Department of Agricultural Extension and Rural Development

Patuakhali Science and Technology University

Climate Smart Agriculture for Climate Smart Agriculture for a Resilient Coastal Bangladesh

Dumki, Patuakhali

Course Profile

Course Code: CSA 6110
Course Title: Remote Sensing and GIS for Climate Smart Agriculture (CSA)
Credit Hour: 2
Student Level: Level- 4, Semester – 1

Rationale: Students of this course are expected to learn and understand the basic concepts of GIS, spatial data and analysis techniques, and how to communicate results using a well-designed map. They will learn about remote sensing data applications and how to use them to support climate-smart agricultural practices for and improved agriculture sustainability.

Objectives: At the end of this course, the students will able to:

- Articulate basic principles of Geographic Information Systems (GIS)
- Articulate the fundamental concepts of spatial data collection and analysis methods as well generate a map out of spatial and non-spatial data using GIS software
- Be able to explain the theory behind of remote sensing and understand the basics of the electromagnetic spectrum, image enhancement and analysis, and their application
- Formulate new functions and apply what they have learned to their own research in the thematic area of CSA.

Learning Objectives	Course Content	Teaching-Learning Strategy	Assessment Strategy
Understand the basic concepts of GIS. Develop fundamental skills of using, manipulating and interpreting spatial data.	**Introduction**: Definition, history and nature of Geographic Information System (GIS); GI Science and GI application **Spatial data and geoinformation:** Maps; Database; Scale; Features; Representation; Generalize; Map projection; Geo-referencing; spatial database; spatial analysis.	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Checklist

Develop an understanding of the underlying theory of spatial data models and to represent them visually	**Spatial data models and modeling:** Entity definition; Spatial data models; Spatial data structures; Vector model versus raster models of spatial data; Modeling of surfaces. **GIS data collection**: Primary geographic data capture; Secondary geographic data capture. **Spatial data visualization:** vector data visualization (point, line and polygon features), raster data visualization, categorized vector and raster data visualization.		
Apply cartographic principles: Represent and manipulate scale, resolution, projection and data management to problems in agriculture.	**Spatial referencing and positioning:** Reference surfaces for mapping, coordinate system, map projection, coordinate transformation, satellite-based positioning and georeferencing, practical examples with data from Patuakhali mapping of mung bean.	Lecture Reading assignment Discussion QA	-Short Answer -Essay -Completion
Learn how to create spatial data and digitize GPS data	**Data Entry and Preparation:** Spatial vector data preparation, digitizing using raster data, data entry using attribute tables, collection of Global positioning system (GPS) data from farmers' fields. Application of collected data and map representation using attribute data, retrieving statistics.	Lecture Reading assignment Discussion QA	-Short Answer -True-False -Matching term
Application of spatial data manipulation and analysis	**Spatial data manipulation and analysis:** Convex hull, clipping, buffer analysis, dissolving and merging data, spatial query from attribute tables, reprojection, data conversion, extract values, reclassification, overlay and zonal statistics.	Lecture Group assignment Demonstration QA	-Short Answer -Completion -Practical exam -Peer rating
Competencies in fundamental map making	**Mapping:** component of a maps layout preparation and thematic mapping through integration of attribute tables and generation of multiple legends.	Lecture Discussion QA	-Short Answer -Essay -Matching term

Basic understanding of concepts of remote sensing Explain how electromagnetic radiation is used in remote sensing Ability to describe basic sensors and function	**Introduction to remote sensing:** What is remote sensing, electromagnetic radiation spectrum, interaction with the atmosphere, remote vs. proximal and passive vs active sensing, characteristics of remotely sensed imagery **Sensors:** location (ground, air, space), satellite types and their characteristics, pixel characteristics, resolution, cameras and aerial photography, type of sensors (multispectral, thermal and microwave)	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Checklist
Ability to describe the basic elements of visual image analysis Demonstrated analytical skill in selection of the most appropriate remote sensing imagery to perform specified analysis	**Image Analysis:** visual interpretation, digital image processing: enhancement, transformation, and classification. Optional: Digital elevation model data processing and production of hillshade, slope aspect, color relief, topographic position index, topographic ruggedness index and roughness.	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Checklist
Ability to work independently and with competence in basic GIS and RS analysis	**GIS and RS Applications:** Crop type mapping, crop monitoring, landuse and land cover mapping, and biomass mapping Optional: flood delineation, soil moisture, land surface temperature, drought mapping, fire analysis and burn mapping, precipitation mapping, precision agriculture applications.	Lecture Reading assignment Presentation QA	-Short Answer -Essay -Checklist

Recommended Books and Periodicals

1. Ahmed, Z.U., Krupnik, T.J., Kamal, M., 2018. Introduction to basic GIS and spatial analysis using QGIS: Applications in Bangladesh. Cereal Systems Initiative for South Asia (CSISA) and the International Maize and Wheat Improvement Center, CIMMYT. Dhaka, Bangladesh. http://csisa.org/wp-content/uploads/sites/2/2018/04/QGIS_CSISA_2018.pdf

2. Huisman, Otto and de By, Rolf. (2009). Principles of geographic information systems : an introductory textbook. https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf

3. Michael N. Demers (2003), Fundamentals of Geographic Information Systems, John Wiley & Sons Ltd. USA.

4. Ian Heywood, Sarah Cornelius and Steve Carver (1999), An Introduction to Geographical Information Systems; Longman, UK.

5. Peter A. Burrough and Rachael A. McDonnell (1998), Principles of Geographical Information Systems, Oxford University Press, UK.

6. Stan Aronoff (1995), Geographic Information Systems: A Management Approach, WDL Publications, Ottawa, Canada.

7. Christopher B. Jones (1999), Geographical Information Systems and Computer Cartography, Longmans, UK.

8. C.P. Lo & Albert K. W. Yeung (2002), Concepts and techniques of Geographic Information Systems, Prentice-Hall, New Delhi, India.

9. Principles of remote sensing: an introductory textbook. K. Tempfli, G.C. Huurneman, W.H. Bakker, L.L.F. Janssen, et al. Fourth edition. University of Twente, Nethrelands, 2009 ISBN 978-90-6164-270-1 Available for on-line reading: http://www.itc.nl/Pub/Home/library/Academic_output/ITC-GIS-and-Remote-Sensing-Textbooks.html

10. Fundamentals of remote sensing. Canada Centre for Mapping and Earth Observation, Natural Resources Canada. Available as PDF: http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9309

11. Fundamentals of Remote Sensing. NASA/ARSET PDF lectures and video recording: https://arset.gsfc.nasa.gov/webinars/fundamentals-remote-sensing

12. http://glad.geog.umd.edu/Potapov/_Library/Fundamentals_RS_Session2_Land_Final.pdf

13. Principles of remote sensing. Centre for Remote Imaging, Sensing and Processing. National University of Singapore On-line learning materials: http://www.crisp.nus.edu.sg/~research/tutorial/rsmain.htm

14. Science Education through Earth Observation for High Schools (SEOS) Project. On-line learning materials: http://www.seos-project.eu/home.html

15. Ahmad, Firoz & Farooq, Asim & Goparaju, Laxmi & Rizvi, Javed. (2020). The Geospatial Understanding of Climate-Smart Agriculture and REDD+ Implementation: Indian Perspective. Ekologia. 39. 72-87. 10.2478/eko-2020-0006.

16. FAO. *"Climate-smart" Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation*; Food and Agriculture Organization of the United Nations: Roma, Italy, 2010.
17. Adamides, G. "A Review of Climate-Smart Agriculture Applications in Cyprus." *MDPI*, Multidisciplinary Digital Publishing Institute, 25 Aug. 2020, www.mdpi.com/2073-4433/11/9/898/htm.