

## Semester-III

### Major/DS Course (Core)

### COMP 3011: Discrete Structures (Theory)

Credit: 5

75 hour

#### Course Objective

This course is designed as a foundational course to make students learn about the mathematical constructs that are used in Computer Science such as Boolean algebra, sets, relations, functions, principles of counting, and recurrences. In this course, the knowledge of mathematical notation, ideas and concepts learnt at the pre-college levels is extended to orient the students towards mathematical thinking required in Computer Science.

#### Course Learning Outcomes

On successful completion of the course, students will be able to:

1. Relate mathematical concepts and terminology to examples in the domain of Computer Science.
2. Model real world problems using various mathematical constructs.
3. Use different proofing techniques; construct simple mathematical proofs using logical arguments.
4. Formulate mathematical claims and construct counter examples

#### Syllabus

1. Introduction: Sets - finite and Infinite sets, uncountably Infinite Sets; functions, relations, Properties of Binary Relations, Closure, Partial Ordering Relations; counting - Pigeonhole Principle, Permutation and Combination; Mathematical Induction, Principle of Inclusion and Exclusion. (10 Hrs)
2. Growth of Functions: Asymptotic Notations, Summation formulas and properties, Bounding Summations, approximation by Integrals. (10 Hrs)
3. Recurrences: Recurrence Relations, Generating functions, Linear Recurrence Relations with constant coefficients and their solution, Substitution Method, Recurrence Trees, Master Theorem. (15 Hrs)
4. Graph Theory: Basic Terminology, Models and Types, multi-graphs and weighted graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and properties of Trees, Introduction to Spanning Trees. (20 Hrs)
5. Propositional Logic: Logical Connectives, Well-formed Formulas, Tautologies, Equivalences, Inference Theory. (20 Hrs)

#### Recommended Books:

1. C.L. Liu , D.P. Mahopatra, Elements of Discrete mathematics, 2nd Edition , Tata McGraw Hill, 1985,
2. Kenneth Rosen, Discrete Mathematics and Its Applications, Sixth Edition ,McGraw Hill 2006
3. T.H. Cormen, C.E. Leiserson, R. L. Rivest, Introduction to algorithms, 3rd edition Prentice Hall on India, 2009

4. M. O. Albertson and J. P. Hutchinson, Discrete Mathematics with Algorithms , John Wiley Publication, 1988
5. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Edition, Jones and Bartlett Publishers, 2009
6. D.J. Hunter, Essentials of Discrete Mathematics

## **Major/DS Course (Core): Data Structures**

### **COMP 3012 : Data Structures (Theory)**

Credit: 4

60 Hrs

#### **Course Objective**

The course aims at developing the ability to use basic data structures like arrays, stacks, queues, lists, trees to solve problems. C++ is chosen as the language to understand implementation of these data structure.

#### **Course Learning Outcomes**

On successful completion of the course, students will be able to:

1. Compare two functions for their rates of growth.
2. Understand abstract specification of data-structures and their implementation.
3. Compute time and space complexity of operations on a data-structure.
4. Identify the appropriate data structure(s) for a given application and understand the trade-offs involved in terms of time and space complexity.
5. Apply recursive techniques to solve problems

#### **Syllabus**

##### **1. Arrays (5 Hrs)**

Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

##### **2. Stacks (5 Hrs)**

Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

##### **3. Linked Lists (10 Hrs)**

Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists

##### **4. Queues (5 Hrs)**

Array and Linked representation of Queue, De-queue, Priority Queues, Queue using Stack

##### **5. Recursion (5 Hrs)**

Developing Recursive Definition of Simple Problems and their implementation; Advantages

and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

#### 6. Trees (20 Hrs)

Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion , Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals);

#### 7. Searching and Sorting (5 Hrs)

Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Bubble Sort, Insertion Sort, Shell Sort, Comparison of Sorting Techniques

#### 8. Hashing (5 Hrs)

Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collusion by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function

#### Reference Books

1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
2. SartajSahni, Data Structures, "Algorithms and applications in C++", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using C and C++:, Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson,1999.
5. D.S Malik, Data Structure using C++,Second edition, Cengage Learning, 2010
6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
7. Aaron M. Tenenbaum, Moshe J. Augenstein, YedidyahLangsam, "Data Structures Using Java, 2003.
8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub,2003
9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited; edition, 2009
10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley,2013
11. Herbert Schildt, "Java The Complete Reference (English) 9th Edition Paperback", Tata McGraw Hill, 2014.
12. D. S. Malik, P.S. Nair, "Data Structures Using Java", Course Technology, 2003.

## Data Structures Lab

Credit: 1

30 Hrs

All programs should be developed in C/Python

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i)using recursion, (ii) using iteration
12. (ii) WAP to display fibonacci series (i)using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
  - (a) Insertion (Recursive and Iterative Implementation)
  - (b) Deletion by copying
  - (c) Deletion by Merging
  - (d) Search a no. in BST
  - (e) Display its preorder, postorder and inorder traversals Recursively
  - (f) Display its preorder, postorder and inorder traversals Iteratively
  - (g) Display its level-by-level traversals
  - (h) Count the non-leaf nodes and leaf nodes
  - (i) Display height of tree
  - (j) Create a mirror image of tree
  - (k) Check whether two BSTs are equal or not
15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.

16. WAP to reverse the order of the elements in the stack using additional stack.
17. WAP to reverse the order of the elements in the stack using additional Queue.
18. WAP to implement Diagonal Matrix using one-dimensional array.
19. WAP to implement Lower Triangular Matrix using one-dimensional array.
20. WAP to implement Upper Triangular Matrix using one-dimensional array.
21. WAP to implement Symmetric Matrix using one-dimensional array.
22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
23. WAP to implement various operations on AVL

## **Skill Enhancement Course (SEC)**

### **COMP 3051: PHP Programming (Practical)**

Credit :3

90Hrs

#### **Course Objective**

The course is designed to introduce programming concepts using PHP to students. The course aims to develop structured as well as object-oriented programming skills using PHP. The course also aims to achieve competence amongst its students to develop correct and efficient PHP programs to solve real life problems.

#### **Course learning outcome**

In this course, you will learn:

- How to use PHP's built-in server to serve static resources
- How to use PHP to add some dynamic aspects to our pages
- How to use HTML forms
- The difference between GET and POST requests
- How to use cookies to store some data in the browser and pass it to the next request
- How to use a session cookie to store data on the server instead of in the browser
- How to build an authentication system
- How to restructure the project
- How to upload files to the website
- How to build a custom solution that catches PHP errors and exceptions and shows a proper error page for them
- How to describe and test all the features you've built in this course using an automated test runner

# Syllabus

Introduction to PHP:

90 hrs

- ☐ PHP introduction, inventions and versions, important tools and software requirements
- ☐ (like Web Server, Database, Editors etc.)
- PHP with other technologies,
- Scope of PHP
- ☐ Basic Syntax, PHP variables and constants
- ☐ Types of data in PHP , Expressions, scopes of a variable (local, global)
- ☐ PHP Operators: Arithmetic, Assignment, Relational, Logical operators, Bitwise, ternary and MOD operator.
- ☐ PHP operator Precedence and associativity
- Handling HTML form with PHP:  
Capturing Form Data
- ☐ GET and POST form methods
- ☐ Dealing with multi value fields
- ☐ Redirecting a form after submission
- PHP conditional events and Loops:  
PHP IF Else conditional statements ( Nested IF and Else)
- ☐ Switch case, while ,For and Do While Loop
- ☐ Goto , Break ,Continue and exit
- PHP Functions:  
Function, Need of Function , declaration and calling of a function
- ☐ PHP Function with arguments, Default Arguments in Function
- ☐ Function argument with call by value, call by reference
- ☐ Scope of Function Global and Local
- String Manipulation and Regular Expression:
  - ☐ Creating and accessing String , Searching & Replacing String
  - ☐ Formatting, joining and splitting String , String Related Library functions
  - ☐ Use and advantage of regular expression over inbuilt function
  - ☐ Use of preg\_match(), preg\_replace(), preg\_split() functions in regular expression
- Array:
  - ☐ Anatomy of an Array ,Creating index based and Associative array ,Accessing array
  - ☐ Looping with Index based array, with associative array using each() and foreach()
  - ☐ Some useful Library function

## Reference Books:

1. Steven Holzner, "PHP: The Complete Reference Paperback", McGraw Hill Education (India), 2007.
2. Timothy Boronczyk, Martin E. Psinas, "PHP and MYSQL (Create-Modify-Reuse)", WileyIndia Private Limited, 2008.
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5", 3rd Edition Paperback, O'reilly, 2014.
4. Luke Welling, Laura Thompson, "PHP and MySQL Web Development", 4th Edition, Addition Paperback, Addison-Wesley Professional, 2008.
5. David Sklar, Adam Trachtenberg, "PHP Cookbook: Solutions & Examples for PHP Programmers", 2014.

## Lab Work:

1. Create a PHP page using functions for comparing three integers and print the largest number.
2. Write a function to calculate the factorial of a number (non-negative integer). The function accept the number as an argument.
3. WAP to check whether the given number is prime or not.
4. Create a PHP page which accepts string from user. After submission that page displays thereverse of provided string.
5. Write a PHP function that checks if a string is all lower case.
6. Write a PHP script that checks whether a passed string is palindrome or not? ( A palindromeis word, phrase, or sequence that reads the same backward as forward, e.g., madam ornurses run)
7. WAP to sort an array.
8. Write a PHP script that removes the whitespaces from a string.

Sample string : 'The quick " " brown fox'

Expected Output :

Thequick""brownfox

9. Write a PHP script that finds out the sum of first n odd numbers.
10. Create a login page having user name and password. On clicking submit, a welcome message should be displayed if the user is already registered (i.e.name is present in the database) otherwise error message should be displayed.
11. Write a PHP script that checks if a string contains another string.
12. Create a simple 'birthday countdown' script, the script will count the number of days between current day and birth day.
13. Create a script to construct the following pattern, using nested for loop.

```
*
* *
* * *
* * * *
* * * * *
```

14. Write a simple PHP program to check that emails are valid.
15. WAP to print first n even numbers.
16. \$color = array('white', 'green', 'red')  
Write a PHP script which will display the colors in the followingway : Output : white, green, red,
  - green
  - red
  - white
17. Using switch case and dropdown list display a —Hello message depending on the language selected in drop down list.
18. Write a PHP program to print Fibonacci series using recursion.
19. Write a PHP script to replace the first 'the' of the following string with 'That'.

Sample : 'the quick brown fox jumps over the lazy dog.'

Expected Result : The quick brown fox jumps over the lazy dog.

## Multi/Interdisciplinary Courses (For Other discipline)

### COMP 3031: Introduction to Cyber Security (Theory)

**Credit: 3**

**45 Hrs**

#### Course Objective

It aims to educate individuals about potential cyber threats, best practices for safeguarding sensitive information, and how to respond effectively in case of a security incident.

#### Course learning outcome

Upon completion of the degree program, students will be able to:

1. Analyse and evaluate the cyber security needs of an organization.
2. Conduct a cyber security risk assessment.
3. Measure the performance and troubleshoot cyber security systems.
4. Implement cyber security solutions.
5. Be able to use cyber security, information assurance, and cyber/computer forensics software/tools.
6. Identify the key cyber security vendors in the marketplace.
7. Design and develop a security architecture for an organization.

#### Syllabus

##### Introduction to Cyber Space

History of Internet, Cyber Crime , Information Security ,Computer Ethics and Security , Choosing the Best Browser according to the requirement and email security, Guidelines to choose web browsers , Securing web browser , Antivirus , Email security 5 hrs

Guidelines for secure password and wi-fi security 5 hrs

Guidelines for setting up a Secure password , Two-steps authentication ,Password Manager ,Wi-Fi Security

Guidelines for social media and basic Windows security

Guidelines for social media security , Tips and best practices for safer Social Networking , Basic Security for Windows ,User Account Password 5 hrs

Smartphone security guidelines 5 hrs

Introduction to mobile phones , Smartphone Security ,Android Security ,IOS Security

Cyber Security Initiatives in India 5 hrs

Counter Cyber Security Initiatives in India , Cyber Security Exercise ,Cyber Security Incident Handling  
Cyber Security Assurance

Online Banking, Credit Card and UPI Security

5 hrs

Online Banking Security , Mobile Banking Security , Security of Debit and Credit Card , UPI Security  
Micro ATM, e-wallet and POS Security

Security of Micro ATMs , e-wallet Security Guidelines ,Security Guidelines for Point of Sales(POS)

Social Engineering

5 hrs

Social Engineering , Types of Social Engineering ,How Cyber Criminal Works ,How to prevent for being a victim of Cyber Crime

Cyber Security Threat Landscape and Techniques

5 hrs

Cyber Security Threat Landscape , Emerging Cyber Security Threats , Cyber Security Techniques ,Firewall  
IT Security Act and Misc. Topics

IT Act , Hackers-Attacker-Countermeasures ,Web Application Security ,Digital Infrastructure Security  
,Defensive Programming

5 hrs

Information Destroying and Recovery Tools

Recovering from Information Loss , Destroying Sensitive Information , CCleaner for Windows

#### Reference Books:

- i) Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity, Dr. Erdal Ozkaya
- ii) Introduction to Cyber Security: concepts, principles, technologies and practices ,Ajay Singh