Syllabus

Course Name: Data Structure and Algorithms **[2:0:2=3]**

Course Content:

Introduction to the data structure, algorithms, asymptotic notations, time and space complexity, 1-D and 2-D arrays, searching algorithms (Linear, Binary), and sorting algorithms (Bubble, Selection, Insertion, Merge, Quick). Performance analysis of sorting algorithms, conceptual understanding of stacks, queues, and linked lists (singly, doubly, circular), applications and operations, progressing to Binary Trees, Binary Search Trees, Binary Heaps, and Balanced Binary Search Trees (AVL Trees), exploration of basic graph terminologies, traversal algorithms (BFS, DFS), spanning trees, and hashing techniques.

Course Outcomes:

CO1: Understand the core concepts of data representation with suitable data structures and efficient access strategies for solving computational problems.

CO2: Apply the knowledge of data structures and algorithms to create effective solutions to real-world problems keeping the time and space complexities in perspective.

CO3: Analyze a proposed algorithmic solution and identify the constraints and practical limitations posed by the implementation technology.

Textbook:

1) Data Structures Using C; Aaron M. Tenenbaum, Y. Langsam and M. J. Augenstein; Pearson Education; Ed. First, 2019.

2) Fundamentals of Data Structures in C, Horowitz, Sahni, and Anderson-Freed- University press, Ed. Second, 2008.

Reference Books:

1) Data Structures and Program Design in C; Robert L. Kruse, Bruce P. Leung, Clovis L. Tondo and Shashi Mogalla; Pearson, Ed. Second, 2006.

2) Data Structures with C, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill Education, Ed. First 2017.

Course Name: Data Analytics using Python [2:0:2=3]

Course Content:

Introduction to Python -Google Colab and Jupyter Notebook, Data Structure, Pandas (reading, writing files, loading data, etc), NumPy, etc.. Matplotlib (area plot, scatter plot, line plot, histogram, bar charts, box plot, heat map, faceting, pair plot), seaborn. What is data science, Various types, and levels of data, Structured vs. Unstructured data, quantitative vs. qualitative data, Data science life cycle, etc. Data collection and preparation, Missing value handling, Data scrubbing, Data transformation, Exploratory Data Analytics, Population and sample, Moments and generating functions, Measure of Variability, Hypothesis Testing, bias, and variance. Supervised classification such as KNN and Unsupervised classification such as K-Mean Clustering, Model Definition, and Training, Model Evaluation. Feature Engineering, Dimension reduction- PCA, Regression Linear Model: Linear regression, logistic Regression.

Course Outcomes:

CO1: Understand basic concepts and visualize data to gain insight.

CO2: Apply data science skills to extract and interpret datasets.

CO3: Analyse and interpret data using statistical models.

Textbook:

1) Sinan Ozdemir. Principles of Data Science: Learn the techniques and math you need to start making sense of your data. Packt Publishing.
2) VanderPlas, Jake. Python data science handbook: Essential tools for working with data. " O'Reilly Media, Inc.", 2023.

Reference Book:

1) Peng, Roger D., and Elizabeth Matsui. The Art of Data Science. A Guide for Anyone Who Works with Data. Skybrude Consulting, 2015.
2) Foreman, John W. Data smart: Using data science to transform information into insight. John Wiley & Sons, 2014.
3) Haider, Murtaza. Getting Started with Data Science: Making Sense of Data with Analytics. IBM Press, 2015.

Course Name: Linear Algebra and Differential Equations [3:0:0=3]

Course Content:

REF and RREF of a matrix, Rank of a matrix, Linear equations, and their solutions using Gaussian elimination method and Gauss-Jordan method, Eigenvalues and eigenvectors, its applications in Markov chain, dynamical systems and system of differential equations, diagonalization of matrices, Vector spaces, subspaces, linear dependence and independence of vectors, linear combination of vectors, spanning set of vectors, basis and dimension of a vector space, Linear transformation and its matrix representation, Kernel and range of Linear transformation. Solution of Exact, linear and Bernoulli's differential equations, applications of differential equations of first order & first degree to simple electric circuits, Newton's law of cooling and orthogonal trajectories, Understanding the reduction of orders, Solution of higher order linear differential equations with constant coefficients, Method of undetermined coefficients, Variation of Parameters, Solution of Cauchy's and Legendre's equations, Modelling and solving linear differential equations of 2nd and higher orders in engineering, Solution of system of linear Equations.

Course Outcomes:

CO1: Understand various concepts of linear systems, vector spaces, eigenvalues and eigenvectors, linear transformation, different types of ordinary differential equations that arise in different fields of engineering problems.

CO2: Apply the concepts of eigenvalue, eigenvectors, linear transformations in graphics and other engineering domains, apply suitable method to solve different types of ODEs arising in engineering and real-world applications.

CO3: Analyse the long-term behaviour of Markov chains and discrete/continuous dynamical systems, analyse the efficiency of different solution methods available to solve higher order ODEs.

CO4: Model real world problems and finding their solutions mathematically as well as with the help of technology and writing a report to summarize the findings.

Textbook:

1) D. Poole, Linear Algebra: A Modern Introduction, 4th Edition, ISBN-13: 978-1-285-46324-7, Cengage Learning, 2015.

2) Zill D. G., A First Course in Differential Equations with Modelling Applications, 11th Edition. ISBN-13: 978-0-495-10824-5, Brooks/Cole, Cengage Learning, 2010.

Reference Book:

1) David C. Lay, Linear Algebra and Its Applications, ISBN: 978-81-775-8333-5, 3rd Edition, Pearson, 2014.

2) Seymour Lipschutz & Marc Lipson, Schaum's Outline of Linear Algebra, ISBN: 978-0071794565, 5th Edition, McGraw-Hill, 2014.

3) Simmons G.F, Differential Equations with Applications and Historical Notes, ISBN: 13:978-1-4987-0259-1, 3rd edition, CRC press, Taylor & Francis Group, 2017.

Course Name: Web Programming [1:0:2=2]

Course Content:

Introduction to CSS, Basic selectors, Formatting, integrating CSS, In-line Styles, Embedded Style sheets, Imported Style Sheet, CSS selectors (element, id and class)

JavaScript: Data Types, Primitive Types, Statements, Keywords, Operators, JavaScript Conditional Statements Function Parameters, Function Return Types, Arrays, JavaScript Objects, Window Objects, Document Object, Object Creation, Adding Methods of Objects, JavaScript Loops & Iteration, Adding Properties of Objects, Event Handling, Enumerating Properties, Callbacks, JSON

Building scalable Web Apps with Server-Side JavaScript: generating dynamic content on the server using Node.js (creating the HTTP server, handlebars, template engines) ; storing and retrieving data in MongoDB

Course Outcomes:

CO1: Understand the use of various CSS elements and JavaScript Objects

CO2: Design and develop a website based on real word scenario to demonstrate the interaction between user-interface and server.

Text Book:

1) Meloni, J., & Jennifer Kyrnin (2018). HTML, CSS, and JavaScript All in One: Covering HTML5, CSS3, and ES6, Sams Teach Yourself.
2) Hardy, B., & Phillips, B. (2017). Android programming: the big nerd ranch guide. Addison-Wesley Professional.

Reference Links:

1) Structuring the web with HTML: https://developer.mozilla.org/en-US/docs/Learn/HTML
2) JavaScript: https://developer.mozilla.org/en-US/docs/Web/JavaScript
3) Introduction to NodeJS: https://nodejs.org/en/learn/getting-started/introduction-to-nodejs

Course Name: Digital Logic Design [2:0:2=3]

Course Content:

Number systems and Boolean algebra: Introduction to number system and Boolean algebra; Boolean identities, basic logic functions, standard forms of logic expressions, simplification of logic expressions. **Combinational logic:** Arithmetic circuits, decoders, encoders, multiplexers, de-multiplexers, and their use in logic synthesis; Hazards in combinational circuits, **Sequential logic circuits:** Latches and Flip Flops (SR, D, JK, T); Timing in sequential circuits; Shift register; Counters – synchronous, asynchronous. **Finite state machines:** Basic concepts and design; Moore and Mealy machines examples; State minimization/reduction, state assignment; Finite state machine design case studies and FSM circuit design.

Course Outcomes

CO1: Analyze and design combinational and sequential circuits.

CO2: Apply the sequential circuit design procedure for solving and implementing circuit design problems.

CO3: Able to understand the requirements of design systems and able to implement it.

Textbook:

1) Mano M.M., Ciletti M.D., “Digital Design”, Pearson India, 4th Edition.

2) Wakerly J.F., “Digital Design: Principles and Practices,” Pearson India, 4th Edition.

Course Name: Object-Oriented Programming using JAVA [2:0:2=3]

Course Content:

Characteristics of Java, the Java environment – JDK, JRE, JVM and JIT Compiler, Object Oriented Programming (OOP) principles – OOP concepts in Java, Lifecycle of a Java program – Java Byte Code, First Java program in Java. Fundamental Programming Structures in Java – Identifiers, Literals, Comments, Data Types, Variables – Scope and lifetime of a variable, and type conversion, Operators, Expressions, Control Flow – conditional statements, switch, loops, and jump statements. Defining classes in Java, Creating an Object, methods, constructors, Overloading – method overloading and constructor overloading, this keyword, static members, nested classes, Packages, Arrays, Strings, Scanner class, Vectors, Wrapper classes. Inheritance – Super classes and sub classes, access modifiers, super keyword, Overriding – method overriding, constructors in sub classes, dynamic method dispatch, abstract classes and methods, final keyword, Interface – defining and implementing an interface, extending the interfaces. Exceptions – errors vs exceptions, types of exceptions – built-in and user-defined exceptions, throwing and catching exceptions – try/catch block, finally block, throw and throws keywords, creating and throwing own exceptions. Multithreading- thread-based vs process-based multitasking, creating threads using Thread class and Runnable interface, fields and methods of Thread class, thread priorities, thread lifecycle methods, synchronizing threads, inter thread communication. I/O Basics – Streams, Byte streams and Character streams, Reading and Writing Console, Reading and Writing Files, The Serializable Interface, Creating files and directories. Collection Framework – List - ArrayList, Linked List and Vector, Set – HashSet and TreeSet, Map – HashTable and HashMap, Accessing a Collection via an iterator, comparator, comparable. Java GUI – AWT vs Swing, JFrame, Swing components – JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JComboBox, ImageIcon and JList, Event Handling in Swing Applications, Layout Management using FlowLayout, Border Layout, and Grid Layout, Using JPanel, Adapter classes. Introduction to JDBC, JDBC Drivers & Architecture, CRUD operation Using JDBC.

Course Outcomes:

CO1: Understand the basics principles of Object-Oriented Programming language and characteristics of Java.

CO2: Use of basic programming constituents and building blocks of Java including literals, identifiers, data types, operators, control flow statements, arrays, strings, classes, interfaces, and packages.

CO3: Apply exception handling and multithreading mechanisms to create robust and efficient software and utilize the modern I/O tools and Collection framework to solve the real-world problems.

CO4: Design and develop GUI-based applications using swings and JDBC.

Textbooks:

1) Herbert Schildt. Java: The Complete Reference. 12th Edition, McGraw Hill Education; 2022.

2) Horstmann Cay S., Core Java Volume II – Advanced Features, Pearson, 2019

References:

1) Khalid A. Mughal and Rolf W Rasmussen, Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA), 1st Ed, Pearson, 2017

2) E. Balagurusamy, Programming with Java – A Primer, 6th Ed, TMH India, 2019