits:** 3	**L-T-P:** 27-12-08	**Learning hours:** 42
Pre-requisite course code and title (if any): Ecology in graduation or as a first semester course at TERI School of Advanced Studies			
Department: Energy and Environment			
Course coordinator(s):		**Course instructor(s):** Dr Sudipto Chatterjee	
Contact details: s.chatterjee@terisas.ac.in			
Course type: Elective		**Course offered in:** Semester 3	

Course description

The course has been designed for students pursuing MSc Climate Science and Policy. The modules of the course will apprise the students on the concept of ecosystems, their types and vulnerabilities to the impacts of climate change. Students will learn the tools for impact studies and get apprised with present level of national and global efforts in mitigation and adaptation strategies.

Learning objectives

The objectives of the course shall be to learn

- The Science of Ecosystems, their evolutionary history, structure and functioning and linkages to climate.
- Study the known impacts of climate change of ecosystems, methods of monitoring and national and global initiatives on ecosystems and climate change.

Course content

Module	Topic	L	T	P
	Module 1: Fundamentals of the concept of Ecosystem			
1.	The evolution of the concept of ecosystem ecology, defining ecosystem, Concept of Primary Productivity. Energy flows in ecosystems. Gaia Hypothesis and the Daisy Model. Class Discussion.	2 1	 1	
2.	The perspectives of Ecosystem Succession The Clements theory of climatic climax, Gleason theories of succession, Assembly Rules and their significance on climate change studies. Class discussion	1	 2	
	Module 2: Climate in Geological time periods			
3.	Understanding of climate in Geological time scales and diversity of life, Precambrian to Phanerozoic. Natural History, Forests and wildlife in India through geological ages and Book Review	2 2	 1	
	Module 3: Fundamentals of Climate- Ecosystem Linkages			

4.	Terrestrial and Aquatic (Fresh Water and Marine), natural and manmade ecosystems responses to global warming with focus on species reported to be vulnerable to Climate Change. Global Vegetation Classification System. Life forms and Plant Functional types Essential Climate and Biodiversity Variables. A quantitative approach to vegetation-climate interaction, History of modelling impacts of Climate change on Vegetation. Journal papers to work on	2 4	 2	
5.	Module 4: Global programmes/ initiatives on Ecosystem- Climate Change Research			
6.	Contributions of Ecosystem approach of the International Biological Programme (IBP), The International Geophysical Year, REDD +Eight national missions of National Action Plan on Climate Change (NAPCC) with an emphasis on : a. National Mission for Sustaining Himalayan Ecosystem (NMSHE); National b. Mission on Strategic Knowledge for Climate Change (NMSKCC). Discussion on Initiatives under National Communication to United Nations Framework on Convention on Climate Change (UNFCCCC)	4	 2	
7.	Ecosystems vulnerable to climate change identified in India. Studies in India on adaptations to climate change. Discussion on a case study.	2	 1	
8.	Discussion on Case studies: Impact of Climate change on ecosystems and species.		2	
9.	Module 5 Species Distribution Modelling for climate change impacts			
10.	The concept of Niche, Grinnel, Elton and Hutchinson: Fundamental and Realized. Biodiversity-Ecosystem functioning. Ecosystem Services. Predicting Ecosystem consequences of biodiversity loss. Practical using software MaxENT/ InVEST including presentation by students. Forest Carbon Sequestration and Blue Carbon	4 1		 8
	Total	**27**	**12**	**8**

Evaluation criteria

Test 1:	15% *
Test 2:	15% *
Assignment and presentation:	30% **
Major Test:	40% ***

*Tests 1 and 2 shall evaluate the students understating of the concepts, the thoroughness in readings on the topics.
** The Assignment will be on a topic assigned by the course coordinator. Assignment to include identification of a climate change ecosystem problem, literature review, designing a methodology and a implementation plan to address the same
***Major Test to undertake an evaluation of students comprehension of all the modules , assess the deeper understanding the student has gained through the course in the entire semester

Learning outcomes

1. The students will be able to appreciate the inter-disciplinarily that is required for Studies related to impacts of climate change on different ecosystems and species.
2. Students will learn tools and techniques related to climate change studies and its impacts on ecosystems and the present level of global and national initiatives to address the same.
3. Students will develop an understanding on India preparedness to address impacts of climate change to ecosystems

Pedagogical approach

Students will be guided through the basic concepts of ecosystem and its linkages to climate change. It will be emphasized upon that ecosystems have been shaped by climate in a geological time period. Students will learn that resilience and vulnerability of ecosystems and species they harbour varies to climate change varies. They would learn the emergent tools and techniques to study change in distributional ranges of species through Ecological Niche Modelling. Students will be apprised of the global initiatives by conservation agencies

Materials

1. Bannerjee, A. (2010) (Ed). Footprints in the Forest. History and Origins of Forests, Forestry and Wildlife in India. Natraj Publishers. Dehradun. P 326.
2. Box, E. O. 1981. Macro climate and plant forms: An introduction to predictive modelling in phytogeography. Dr. W Junk Publishers. The hague. 258
3. Canadell Josep , Diane E. Pataki. 2007. (Eds). Terrestrial Ecosystems in a changing World. Springer-Verlag. Berlin. 336 P.
4. Edwards, Paul, N. 2010. A vast Machine. Computer models, climate data and the politics of global warming. The MIT Press. Cambridge. London. P 518.
5. Jones, Hamlyn. G. 2014. Plants and microclimate. Cambridge. UK. P. 407.
6. Lovejoy Thomas and Lee Hannah. Climate Change and Biodiversity
7. Sala Oslvaldo E, Robert B Jackson, Harold A Money, Robert W Howarth (Ed).2000. Methods in Ecosystem Science. Springer.420
8. Solomon Allen M and Herman S. Shugart. 1993. Vegetation Dynamics and Global Change. Springer and IIASA.P 337.

In addition
1. Books authored by James Lovelock on Gaia hypothesis.

Journal
1. Publications by Profs Raman Sukumar and N H Ravindranath at IISc Bangalore and publications from IITM, Pune.
2. Diamond Jared on Assembly rules

Additional information (if any): Readings may be updated for this course

Student responsibilities
Attendance, Intensive readings, Active participation in Class discussions.

Course Reviewers

The course is reviewed by the following experts.

1. Prof P.K. Joshi, School of Environmental Sciences, Jawaharlal Nehru University
2. International Union for Conservation of Nature, India.
3. Dr Anurag Danda, Sunderbans Programme, WWF India
4. Dr. Indu Murthy. Consultant Scientist at Indian Institute of Science, Bangalore
5. Prof J Garg, GGS Indraprastha University, New Delhi