

## DISCIPLINE SPECIFIC ELECTIVE (DSE-EVS-17): ENVIRONMENTAL SUSTAINABILITY AND DATA VISUALIZATION

### 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-17:<br>ENVIRONMENTAL SUSTAINABILITY AND DATA VISUALIZATION | 4       | 2                                 | 0        | 2                   | Class XII pass       | NA                          |

### Learning objectives

The Learning Objectives of this course are as follows:

- Develop skills in data collection, cleaning, and preparation for visualization
- Learn various data visualization techniques for environmental data analysis and communication
- Apply data analysis and visualization skills to real-world environmental sustainability problems
- Develop critical thinking skills in environmental sustainability and data visualization

### Learning outcomes:

After the course, students will be able to

- Collect, clean, and prepare environmental data for analysis and visualization
- Use various data visualization techniques such as line charts, heat maps, and tree maps for environmental data analysis and communication
- Apply data analysis and visualization skills to real-world environmental sustainability problems and create compelling data visualization presentations
- Develop critical thinking skills in environmental sustainability and data visualization and evaluate the effectiveness of different visualization techniques for different audiences

### SYLLABUS OF DSE-EVS-17

Theory (02 Credits: 30 lectures)

#### UNIT – I Introduction to Environmental Sustainability and Data Visualization (2 Weeks) (4 lectures)

Introduction to environmental sustainability, Introduction to data visualization, Overview of environmental data sources, Role of data visualization in environmental sustainability, Basic statistical concepts, Introduction to data analysis software (e.g. Excel, R, Python), Introduction to data visualization software (e.g. Tableau, Power BI), Case studies in environmental sustainability and data visualization

### **UNIT – II Climate Change and Data Visualization (2 Weeks) (4 lectures)**

Overview of climate change and its causes, Analysis of climate change data (e.g. temperature, carbon emissions), Visualization of climate change data (e.g. line charts, heat maps), Communicating climate change data to various audiences, Case studies in climate change data visualization

### **UNIT – III Resource Depletion and Data Visualization (2 Weeks) (4 lectures)**

Overview of resource depletion (e.g. water, oil, minerals), Analysis of resource depletion data, Visualization of resource depletion data (e.g. bar charts, scatter plots), Communicating resource depletion data to various audiences, Case studies in resource depletion data visualization

### **UNIT – IV Pollution and Data Visualization (2 Weeks) (4 lectures)**

Overview of pollution (e.g. air, water, soil), Analysis of pollution data, Visualization of pollution data (e.g. maps, histograms), Communicating pollution data to various audiences, Case studies in pollution data visualization

### **UNIT – V Biodiversity Loss and Data Visualization (2 Weeks) (4 lectures)**

Overview of biodiversity loss, Analysis of biodiversity data, Visualization of biodiversity data (e.g. network graphs, tree maps), Communicating biodiversity data to various audiences, Case studies in biodiversity data visualization

### **UNIT – VI Sustainability in Industry and Data Visualization (2½ Weeks) (5 lectures)**

Overview of sustainability in various industries (e.g. agriculture, energy, transportation), Analysis of sustainability data in industry, Visualization of sustainability data in industry (e.g. bubble charts, stacked bars), Communicating sustainability data in industry to various audiences, Case studies in sustainability data visualization in industry

### **UNIT – VII Communicating Environmental Data (2½ Weeks) (5 lectures)**

Overview of communication strategies for environmental data, Choosing appropriate visualization types for different audiences, Design principles for effective data visualizations, Best practices for communicating environmental data, Case studies in effective communication of environmental data

### **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. Understand the basics of data visualization and different types of charts/graphs
2. Analyze climate change data and create visualizations using line charts and heat maps
3. Examine data on resource depletion and generate visual representations using bar graphs and scatter plots.
4. Create visual representations of pollution data by using maps and histograms after examining the dataset.

5. Analyze biodiversity data and create visualizations using network graphs and tree maps.
6. Assess sustainability data across different industries and produce visualizations using stacked bars and bubble charts.
7. Design effective visualizations and communicate environmental data to various audiences.
8. Use GIS software to analyze and visualize environmental data
9. Collect environmental data from online sources using web scraping techniques.
10. Use NLP techniques to analyze environmental data from textual sources.
11. Create visualizations that support decision-making processes related to environmental sustainability.
12. Use data storytelling techniques to communicate environmental sustainability issues and solutions

### 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

- Berg, L. R., & Hassenzahl, D. M. (2016). *Visualizing Environmental Science*. John Wiley & Sons.
- Cairo, A. (2019). *How Charts Lie: Getting Smarter about Visual Information*. W. W. Norton & Company.
- Healy, K. (2018). *Data Visualization: A Practical Introduction*. Princeton University Press.
- Theus, M. (2019). *Interactive Data Visualization: Foundations, Techniques, and Applications*. Chapman and Hall/CRC.
- Tufte, E. R. (2017). *The Visual Display of Quantitative Information*. Graphics Press.

### Suggested readings

- Baumer, B., Kaplan, D. T., & Horton, N. J. (2020). *Modern Data Science with R*. CRC Press.
- Handbook: Berg, L. R., & Hassenzahl, D. M. (2016). *Visualizing Environmental Science*. John Wiley & Sons.
- Kellner, K., & Niederer, C. (Eds.). (2019). *Data Visualization in Society*. Amsterdam University Press.
- Mann, D. J. (2018). *Data Visualization for Social Science: A Practical Introduction with R and ggplot2*. Routledge.
- Theus, M. (2019). *Interactive Data Visualization: Foundations, Techniques, and Applications*. Chapman and Hall/CRC.
- Wickham, H., & Grolemund, G. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media.

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