**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**

**WORK INTEGRATED LEARNING PROGRAMMES**

**HANDOUT-FLIPPED**

**Part A: Course Design**

|  |  |
| --- | --- |
| **Course Title** | **Data Visualization** |
| **Course No(s)** | **BA ZC420 / SE ZC420** |
| **Credit Units** | **4** |
| **Credit Model** |  |
| **Content Authors** | SWARNA CHOUDHARY |

**Course Objectives**

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| --- | --- |
| **No** | Description |
| **CO1** | The course aims at understanding the concept of good data visualization |
| **CO2** | Best Practices of Dashboard Design |
| **CO3** | Data Visualization using Tableau |
| **CO4** | Data Visualization using Python (Bokeh/Matplotlib/Seaborn) |

**Text Book(s)**

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| --- | --- |
| T1 | Storytelling with Data, A data visualization guide for business professionals, by Cole Nussbaumer Knaflic; Wiley |
| T2 | Information Dashboard Design: Displaying data for at-a-glance monitoring, Stephen Few, second edition |

**Reference Book(s) & other resources**

|  |  |
| --- | --- |
| R1 | Hands on Data Visualization with Bokeh: Interactive web plotting for Python using Bokeh, by Kevin Jolly |

**Learning Outcomes:**

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| --- | --- |
| 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 (Bokeh/Matplotlib/Seaborn) |

**Part B: Content Development Plan**

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| --- | --- |
| **Academic Term** | Second Semester 2020-2021 |
| **Course Title** | Data Visualization |
| **Course No** | **BA ZC420 / SE ZC420** |
| **Content Developer** | SWARNA CHOUDHARY |

**Glossary of Terms**

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| --- | --- | --- |
| **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 Hour** | **CH** | Contact Hour (CH) stands for an 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 32 CH. |
| **Recorded Lecture** | **RL** | RL stands for Recorded Lecture or Recorded Lesson. It is presented to the student through an online portal. A given RL unfolds as a sequences of video segments interleaved with exercises. |
| **Lab Exercises** | **LE** | Lab exercises associated with various modules |
| **Self-Study** | **SS** | Specific content assigned for self study |
| **Homework** | **HW** | Specific problems/design/lab exercises assigned as homework |

**Modular Structure**

**Module Summary**

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| --- | --- |
| **No.** | **Title of the Module** |
| M1 | Introducing Data Visualizations |
| M2 | Designing Visuals |
| M3 | Building Dashboards |
| M4 | Exploring Data Visualization Tools |
| M5 | Visual Analytics with Tableau |
| M6 | Plotting Visuals with Python |

**Detailed Structure**

**M1: Introducing Data Visualizations**

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| --- | --- | --- |
| **Type** | **Description/Plan/Reference** | |
| DV\_RL\_1.1.1 | Why Data Visualizations? | |
| DV\_RL\_1.1.2 | Explanatory Analysis | |
| DV\_RL\_1.1.3 | Understanding Context | |
| DV\_RL\_1.1.4 | Storytelling Ideas | |
| DV\_RL\_1.1.5 | Tables & related visuals | |
| DV\_RL\_1.1.6 | Axis based Visualization | |
| DV\_RL\_1.1.7 | Visuals to be Avoided | |
| CS 1.1 | * Need for visualizations in data analysis * Understanding Context with example | T1 Ch 1 |
| CS 1.2 | * Discussion of Storytelling Concepts * Guidelines for selection of visuals | T1 Ch1,2 |
| SS 1 | * [Why Do We Visualize Quantitative Data?](https://www.perceptualedge.com/blog/?p=1897) * [Data Visualization – How to Pick the Right Chart Type?](https://eazybi.com/blog/data_visualization_and_chart_types/) * [5 Things You Should Know Before You Make a Pie Chart](https://blog.socialcops.com/academy/resources/5-things-know-make-pie-chart/) | |

**M2: Designing Visuals**

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| --- | --- | --- | --- |
| **Type** | **Description/Plan/Reference** | | |
| Effective Visuals Design-I | | | |
| DV\_RL\_2.1.1 | Cognitive Load | | |
| DV\_RL\_2.1.2 | Clutter | | |
| DV\_RL\_2.1.3 | Gestalts' Principle of Visual Medium | | |
| DV\_RL\_2.1.4 | Other types of Clutter | | |
| DV\_RL\_2.1.5 | Decluttering Exercise I | | |
| DV\_RL\_2.1.6 | Decluttering Exercise II | | |
| CS 2.1 | * Cognitive Load and Clutter * Visual Ordering | | T1 Ch3 |
| CS 2.2 | * Use of Contrast * Guidelines for decluttering of visuals | | T1 Ch3 |
| SS 2 | * [Designing great visualizations](https://www.tableau.com/sites/default/files/media/designing-great-visualizations.pdf) * [Visual Perception](https://www.perceptualedge.com/articles/ie/visual_perception.pdf) | | |
| Effective Visuals Design-II | | | |
| DV\_RL\_2.2.1 | Types of Memory | | |
| DV\_RL\_2.2.2 | Pre-attentive Attributes in Texts/Tables | | |
| DV\_RL\_2.2.3 | Pre-attentive Attributes in Graphs | | |
| DV\_RL\_2.2.4 | Strategic Use of Color in Visuals | | |
| DV\_RL\_2.2.5 | Visual Makeover Case Study | | |
| DV\_RL\_2.2.6 | Design Concepts I | | |
| DV\_RL\_2.2.7 | Design Concepts II | | |
| CS 3.1 | * Grabbing Audience Attention * Examples of pre-attentive attribute usage | T1 Ch4 | |
| CS 3.2 | * Examples of usage of traditional design concept in visuals design | T1 Ch5 | |
| SS 3 | * [The Data Visualization Design Process: A Step-by-Step Guide for Beginners](https://depictdatastudio.com/data-visualization-design-process-step-by-step-guide-for-beginners/) | | |

**M3: Building Dashboards**

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| **Type** | **Description/Plan/Reference** | |
| Dashboard | | |
| DV\_RL\_3.1.1 | Dashboards | |
| DV\_RL\_3.1.2 | Types of Dashboards | |
| DV\_RL\_3.1.3 | Characteristic of Dashboard | |
| DV\_RL\_3.1.4 | Dashboard Data | |
| CS 4.1 | * Discussion about Performance Dashboards | T2 Ch1,2 |
| CS 4.2 | * Example dashboards from different domains like sales, finance etc. | T2 Ch8 |
| SS 4 | * [A Guide to Creating Dashboards People love to use, Translating Delicious Data into a Beautiful Design](https://static1.squarespace.com/static/52f42657e4b0b3416ff6b831/t/55b9117ae4b060a0d84fef15/1438191994754/Dashboards_People_Love_To_Use_Whitepaper_v2.pdf) | |
| Dashboard Design | | |
| DV\_RL\_3.2.1 | Mistakes in Dashboard Design I | |
| DV\_RL\_3.2.2 | Mistakes in Dashboard Design II | |
| DV\_RL\_3.2.3 | Visual Design Process - I | |
| DV\_RL\_3.2.4 | Visual Design Process - II | |
| DV\_RL\_3.2.5 | Visual Design Process - III | |
| DV\_RL\_3.2.6 | Visual Design Process - IV | |
| DV\_RL\_3.2.7 | Visualization / Dashboards Tools Overview | |
| CS 5.1 | * More examples about dashboard design mistakes * Illustration of Visual Design Process | T2 Ch3  T2 Ch5 |
| CS 5.2 | * Dashboard for Usability * Dashboard / Visualization tools Orientation | T2 Ch7 |
| SS 5 | * [Pervasive Hurdles to Effective Dashboard Design](https://www.perceptualedge.com/articles/visual_business_intelligence/pervasive_hurdles_to_dd.pdf) * [Dashboard Design for at-a-glance monitoring](http://www.perceptualedge.com/files/Dashboard_Design_Course.pdf) * [3 Key Criteria When Selecting Data Visualization Tools](https://www.business2community.com/big-data/3-key-criteria-selecting-data-visualization-tools-01565960#wZfj51hTyThYSuHQ.97) * [20 free and open source data visualization tools](https://dzone.com/articles/20-free-and-open-source-data-visualization-tools) | |

**M4: Exploring Data Visualization Tools**

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| **Type** | **Description/Plan/Reference** | |
| DV\_RL\_4.1.1 | Google Data Studio (GDS) | |
| DV\_RL\_4.1.2 | GDS - Connect | |
| DV\_RL\_4.1.3 | GDS - Visualize I | |
| DV\_RL\_4.1.4 | GDS - Visualize II | |
| DV\_RL\_4.1.5 | GDS - Share | |
| DV\_RL\_4.1.6 | Microsoft PowerBI | |
| DV\_RL\_4.1.7 | PowerBI Data Connections | |
| DV\_RL\_4.1.8 | PowerBI Dashboard Design | |
| DV\_RL\_4.1.9 | PowerBI Dashboard Shairing | |
| CS 6.1 | * Exploration Data using Google Data Studio features | GDS Docs |
| CS 6.2 | * Analysis of Data using Microsoft Power BI desktop version | PowerBI Docs |
| SS 6 | * [10 Best Practices for Building Effective Dashboards](https://www.tableau.com/learn/whitepapers/10-best-practices-building-effective-dashboards) * [A Beginner's guide and tutorial for Google Data Studio](https://www.seerinteractive.com/blog/google-data-studio-tutorial/) * [Microsoft PowerBI Getting Started Tutorial](https://docs.microsoft.com/en-us/power-bi/desktop-getting-started) | |

**M5: Visual Analytics with Tableau**

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| Type | Description/Plan/Reference | |
| Analyzing Data with Tableau-I | | |
| DV\_RL\_5.1.1 | Need for Visual Analysis | |
| DV\_RL\_5.1.2 | Tableau Ecosystem | |
| DV\_RL\_5.1.3 | Tableau Desktop Getting Started | |
| DV\_RL\_5.1.4 | Tableau Data Connections | |
| DV\_RL\_5.1.5 | Tableau Metadata Management | |
| DV\_RL\_5.1.6 | Tableau Data Extracts | |
| DV\_RL\_5.1.7 | Tableau Data Prep | |
| DV\_RL\_5.1.8 | Tableau Joins | |
| DV\_RL\_5.1.9 | Tableau Data Blending | |
| DV\_RL\_5.1.10 | Tableau Visual Analysis | |
| DV\_RL\_5.1.11 | Tableau Visual Interface | |
| DV\_RL\_5.1.12 | Tableau Drill Downs and Hierarchies | |
| DV\_RL\_5.1.13 | Tableau Sorting | |
| DV\_RL\_5.1.14 | Tableau Grouping | |
| CS 7.1 | * Discussion Visual Analysis for Everyone * Data Preparation with Tableau Desktop features | Tableau Learning |
| CS 7.2 | * Exploring Cards , Shelves on Visual Interface * Data Exploration with Tableau Features | Tableau Learning |
| SS 7 | * [Visual Analysis Best Practices: A Guidebook](https://www.tableau.com/learn/whitepapers/tableau-visual-guidebook) * [Tableau for Students](https://www.tableau.com/academic/students) * [Best practices for tidy data using Tableau](https://www.tableau.com/learn/whitepapers/data-prep-best-practices) | |
| Analyzing data with Tableau-II | | |
| DV\_RL\_5.2.1 | Tableau Filtering | |
| DV\_RL\_5.2.2 | Tableau Parameters | |
| DV\_RL\_5.2.3 | Tableau Calculations I | |
| DV\_RL\_5.2.4 | Tableau Calculations II | |
| DV\_RL\_5.2.5 | Tableau Calculations III | |
| DV\_RL\_5.2.6 | Tableau Dashboard I | |
| DV\_RL\_5.2.7 | Tableau Dashboard II | |
| DV\_RL\_5.2.8 | Tableau Dashboard III | |
| DV\_RL\_5.2.9 | Tableau Stories | |
| CS 8.1 | * Exploring Filtering, Groups, Hierarchies in detail * Exploring Tableau Built-in Functions | Tableau Learning |
| CS 8.2 | * Story-boarding data story * Putting Compelling Data Visualizations into Persuasive Business Presentations | Tableau Learning |
| SS 8 | * [Get Started with Tableau Desktop](https://onlinehelp.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-connect.htm) * [Best Practices for Telling Great Stories](https://onlinehelp.tableau.com/current/pro/desktop/en-us/story_best_practices.htm) | |

**M6: Plotting Visuals with Python**

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| Type | Description/Plan/Reference | |
| Plotting Visuals with MatplotLib | | |
| DV\_RL\_6.1.1 | Matplotlib Installattion | |
| DV\_RL\_6.1.2 | MatplotLib First Visual | |
| DV\_RL\_6.1.3 | Parts of Visual | |
| DV\_RL\_6.1.4 | Life Cycle of a Plot | |
| DV\_RL\_6.1.5 | MatlplotLib PyPlot | |
| DV\_RL\_6.1.6 | MatplotLib Plotting Other Visuals | |
| CS 9.1 | * Data Visualization samples with MatplotLib | Matplotlib Docs |
| CS 9.2 | * Geospatial and Three D visualization with MatplotLib | Matplotlib Docs |
| SS 9 | * [Samples MatplotLib charts](https://matplotlib.org/tutorials/introductory/sample_plots.html#sphx-glr-tutorials-introductory-sample-plots-py) * [Pyplot tutorial](https://matplotlib.org/tutorials/introductory/pyplot.html#sphx-glr-tutorials-introductory-pyplot-py) | |
| Plotting Visuals with Seaborn and Bokeh | | |
| DV\_RL\_6.2.1 | Seaborn Vs MatplotLib | |
| DV\_RL\_6.2.2 | Seaborn Plotting Statistical Relationships | |
| DV\_RL\_6.2.3 | Seaborn Visualizing Continuity with Lines | |
| DV\_RL\_6.2.4 | Seaborn Plotting Categorical Data | |
| DV\_RL\_6.2.5 | Seaborn Plotting Univariate Distribution | |
| DV\_RL\_6.2.6 | Seaborn Plotting BiVariate Distributions | |
| DV\_RL\_6.2.7 | Seaborn Plotting Linear Regression Models | |
| DV\_RL\_6.2.8 | Bokeh introduction | |
| DV\_RL\_6.2.9 | Bokeh Building Blocks | |
| DV\_RL\_6.2.10 | Bokeh Glyphs | |
| DV\_RL\_6.2.11 | Bokeh Simple Plots | |
| DV\_RL\_6.2.12 | Bokeh Plotting with Different Data Structures | |
| DV\_RL\_6.2.13 | Bokeh Decorating the Visuals | |
| DV\_RL\_6.2.14 | Bokeh Interactive Server Side Applications I | |
| DV\_RL\_6.2.15 | Bokeh Interactive Server Side Applications II | |
| DV\_RL\_6.2.16 | Bokeh Interactive Server Side Applications III | |
| CS 10.1 | * Data Visualization samples with Seaborn * Viewing statistical relationship with Seaborn visuals | Seaborn Docs |
| CS 10.2 | * Data Visualization samples with Bokeh * Building server side application using Bokeh | R1 |
| SS 10 | * [Seaborn Tutorial for Beginners](https://www.kaggle.com/kanncaa1/seaborn-tutorial-for-beginners) * [Interactive Data Visualization in Python With Bokeh](https://realpython.com/python-data-visualization-bokeh/) | |

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| **CS** | **CH** | **Pre-CH** | **During CH** | **Post-CH** |
| 1 | 1 | DV\_RL\_1.1.1- 1.1.4 | CS 1.1 |  |
| 2 | DV\_RL\_1.1.5-1.1.7 | CS1.2 | SS 1 |
| 2 | 3 | DV\_RL\_2.1.1-2.1.3 | CS 2.1 |  |
| 4 | DV\_RL\_2.1.4-2.1.6 | CS 2. 2 | SS 2 |
| 3 | 5 | DV\_RL\_2.2.1-2.2.5 | CS 3.1 |  |
| 6 | DV\_RL\_2.2.6-2.2.7 | CS 3.2 | SS 3 |
| 4 | 7 | DV\_RL\_3.1.1-3.1.2 | CS 4.1 |  |
| 8 | DV\_RL\_3.1.3-3.1.4 | CS 4.2 | SS 4 |
| 5 | 9 | DV\_RL\_3.2.1-3.2.2 | CS 5.1 |  |
| 10 | DV\_RL\_3.2.3-3.2.7 | CS 5.2 | SS 5 |
| **Mid Semester Exam** | | | | |
| 6 | 11 | DV\_RL\_4.1.1-4.1.5 | CS 6.1 |  |
| 12 | DV\_RL\_4.1.6-4.1.9 | CS 6.2 | SS 6 |
| 7 | 13 | DV\_RL\_5.1.1-5.1.9 | CS 7.1 |  |
| 14 | DV\_RL\_5.1.10-5.1.14 | CS 7.2 | SS 7 |
| 8 | 15 | DV\_RL\_5.2.1-5.2.5 | CS 8.1 |  |
| 16 | DV\_RL\_5.2.6-5.2.9 | CS 8.2 | SS 8 |
| 9 | 17 | DV\_RL\_6.1.1-6.1.3 | CS 9.1 |  |
| 18 | DV\_RL\_6.1.4-6.1.6 | CS 9.2 | SS 9 |
| 10 | 19 | DV\_RL\_6.2.1-6.2.7 | CS 10.1 |  |
| 20 | DV\_RL\_6.2.8-6.2.16 | CS 10.2 | SS 10 |
| **End Semester Exam** | | | | |

**Experiential Leaning Component**

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| --- | --- | --- |
| **Activity** | **Topic** | **Description** |
| 1 | Getting started with Tableau | * Setup of Tableau Desktop for Analytics   + Tableau License for BITS students   + Obtaining and installing Tableau desktop |
| 2 | Visual Analysis with Tableau | * Basic visualizations and operations using Tableau   + Familiarity with Data prep   + Basic plotting   + Operations on visualizations |
| 3 | Advanced Visual Analysis with Tableau | * Visualizations supporting advanced operations   + Analytics   + Maps   + Calculated fields |
| 4 | Dashboards and Storytelling with Tableau | * Preparing dashboards for storytelling   + Dashboards   + Stories   + Formulate a story using the visuals and dashboards |
| 5 | Getting started with Python | * Python Setup   + Usage of Python and Anaconda Navigator platform with Jupyter notebooks |
| 6 | Plotting visuals with Python Matplotlib | * Matplotlib library for Data visualization   + Usage of Python and Matplotlib library available for data plotting |

**Evaluation Scheme**:

Legend: EC = Evaluation Component; AN = After Noon Session; FN = ForeNoon Session

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No | Name | Type | Duration | Weight | Day, Date, Session, Time |
| EC-1 | Experiential Learning Assignment-I | Online  Take home | - | 10% | TBA |
| Experiential Learning  Assignment-II | - | 15% | TBA |
| EC-2 | Mid-Semester Test | Open Book | 2 hours | 30% | Sunday, 07/03/2021 (FN)  10 AM - 12 Noon |
| EC-3 | Comprehensive Exam | Open Book | 2 hours | 45% | Sunday, 02/05/2021 (FN)  10 AM - 12 Noon |

**Exam Syllabus:**

Syllabus for Mid-Semester Test (Closed Book): Topics in Module 1 to 3

Syllabus for Comprehensive Exam (Open Book): All topics Module 1 to 6

**Important links and information:**

Elearn portal: https://elearn.bits-pilani.ac.in

Students are expected to visit the Elearn portal 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 the Elearn portal.

Evaluation Guidelines:

1. EC1 consists of two assignments. 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 on the Elearn portal. 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.