

DISCIPLINE SPECIFIC ELECTIVE (DSE-EVS-16): DATA ANALYTICS FOR ENVIRONMENTAL SUSTAINABILITY

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSE-EVS-16: DATA ANALYTICS FOR ENVIRONMENTAL SUSTAINABILITY	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Introduce the concepts and principles of data analytics in the context of environmental sustainability
- Enable to collect, process, analyze, and visualize environmental data using appropriate software tools and techniques
- Equip to apply statistical and machine learning techniques to environmental data analysis and interpretation
- Provide practical experience in using data analytics for environmental impact assessment, carbon accounting, and waste management
- Enhance understanding of the role of data analytics in promoting sustainable development and environmental stewardship

Learning outcomes:

After the course, students will be able to

- Describe the principles and importance of data analytics for environmental sustainability
- Collect and process environmental data using appropriate software tools
- Analyze environmental data using statistical and machine learning techniques.
- Visualize environmental data using appropriate software tools and techniques
- Apply data analytics to environmental impact assessment, carbon accounting, and waste management
- Demonstrate critical thinking, problem-solving, and decision-making skills related to environmental sustainability

SYLLABUS OF DSE-EVS-16

Theory (02 Credits: 30 lectures)

UNIT – I Introduction to Environmental Sustainability and Data Analytics

(2 Weeks) (4 lectures)

Introduction to environmental sustainability, Overview of data analytics, Importance of data analytics in environmental sustainability, Data types and sources for environmental sustainability, Techniques for data analysis and interpretation, Environmental data

visualization, Case studies in data analytics for environmental sustainability, Ethics of data collection and analysis in environmental sustainability

UNIT – II Environmental Data Collection and Processing (2 Weeks) (4 lectures)

Overview of environmental data collection methods, Techniques for cleaning and preprocessing environmental data, Quality assurance and quality control for environmental data, Big data and cloud computing for environmental data processing, Data warehousing and data management in environmental sustainability, Geographic information systems (GIS) for environmental data, Data integration and data fusion for environmental sustainability, Challenges and limitations of environmental data collection and processing

UNIT – III Data Analytics Techniques for Environmental Sustainability (2 Weeks) (4 lectures)

Introduction to statistical analysis for environmental data, Regression analysis for environmental data, Time series analysis for environmental data, Spatial analysis for environmental data, Machine learning techniques for environmental data analysis, Data clustering and classification for environmental sustainability, Network analysis for environmental sustainability, Visualization techniques for environmental sustainability data

UNIT – IV Modeling and Simulation for Environmental Sustainability (2 Weeks) (4 lectures)

Introduction to modeling and simulation in environmental sustainability, Modeling techniques for environmental sustainability, Environmental systems dynamics modelling, Agent-based modeling for environmental sustainability, System dynamics modeling for environmental sustainability, Optimization modeling for environmental sustainability, Monte Carlo simulation for environmental sustainability, Case studies in modeling and simulation for environmental sustainability

UNIT – V Environmental management and conservation using data analytics (2 Weeks) (4 lectures)

Data analytics for: environmental impact and risk assessment, environmental regulations compliance, conservation monitoring; Case studies of using data analytics in: biodiversity conservation, and water and waste management

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Introduction to R programming for environmental data analysis
2. Cleaning and preprocessing environmental data using Excel
3. Visualization of environmental data using Tableau
4. Regression analysis for environmental data using R
5. Time series analysis for environmental data using Python

6. Spatial analysis for environmental data using ArcGIS
7. Data clustering and classification for environmental sustainability using R
8. Monte Carlo simulation for environmental sustainability using Excel
9. Environmental impact assessment using data analytics
10. Carbon accounting and management using Excel
11. Analysis of weather and climate data using Python
12. Social media analysis for environmental sustainability using Netlytic

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Cooper, J. (2016). Environmental impact assessment: A practical guide (2nd ed.). Wiley-Blackwell.
- Grolemund, G., & Wickham, H. (2018). R for data science: Import, tidy, transform, visualize, and model data. O'Reilly Media.
- James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An Introduction to Statistical Learning: With Applications in R. Springer.
- Lawhead, J. (2018). Learning ArcGIS Pro. Packt Publishing.
- Matthews, H. D. (2020). Climate data analytics: An introductory guide. Cambridge University Press.
- Wall, D. H., & Evans, D. A. D. (2018). Environmental analytics: Methods and applications for the chemical and environmental sciences. Wiley.
- Zhang, Y., Lu, Y., & Guo, M. (2020). Big data analytics for environmental sustainability: Challenges, opportunities and practices. Springer.

Suggested readings

- Alexander, M. J., & Walkenbach, J. (2019). Excel 2019 Bible. Wiley.
- Kaufman, L., & Rousseeuw, P. J. (2009). Finding groups in data: An introduction to cluster analysis (2nd ed.). Wiley.
- Murray, S. (2020). Tableau your data!: Fast and easy visual analysis with Tableau Software. Wiley.
- Petts, J. (2018). Handbook of environmental impact assessment (2nd ed.). Wiley.
- Sleeter, B. M., & Davis, K. F. (2019). Mapping with ArcGIS Pro: Design accurate and user-friendly maps to share the story of your data. Packt Publishing.
- VanderPlas, J. (2016). Python data science handbook: Essential tools for working with data. O'Reilly Media.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.