Course Title: Data Visualization

Course Code: CSE628

Exam Hours: 2   **CIE Marks**: 60
Credits: 3   **SEE Marks**: 40

Course Description (from syllabus)/Rational:
"A picture is worth a thousand words". We are all familiar with this expression. It especially applies when trying to explain the insight obtained from the analysis of increasingly large datasets. Data visualization plays an essential role in the representation of both small and large-scale data.

One of the key skills of a data scientist is the ability to tell a compelling story, visualizing data and findings in an approachable and stimulating way. Learning how to leverage a software tool to visualize data will also enable you to extract information, better understand the data, and make more effective decisions.

The main goal of this Data Visualization course is to learn how to take data that at first glance has little meaning and present that data in a form that makes sense to people. Various techniques have been developed for presenting data visually but in this course, we will be using several data visualization libraries in Python, namely Matplotlib, Seaborn, and Folium.

Course Learning Outcomes (COs) after successfully completing this course, a student will be able to:

CLO1	Design and create data visualizations and Conduct exploratory data analysis using visualization.
CLO2	Use knowledge of perception and cognition to evaluate visualization design alternatives.
CLO3	Identify opportunities for application of data visualization in various domains.
CLO4	Critique existing visualizations based on data visualization theory and principles.

Mapping of Course Learning Outcomes to Program Learning Outcomes [attainment level used for COs from 1(weak)-3(strong) correlation]

PO's/ CO's	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1				2								
CLO2		3										
CLO3				2								
CLO4		3										

Teaching and Learning Activities (TLAs):

TLA1	Lectures once a week using multimedia and board and marker of different topics.
TLA2	Active discussion in class regarding efficient solving of the logical and mathematical problems.
TLA3	Group discussion and presentation regarding diverse problems and corresponding lectures.
TLA4	Evaluation of class performances in order to reach each student in a class for every topic.

Course Plan/Lesson Plan

Week	Lesson	Topic	Teaching and Learning Activities (TLA's)	Assessment (Asg./CT/Mid/Final)
1	Les. 1 (Theory)	**a.** Why Visualize Data? **b.** Introduction to SVG and CSS. **c.** Introduction to JavaScript. **d.** Introduction to VizHub. **e.** Making a Face with D3.js.	TLA1	None
2, 3	Les. 2, 3 (Theory)	Input for Visualization: Data and Tasks Loading and Parsing Data with D3.js	TLA1, TLA2	MCQ for overall assessment of class prior to class test
4	Les. 4 (Theory)	**a.** Bar Chart, Vertical & Horizontal **b.** Pie Chart and Coxcomb Plot **c.** Line Chart **d.** Area Chart	TLA2, TLA4, TLA1	Class Test # 1
5	Les. 5 (Theory)	Making Maps Visualizing Trees and Networks	TLA1, TLA2, TLA2	
6	Les. 6 (Theory)	**a.** Adding interaction with Unidirectional Data Flow **b.** Using UI elements to control a scatter plot **c.** Panning and Zooming on a Globe **d.** Adding tooltips	TLA1, TLA2	
7	**Midterm Examination**			
8	Les. 7 (Theory)	**a.** Small Multiples **b.** Linked Highlighting with Brushing **c.** Linked Navigation: Bird's Eye Map	TLA3, TLA4, TLA1	Class Test # 2
9	Les. 8, 9 (Theory)	**a.** Histograms **b.** Aggregating Data with Group-By **c.** Hexbin Mapping **d.** Crossfiltering	TLA3, TLA4, TLA1	Team Project Presentation
10	Les. 10 (Theory)	Ethical Frameworks: Building a Migrant Deaths Dashboard	TLA1, TLA3, TLA2	
11, 12	Les. 11, 12 (Theory)	**a.**	TLA3, TLA4, TLA1	Class Test # 3
13	Les. 13	**a.**	TLA1, TLA2,	

	(Theory)		TLA4	
14	**Final Examination**			

Textbook

Ethical Data and Information Management: Concepts, Tools and Methods; Katherine O'Keefe

Reference Books

Encyclopedia of Information Ethics and Security, Marian Quigley

CIE – Breakup (Theory) [60 marks]

Bloom's Criteria	Attendance (07)	Class Test (15)	Assignment (05)	Presentation (08)	Mid Exam (25)
Remember		05			
Understand		05	02	02	05
Apply		05		03	05
Analyze			03		05
Evaluate					05
Create				03	05

SEE – Semester End Examination [40 marks] {Theory}

Bloom Criteria	Score for the Test
Remember	05
Understand	05
Apply	15
Analyze	05
Evaluate	05
Create	05

Program Outcomes and Assessment

Program Outcomes (POs) are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and

attitudes that students acquire while progressing through the program. The program must demonstrate that by the time of graduation, students have attained a certain set of knowledge, skills and behavioral traits to some acceptable minimum level. The BAETE specifically requires that students acquire the following graduate attributes.

[PO1] Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

[PO2] Problem analysis: Identify, formulate, research the literature and analyze complex engineering problems and reach substantiated conclusions using first principles of mathematics, the natural sciences and the engineering sciences.

[PO3] Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety as well as cultural, societal and environmental concerns.

[PO4] Investigation: Conduct investigations of complex problems, considering design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.

[PO5] Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO6] The engineer and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

[PO7] Environment and sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

[PO8] Ethics: Apply ethical principles and commit to professional ethics, responsibilities and the norms of the engineering practice.

[PO9] Individual work and teamwork: Function effectively as an individual and as a member or leader of diverse teams as well as in multidisciplinary settings.

[PO10] Communication: Communicate effectively about complex engineering activities with the engineering community and with society at large. Be able to comprehend and write effective reports, design documentation, make effective presentations and give and receive clear instruction.

[PO11] Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work as a member or a leader of a team to manage projects in multidisciplinary environments.

[PO12] Life-long learning: Recognize the need for and have the preparation and ability to engage in independent, life-long learning in the broadest context of technological change.