Category-IV

Pool of Generic Electives offered by Department of Electronic Science

GENERIC ELECTIVES (GE-2A): **Digital System Design**

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	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Digital System Design	4	3	0	1	Class 12th Pass with PCM or Physics, Comp. Sc. & Maths.	Nil	Electronic Science

Learning Objectives

In addition to familiarization with the combinational and sequential circuits, students will be adept in using simulation of digital circuits on software, which is in high demand, for designing combinational or sequential circuits. As there are lot of industrial and research-based job opening in the area, the course offers a hands-on in designing digital systems on hardware and testing with a holistic approach to the subject, making students ready for the industry or research

Learning outcomes

After completion of the course, students will be able to-

Understand and represent numbers in powers of base and concepts of Boolean algebra.
Understand basic logic gates and minimization techniques.
Analyze and design combinatorial circuits.
Analyze and design sequential circuits.

SYLLABUS

UNIT – I Number Systems and Boolean Algebra (09 Hours)

Number System and Boolean algebra: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, Gray Code. Boolean algebra- Positive and negative logic. Boolean laws, De Morgan's theorems, simplification of Boolean expressions-SOP and POS

UNIT – II Logic Gates and Minimization (12 Hours)

Logic gates and Karnaugh map: Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map minimization of 3 and 4 variable functions/expressions.

UNIT – III Combinational Circuits (12 Hours)

Combinational logic analysis and design: Multiplexers and Demultiplexers, Adder (half and full), Subtractor (half and full), Parallel adder/subtractor, Encoder and Decoder, Understanding VHDL program of a Full Adder and 3 to 8 decoder

UNIT – IV Flip Flops and Counters (12 Hours)

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (synchronous and asynchronous, ring and Johnson)

Practical component (if any) - Digital System Design Lab – 30 Hours

(Hardware and Circuit Simulation Software)

To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Design a Half and Full Adder.
3. Design a Half and Full Subtractor.
4. Implement Boolean functions using 8X1 and 16X1 Multiplexers.
5. Implement Boolean functions using decoder.
6. Implement an encoder.
7. Study of counters using dedicated counter ICs.
8. Study of registers (SISO, SIPO, PISO and PIPO) using universal shift register IC.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than seven.

Essential/recommended readings

1. M. Morris Mano Digital System Design,Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum_s Outline Series, Tata McGraw- Hill (1994)

GENERIC ELECTIVES (GE-2B): **Data Visualization Techniques**

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	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Data Visualization Techniques	4	3	0	1	Class XII Passed with Maths	Basic Knowledge of Python Programming Language	Electronic Science

Learning Objectives

This course is all about data visualization, the art and science of turning data into readable graphics. It enables the students to design and create data visualizations based on data available and tasks to be achieved. This process includes data modeling, data processing (such as aggregation and filtering), mapping data attributes to graphical attributes, and strategic visual encoding based on known properties of visual perception as well as the task(s) at hand. Students will also learn to evaluate the effectiveness of visualization designs, and think critically about each design decision, such as choice of color and choice of visual encoding. Students will create their own data visualizations, and learn to use Open-Source data visualization tools.

Learning outcomes

After completion of the course, students will be able to-

Design and create data visualizations.
Conduct exploratory data analysis using visualization.
Craft visual presentations of data for effective communication.
Use knowledge of perception and cognition to evaluate visualization design alternatives.
Design and evaluate color palettes for visualization based on principles of perception.
Apply data transformations such as aggregation and filtering for visualization.
Identify opportunities for application of data visualization in various domains.

Tools Required: Open-source Visualization tools, Python, Plotly, Tableau

SYLLABUS

UNIT – I Understanding Data Visualization (09 Hours)

Introduction to Data Visualization, Various tools for Data Visualization. Introduction to Numpy, Pandas and Matplotlib. Structured & Semi-structured Dataset, Data Cleaning and Preparation. Handling Missing Data, Data Transformation. Basic Plotting with Matplotlib, Dataset on Immigration e.g. Canada (source: https://open.canada.ca)/ any other. Univariate and Multivariate Visualization. Introduction to cloud computing.

UNIT – II Data Visualization Techniques (12 Hours)

Data Visualizations Techniques: Line Plots, Area Plots, Histograms, Bar Charts, Pie Charts, Box Plots, Scatter Plots, Bubble Plots, Waffle Charts, Word Clouds, Seaborn and Regression Plots, Creating Maps and Visualizing Geospatial Data - Introduction to Folium, Maps with Markers, Choropleth Maps.

UNIT – III Creating Dashboards with Plotly (12 Hours)

Introduction to Seaborn, Basic plotting with Seaborn. Introduction to Plotly. Scatter chart, Bubble Plot, Pie chart, Gantt chart, Contour plotting, Sunburst and Polar charts, Heatmaps.

UNIT – IV Data Visualization using Tableau (12 Hours)

Introduction to Tableau Desktop, connecting to dataset, Data preparation, Filtering and sorting data, Creating basic chart types (bar charts, line charts etc.), Assembling a dashboard layout, Using dashboard filters, Transform the data, Simple calculations in Tableau, Creating advanced chart types. Introduction to Data Story.

Practical component (if any) - Data Visualization Techniques Lab – 30 Hours

(Perform practical on Dataset available at Kaggle / Github / UCI Machine Learning Repository)

1. Visualization of Spreadsheet Models.
2. Visualization of Semi-Structured Data.
3. Interactive Plots in Python and Tableau.
4. Hierarchical and Topographical Data Visualizations in Tableau.
5. Calendar Heatmaps and Flow Data Visualizations in Python.
6. Time Series Data Visualization in Plotly.
7. Creating cloud account Amazon/Azure/Google/IBM to store images /files / programs.
8. Use a dataset that contains immigration details e.g. Canada for a given duration of 30 years (Canada Immigration Dataset, source: https://open.canada.ca) or any other
    a. Create an area plot for top 6 immigrant countries in a given duration.
    b. Create and year-wise immigrant bar chart from India to Canada in a given duration.
    c. Create a boxplot of immigrants for three given countries.

d. Show the total no. of immigrants using Area Chart and Pie chart for two given countries.
e. Create a scatter Histogram for the immigrants in the given year for two specific countries.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than seven.

Essential/recommended readings

1. Data Visualization with Python for Beginners: Visualize Your Data using Pandas, Matplotlib and Seaborn by AI Publishing. ISBN: 1733042680-978
2. Learn and Practice Data Visualization using Python by Swapnil Saurav, Eka Publishers. ISBN: 8194633426-978
3. Python Data Science Handbook by Jake VanderPlas, Shroff/O'Reilly. ISBN: -978 9352134915
4. Data Visualization with Tableau by Praveen Kumar, Gurucool Publishing. ISBN: 8194746997-978
5. Interactive Dashboards and Data Apps with Plotly and Dash by Elias Dabbas, Packt Publishing Limited. ISBN: 1800568914-978

Suggestive readings -

1. Python Data Science Handbook by Jake VanderPlas, Shroff/O'Reilly. ISBN: 9352134915-978
2. Data Science from Scratch: First Principles with Python by Joel Grus, Shroff/O'Reilly. ISBN: 9352138326-978

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