Urban Resilience and Adaptation for India and Mongolia
curricula, capacity, ICT and stakeholder collaborati
support green & blue infrastructure and nature-ba
solutions
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Template syllabus of the new/revised courses

Course Name: ECOL 472: ENVIRONMENTAL INFORMATICS AND MODELING

Number of credits: 3

Period: Monsoon semester

Coordinator	**S Jayakumar**
Credits	3
Lecturers	--
Level	Postgraduate
Host institution	Pondicherry University
Course duration	18 weeks
New/revised	Revised

Summary

This 3 ECTS course provides the fundamentals of environmental informatics, different types of database management system, spatial data structure, how to extract information from different data sources such as air borne data, space borne data, climate data, GPS, topographical maps and how to convert them into digital form. It also teaches the students how to integrate and analyse the trend and pattern. It also introduces the students the concept of weightage, how to assign class weightage and layer weightage. The fundamentals of spatial modelling and how to perform modelling to identify the suitability and vulnerability. It also introduces the components of an information system and of remote sensing. This course also demonstrates data collection using GPS, Map reading, DBMS, 2D analysis and 3D analysis

Target student audiences

Master students majoring in Ecology and Environmental Sciences, Computer Science, Physics, Statistics, Pollution technology and environmental engineering, geosciences, sociology will be the target audiences.

Prerequisites

Required courses (or equivalents): Basic understanding on Mathematics (school higher level), English language skill, computer operation (Windows/Mac).

Aims and objectives

The main aim of the course is to provide students what is environmental informatics and modeling and how can it be accomplished. The objectives of the course are to provide the

important aspects of DBMS, to explain how do extract information from various datasets, to provide a fundamental understanding on how to integrate data, perform analysis and interpret the outputs, to provide the students to know about the basic components of information system, to make them understand how to perform suitability and vulnerability modeling and to demonstrate 2D and 3D data analysis.

The Authentic Tasks are:

General learning outcomes:

By the end of the course, successful students will:

1. Know the significance of environmental informatics and its relevance to the natural resources management.
2. be familiar with various database management systems
3. be able to retrieve data from DBMS through query
4. know the different types of information extraction
5. be able to conceptualize the types of thematic maps required and the appropriate source of data to prepare the different types thematic maps in both analog and digital formats
6. be able to think spatially to manage the natural resources
7. be familiar with the concept and framework of information system.
8. know the concept of 2d and 3d data analysis.

Overview of sessions and teaching methods

The course will make most of interactive and self-reflective methods of teaching and learning.

Learning methods

- In class Lectures (face-to-face)
- E-learning materials – Video lectures
- Group work – Fieldtrip, data collection, analysis and report presentation
- Literature review and assignment submission

Course outline

Week - 1	Introduction to environmental informatics
	Environmental data, sampling, primary and secondary data
Week - 2	Data sources, data quality and standards
Week - 3	Introduction to database management system
Week - 4	Significance of DBMS and spatial data structures

Week - 5	Resource information extraction – air borne, space borne and data
	Resource information extraction from topomap and climate data
Week - 6	Digital database creation
	Introduction to data analysis and visualization
Week – 7	Data integration, trend analysis, pattern analysis
Week – 8	Understanding data layers and weightage
Week – 9	Spatial environment and spatial analysis
	Introduction to spatial modeling
Week – 10	Environmental suitability and vulnerability modeling
Week – 11	Structure and components of information system
Week – 12	Working with GPS and data handling
Week – 13	Map reading and information extraction
Week – 14	2d data analysis
Week – 15	3d data analysis

Literature

Compulsory

1. Bungartz, HJ, Kranzlmuller D and Weinberg, V 2019. Advances and New Trends in Environmental Informatics: Managing Disruption, Big Data and Open Science Springer Publication. ISBN-13: 978-3030076191.

2. Avouris, NM., and Page, B. 2010. Environmental Informatics: Methodology and Applications of Environmental Information Processing, Springer Publication.

3. Agarwal, S.K., 2002. Eco-informatics, APH Publishing Corporation, 1535 pages, ISBN-13: 978-8176483247.

Recommended:

1. Coronel, C., Morris, S., Rob, P., 2009. Database Systems: Design, Implementation and Management, 9th Ed., Course Technology, 700 pages, ISBN-13: 978-0538748841.

2. Maguire, D., Batty, M., Goodchild, M., (Eds.) 2005, GIS, Spatial Analysis, and Modeling, Esri Press, 496 pages, ISBN-13: 978-1589481305.
3. Goodchild, M.F., Parks, B.O., Steyaert, L.T., (Eds.), 1993. Environmental Modeling with GIS (Spatial Information Systems) Oxford University Press, USA, 520 pages, ISBN-13: 978-0195080070.
4. Jorgensen, S. E., Chon, T-S., Recknage, F. A., 2009. Handbook of Ecological Modeling and Informatics, WIT Press, 448 pages, ISBN-13: 978-1845642075.

Revised Syllabus
ENVIRONMENTAL INFORMATICS AND MODELING

ECOL -472 **CREDIT: 3**

COURSE OBJECTIVE: To introduce the database concepts, data source, spatial data structure, information extraction. To understand the capabilities of spatial database and geographical information system in solving environmental problems.

Unit – I: Introduction to environmental informatics, definition, components, environmental data – air, water, soil, flora, fauna, weather, data variable and sampling, primary and secondary data, spatial and non-spatial data, data sources, data quality and standards**. (8 hrs)**

Unit – II: Data management: Database management system (DBMS) – Hierarchical database management system, network database management system, relational database management system and object oriented database management system; significance of DBMS, data types, data storage, data query and retrieval; spatial data structure – raster data, vector data, advantages and limitations, remote sensing data – satellite data, air borne data, thematic and attribute data, hardware and software requirements. **(8 hrs)**

Unit – III: Information extraction: Resource information extraction from aerial survey – air borne data, space borne data, data collection using global positioning system, topographical maps, climatic data – temperature, rainfall; spatial database creation - thematic maps, definition, types of thematic maps, components of map, scale of map, abstraction, mapping accuracy; digital database creation – scanning and digitization; non-spatial database creation. **(8 hrs)**

Unit – IV: Analysis and visualization: Data integration, analysis - data input, process, output; data visualization – trend analysis, pattern analysis, data layers – class value/weightage, layer value/weightage; data integration in GIS domain – grid data, cell size, spatial environment; spatial analysis: proximity/buffer analysis, overlay analysis, arithmetic overlay, weighted overlay**. (8 hrs)**

Unit – V: Spatial modeling: Environmental suitability modeling for afforestation, environmental vulnerability modeling for forest fire, components, structure, organization, maintenance, updating of information system. Demonstration: (1) Data collection using Global Positioning System (GPS), 2) Map reading and Information extraction from Survey of India (SOI) topographical map, 3) Data base management system, 4) 2d data analysis, 5) Digital elevation model from elevation data – SRTM and contour **(8 hrs).**

Course workload

The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities (42 hours)			
Lectures	Understanding the fundamentals of environmental informatics and modeling in natural resources management	Class participation	20 hours
Moderated in-class discussions	Understanding the database management system, basic structure and function of information system	Class participation and preparedness for discussions	7 hours
In-class assignments, field assignment	Understanding information extraction from different data sources, basic framework of data collection, sampling, data quality standards	Class participation and preparedness for assignments	5 hours
Reading and discussion of assigned papers for seminars and preparation for lectures	Understanding the application of environmental informatics in various sectors, how do institutions make use of environmental informatics for better management of resources, how do people benefit of it, how to improve the information system more robust and user friendly.	Class participation, creative and active contribution to discussion	5 hours
Group project presentation	Ability to make presentation, effective communication, critical interpretation of data, response to audience	Quality of group assignments and individual presentations	5 hours
Independent work (100 hours)			
Group work:	Ability to understand the potential significance and applications of information system in various	Quality of group assignments	30 hours

- Contribution to the group case-study projects - Contribution to the preparation and delivery of individual presentation	sectors, ability to conceptualize the information system and system's requirement, ability to assess the usage of information system by public, scientists and bureaucrats team work, problem solving, discussion with members of the group, convey the ideas clearly	and individual presentations	
Course group assignment	Ability to conceptualize the framework for environmental informatics with reference to a particular sector/resource, ability to identify data needs, quality standards, data integration, ability to prepare spatial model diagram with suitable weights to relevant thematic layers	Quality of developed strategy and their presentation	20 hours
Group presentation	Ability to interpret data, to analyze audience, and to use the concepts, tools, and methods for communicating the strategy developed	Quality of group assignments and individual presentations	25 hours
Individual study	Ability to understand the fundamental and environmental informatics and its importance, Understanding of various DBMS, information from different datasets, comprehensive knowledge on data integration, analysis, and modeling	Quality of answers to questions in the final examination	25 hours
Total			***142 hours***

Grading

The students' performance will be based on the following:

Assessment

- Progress assessment (40%):

- Exercise (10%): students have to complete the quiz or seminar of each topic.
- Homework (10%): 1. Journal paper review (5%), Assignment on information extraction (5 %) or one essay on conceptual framework of environmental informatics (5%)
- Group report (20%): The entire class will be divided into groups of 5-6 students and be given an option to choose any one of the following topics for group project report.
    - Biodiversity information system
    - Forest information system
    - Soil information system
    - Ocean information system
    - Agriculture information system
    - Fire information system
    - Land information system

- Final assessment (60%):
    - Final examination (60%)

Evaluation

Performances of students in each paper are expressed in terms of marks as well as in Letter Grades. In case of fractions the marks shall be rounded off to nearest integer. The class interval for the purpose of awarding the grades can be arrived at by dividing the difference between the highest mark secured and the minimum pass mark by 6 as there are six passing grades. The formula is given below:

K = (X-50)/6

Where, K = class interval, X= the highest mark in the subject.

The grades may be awarded as given in the following Table II.

Table II

Range of Marks in %	Letter Grade	Points for Calculate of CGPA
X to (X-K)+1	O	10
(X-K) to (X-2K)+1	A+	9
(X-2K) to (X-3K)+1	A	8
(X-3K) to (X-4K)+1	B+	7
(X-4K) to (X-5K)+1	B	6
(X-5K) to 50	C	5
Below 50	F	0

Failure due to lack of attendance	FA	0

K should not be rounded off to less than two decimal places. The numbers given in Range of Marks column, (X-K), (X-2K), (X-3K), etc., can be rounded off to the nearest whole number.

In courses where the number of students who have secured 50 marks and above is less than 10 then grading may be given based on the Table III.

Table III

Range of Marks in %	**Letter Grade**	**Points for Calculate of CGPA**
81-100	O	10
71-80	A+	9
66-70	A	8
61-65	B+	7
56-60	B	6
50-55	C	5
Below 50	F	0
Failure due to lack of attendance	FA	0

In order to declare the pass, a Student should get

a) A minimum of 40% marks in end-semester exam, and

b) A minimum of 50% marks in aggregate when Internal Assessment and End-Semester marks are added.

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