# BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
## WORK INTEGRATED LEARNING PROGRAMMES

## COURSE HANDOUT-REGULAR

## Part A: Content Design

| | |
|---|---|
| **Course Title** | **Data Visualization and Interpretation** |
| **Course No(s)** | **ZG555** |
| **Credit Units** | 5 |
| **Course Author** | Febin.A.Vahab |
| **Version No** | 1.0 |
| **Date** | |

**Course Description**

The Context of Data Visualization, the importance of context, choosing an effective visual, clutter is your enemy, focus your audience's attention, think like a designer, dissecting model visuals, lessons in storytelling, taxonomy of Data Visualization Methods, Clarifying the Vision, Variations in Dashboard Uses and Data, Common Mistakes in Dashboard Design, Tapping into the Power of Visual Perception, Applying the Principles of Visual Perception to Dashboard Design, Characteristics of a Well-Designed Dashboard, Effective Dashboard Display Media, Designing Dashboards for Usability. Explore Tableau, Python Libraries-Matplotlib, Seaborn, Bokeh.

**Course Objectives**

| No | Description |
|---|---|
| **CO1** | To introduce key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction. |
| **CO2** | Solving various visualization problems using tools like Tableau and Python. |
| **CO3** | Best Practices of Dashboard Design, Designing dashboards meeting the design principles for various requirements |

**Learning Outcomes:**

| No | Learning Outcomes |
|---|---|
| LO1 | Concepts and best practices of Data Visualization |
| LO2 | Best practices of Information Dashboard Design |
| LO3 | Data Visualization using Tableau |
| LO4 | Data Visualization using Python |

| Text Book(s) | |
|---|---|
| T1 | Data Visualisation : A Successful Design Process By Andy Kirk |
| T2 | Storytelling with Data, A data visualization guide for business professionals, by Cole Nussbaumer Knaflic; Wiley |
| T3 | Information Dashboard Design: Displaying data for at-a-glance monitoring, Stephen Few, second edition |
| **Reference Book** | |
| R1 | Matplotlib for Python Developers: Effective techniques for data visualization with Python, by Aldrin Yim, Claire Chung and Allen Yu |

# Part B: Content Development Plan

| | |
|---|---|
| **Academic Term** | **Second Semester 2019-20** |
| **Course Title** | **Data Visualization and Interpretation** |
| **Course No** | **DSECL ZG555** |
| **Credit** | 5 |
| **Content Developer** | Febin.A.Vahab |

**Glossary of Terms**

| Module | M | Module is a standalone quantum of designed content. A typical course is delivered using a string of modules. M2 means module 2. |
|---|---|---|
| Contact Session | CS | Contact Session (CS) stands for a 2 hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 16 CS. |
| Lab Exercises | LE | Lab exercises associated with various modules |

**Modular Structure**

| No. | Title of the Module |
|---|---|
| M1 | Data Visualizations and Practices |
| M2 | Data Visualization with Tableau |
| M3 | Effective Dashboard Design |
| M4 | Data Visualization with Python – 1   (Matplotlib) |
| M5 | Data Visualization with Python – 2   (Seaborn,Bokeh) |

**Detailed Structure**

| Type | Description/Plan | Reference Text Book/Chapters |
|---|---|---|
| **M1: Data Visualizations and Practices**<br>**Contact Session 1-5** | | |
| CS1 | • Introduction<br>• Exploiting the Digital age<br>• Visualisation as a Discovery tool<br>• Visualisation skills for the masses<br>• The Visualisation methodology<br>• Visualisation design objectives<br>• Exploratory vs. explanatory analysis<br>• Understanding the context for data presentations | T1 Ch 1<br>T2 Ch 1 |
| CS2 | • Choosing an effective Visual<br>• Cluttering<br>• Pre-attentive Attributes<br>• Design concepts<br>• Dissecting model visuals | T2 Ch 2<br>T2 Ch 3<br>T2 Ch 4<br>T2 Ch 5<br>T2 Ch 6 |
| CS3 | • Lessons in Storytelling<br>**Taxonomy of Data Visualisation Methods**<br>• Comparing Categories<br>   • Dot Plot<br>   • Bar Chart<br>   • Floating Bar | T2 Ch 7<br>T1 Ch 5 |
| CS4 | **Taxonomy of Data Visualisation Methods**<br>• Comparing Categories (contd..)<br>   • Histogram<br>   • Radial Chart<br>   • Glyph Chart<br>• Assessing hierarchies and part-to-whole relationships<br>• Showing changes over time<br>• Plotting connections and relationships<br>• Mapping geo-spatial data | T1 Ch 5 |
| CS5 | [This session can be planned so as to give an overview of latest tools (other industry relevant tools beyond those covered in the course) available in the market.]<br>**Data Visualization Tools:** Landscape of Data Visualization tools<br>• Desktop based tools<br>• Online visualization tools<br>• Visualization libraries<br>• Open source vs Proprietary tools | Documentations of listed products / services / tools |

**M2: Data Visualization with Tableau**
**Contact Session 6-8**

| Type | Description/Plan | Reference |
|---|---|---|
| CS6 | • Creating Visual Analytics with Tableau Desktop<br>• Connecting to Your Data | https://help.tableau.com/current/pro/desktop/en-us/whatsnew_desktop.htm |
| CS7 | • Building Your Visualizations<br>• Creating Calculations to Enhance Your Data | |
| CS8 | • Using Maps to Improve Insight<br>• Developing an Ad Hoc Analysis Environment | |
| **SELF STUDY** | | |
| | • Explore the different types of visuals that can be plotted with Tableau interface | |

**M3: Effective Dashboard Design**
**Contact Session 9-11**

| Type | Description/Plan | Reference |
|---|---|---|
| CS9 | • Dashboard-Introduction<br>• Variations in Dashboard Uses and Data<br>   • Categorizing Dashboards<br>   • Typical Dashboard Data<br>• Common Mistakes in Dashboard Design | T3 Ch 1<br>T3 Ch 2<br>T3 Ch 5<br>T3 Ch 3 |
| CS10 | • Power of Visual Perception<br>   • Understanding the Limits of Short-Term Memory<br>   • Visually Encoding Data for Rapid Perception<br>   • Applying the Principles of Visual Perception to Dashboard Design<br>• Characteristics of a Well-Designed Dashboard<br>• Effective Dashboard Display Media<br>• Dashboards design for Usability | T3 Ch 4<br>T3 Ch 5<br>T3 Ch 6<br>T3 Ch 7 |
| CS11 | • Building Your First Advanced Dashboard<br>   • Best Practices for Effective Dashboards<br>   • Create a Dashboard<br>   • Size and Lay Out Your Dashboard<br>   • Build Accessible Dashboards<br>• Tableau Stories<br>   • The Story Workspace<br>   • Best Practices for Telling Great Stories<br>   • Create a Story<br>   • Example – A Story That Examines a Trend | https://help.tableau.com/current/pro/desktop/en-us/dashboards.htm<br><br>https://help.tableau.com/current/pro/desktop/en-us/stories.htm |

**M4: Data Visualization with Python – 1 (Matplotlib)**
**Contact Session 12-13**

| Type | Description/Plan | Reference |
|------|------------------|-----------|
| CS12 | <ul><li>Merits of Matplotlib</li><li>Matplotlib visuals basics</li><li>Getting Started with Matplotlib</li><li>Decorate Graphs with Plot Styles and Types</li><li>Advanced Matplotlib</li></ul> | R1 Ch 1<br>R1 Ch 2<br>R1 Ch 3<br>R1 Ch 4 |
| CS13 | **Matplotlib in the real word**<ul><li>Plotting data from a database</li><li>Plotting data from a CSV file</li><li>Plotting data from the Web</li><li>Plotting extrapolated data using curve fitting</li><li>Plotting geographical data</li></ul> | R1 Ch 9 |

**M5: Data Visualization with Python – 2 (Seaborn and Bokeh)**
**Contact Session 14-16**

| Type | Description/Plan | Reference |
|------|------------------|-----------|
| CS14 | **Seaborn package**<ul><li>Seaborn vs Matplotlib</li><li>Seaborn Vs MatplotLib</li><li>Seaborn Plotting Statistical Relationships</li><li>Seaborn Visualizing Continuity with Lines</li><li>Seaborn Plotting Categorical Data</li><li>Seaborn Plotting Univariate Distribution</li><li>Seaborn Plotting BiVariate Distributions</li><li>Seaborn Plotting Linear Regression Models</li></ul> | https://seaborn.pydata.org/<br><br>https://www.datacamp.com/community/tutorials/seaborn-python-tutorial<br><br>https://www.datacamp.com/courses/introduction-to-data-visualization-with-python |
| CS15<br>CS16 | **Bokeh**<ul><li>Bokeh introduction</li><li>Bokeh Building Blocks</li><li>Bokeh Glyphs</li><li>Bokeh Simple Plots</li><li>Bokeh Plotting with Different Data Structures</li><li>Bokeh Decorating the Visuals</li><li>Bokeh Interactive Server Side Applications</li></ul> | https://docs.bokeh.org/en/latest/docs/user_guide.html#userguide |

**Detailed Plan for Lab work**

| Lab No | Lab Objective | Lab Sheet Access URL | Content Reference |
|---|---|---|---|
| LE 1 | Getting Started with Tableau | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #2 |
| LE 2 | Visual Analysis with Tableau | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #2 |
| LE 3 | Advanced Visual Analytics with Tableau | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #2 |
| LE 4 | Dashboards and Storytelling with Tableau | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #3 |
| LE 5 | Getting started with Python | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #4 |
| LE 6 | Plotting Visuals with Matplotlib. | http://bitscsis.vlabs.platifi.com/index1.html#!/resources | Module #4 |

**Detailed Plan for Case studies**

| Case study No | Case study Objective | Case study Sheet Access URL |
|---|---|---|
| 1 | Importance of visualization in data analysis | Insert Link here |

**Evaluation Scheme**:
Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

| No | Name | Type | Duration | Weight | Day, Date, Session, Time |
|---|---|---|---|---|---|
| EC-1 | Quiz | Online | - | 5% | |
| EC-1 | Assignment | Online | - | 25% | |
| EC-2 | Mid-Semester Test | Closed Book | 1.5 hours | 30% | |
| EC-3 | Comprehensive Exam | Open Book | 2.5 hours | 40% | |

**Note: Assignment can be replaced by QUIZ also.**
Syllabus for Mid-Semester Test (Closed Book): Topics in Session Nos. 1 to 8
Syllabus for Comprehensive Exam (Open Book): All topics (Session Nos. 1 to 16)

**Important links and information:**
**CANVAS:** https://bits-pilani.instructure.com/
Students are expected to visit the CANVAS course page on a regular basis and stay up to date with the latest announcements and deadlines.
Contact sessions: Students should attend the online lectures as per the schedule provided on CANVAS.
Evaluation Guidelines:
1. EC1 consists of two assignments(Quiz/Assignment). Announcements will be made on the portal, in a timely manner.

2. For Closed Book tests: No books or reference material of any kind will be permitted.
3. For Open Book exams: Use of books and any printed / written reference material (filed or bound) is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam which will be made available in CANVAS. The Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self study schedule as given in the course handout, attend the online lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.