

Detailed Syllabus
Lecture-wise Breakup

Course Code	23B61CS121	Semester II (EVEN) (specify Odd/Even)	Session 2023-24 Month from January to December
Course Name	Data Structures		
Credits	3-1-0	Contact Hours	4

Faculty (Names)	Coordinator(s)	Dr. Niyati Aggrawal
	Teacher(s) (Alphabetically)	Dr. Manju, Dr. Niyati Aggrawal

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain the basics of data structures, their need and types viz. linear and non-linear, abstract data types.	Understand Level (Level 2)
CO2	Implement various linear data structures and their related operations.	Apply Level (Level 3)
CO3	Implement various non- linear data structures and their related operations.	Apply Level (Level 3)
CO4	Apply appropriate data structure to solve a given problem.	Analyze Level (Level 4)
CO5	Assess appropriate data structure for any given real-world problem.	Evaluate Level (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Fundamentals of Linear and Non-Linear Data Structures, need of data structures, Memory Allocation – Static and dynamic, Introduction to Abstract Data Types.	3
2.	Linear Data Structures	Review of Arrays: One dimension, two-dimension, memory representation, address calculation, and related operations. Linked List: Singly, Doubly, Circular, and related operations like Creation, Insertion, Deletion, Modification, Searching,	8

		Sorting, Reversing, and Merging.	
3.	Abstract data types	Stack: Static and dynamic implementation, operations, applications like conversion between polish and reverse polish notations. Queue: Static and dynamic implementation, operations, types: linear, circular, doubly ended.	5
4.	Searching and Sorting	Searching – Review of Linear Search and Binary Search. Hashing – Hash Table, Chaining, Probing. Sorting – Merge, Quick, Radix, Bucket, and Count. Review of insertion, selection, bubble sort.	8
5.	Non-Linear Data Structures	Trees: Notations & Terminologies, Memory Representation, Binary Trees Types- Complete, Full, Strict. Tree Traversals (Recursive and non-recursive), Binary Search Tree and Basic Operations, Threaded Binary Tree. Balanced BST: AVL Tree, B Tree. Priority Queue using Binary Heaps. Graphs: Notations and Terminologies, Memory Representation: Adjacency Matrix and List; Graph Traversal using DFS and BFS.	18
Total number of Lectures			42

Evaluation Criteria		
Components	Maximum Marks	
T1	20	
T2	20	
End Semester Examination	35	
TA	25	
(Mini Project(10), Attendance(5), Assignment/Quiz/Programming Contest(10))		
Total	100	

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
Text Book:	
1	Dinesh P. Mehta and Sartaj Sahni, Handbook of Data Structures and Applications, 2 nd Ed., Chapman and Hall/CRC Computer and Information Science Series, CRC Press
2	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to rithms, MIT Press, 3rd Edition, 2009

3	Seymour Lipschutz, Data Structures with C, Schaum's Outline Series, McGraw Hill, 2010
4	Y. Langsam, M. J. Augenstein and A.M. Tanenebaum, “Data Structures using C and C++”, Pearson Education India, Second Edition, 2015.
Reference Book	
1	Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983
2	Y. Kanetkar “ Data Structures through C”, BPB Publication, Third Edition, 2019.
3	R.F Gilberg, and B A Frouzan- “Data Structures: A Pseudocode Approach with C”, Thomson Learning, Second Edition, 2004.
4	E. Horowitz and S. Sahni, “Fundamentals of Data Structures in C”. Universities Press, Second edition, 2008.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	1			1		1
	Analysis of problems to explain the need of different types of data structures	Analyse real time problems to suggest relevant Data structures	Understand to compare different solutions for a single problem in hand	Explore different offline/online tools available for implementing solutions			Understand the need for learning DS in real life		Understand the role of DS at software level to be embedded as appropriate solution for hardware to work
CO2	2	2	1	1			2		1
	Fundamentals of stack, queue, linked list	Analyse solution using stack, queue and lists	Using Linear DS design solution efficient than brute force	Use different offline/online tools available for implementing solutions using Linear DS			Apply linear DS and map them to different real-life scenarios to understand their impact on betterment of life		Develop solutions using Linear DS at software level to be embedded as appropriate solution for hardware to work
CO3	2	2	1	1			2		1
	Fundamentals of Multi list, tree and graphs	Analyse solution using Multi list, tree and graphs	Using Non-Linear DS design solution efficient than brute force	Use different offline/online tools available for implementing solutions using Non-Linear DS			Apply Non-Linear DS and map them to different real-life scenarios to understand their impact on betterment of life		Develop solutions using Non-Linear DS at software level to be embedded as appropriate solution for hardware to work
CO	2	2	1	1	2	1	3		1

4	Mapping appropriate DS according to problem in hand	Identify which DS is suitable for the problem	Apply DS w.r.t. which a solution can be developed for a problem	Use different offline/online tools available for implementing solutions using various Data structures	Engineer solution to real time problems using appropriate DS/ that's of societal usage	PBL component to apply all learned DS to learn project management and team work	Develop solution to real life applications using combination of different DS		Develop solutions using various DS at software level to be embedded as appropriate solution for hardware to work
CO 5	3	3	2	1	3	1	3		1
	Assess different approaches on a single problem	Analyse at DS level using pseudo time/space calculation	Choose best DS w.r.t. which most efficient solution can be proposed	Use different offline/online tools available for implementing and analysing solutions using various Data structures	Engineer effective solution to real time problems using appropriate DS/ that's of societal usage	PBL component to develop the most efficient solution using all learned DS to learn project management and team work	Develop and analyse solution to real life applications using combination of different DS		Assess solutions using various DS at software level to be embedded as appropriate solution for hardware to work

Detailed Syllabus
Lab-wise Breakup

Course Code	23B65CS124	Semester : II	Session 2023-24	
			Month from January to December	
Course Name	Data Structure Lab			
Credits	0-0-1	Contact Hours	2	
Faculty (Names)	Coordinator(s)	Dr. Manju		
	Teacher(s) (Alphabetically)	Dr. Manju, Dr. Niyati Aggrawal		

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Demonstrate concepts of C programming language.	Apply Level (C3)
CO2	Apply various linear data structures and their related operations to solve the real-world problems.	Apply Level (C3)
CO3	Apply various non- linear data structures and their related operations to solve the real-world problems.	Analyze Level (C4)
CO4	Choose appropriate data structure to solve a given problem.	Evaluate Level (C5)
CO5	Create an application that utilizes the data structures to efficiently solve real-world problems	Create Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Labs for the module
1.	Introduction	Lab 1: Programs based on Memory Allocation – Static and dynamic, pointer arithmetic, structures	1
2.	Linear Data Structures	Lab-2: Review of Arrays: One dimension, two-dimension, memory representation, address calculation, and related operations. Lab-3-4: Linked List: Singly, Doubly, Circular, and related operations like Creation, Insertion, Deletion, Modification, Searching, Sorting, Reversing, and Merging.	3
3.	Abstract data types	Lab-5: Stack: Static and dynamic implementation, operations, applications like conversion between polish and reverse polish notations. Lab 6: Queue: Static and dynamic implementation, operations, types: linear, circular, doubly ended.	2

4.	Searching and Sorting	<p>Lab 7: Searching – Review of Linear Search and Binary Search. Hashing – Hash Table, Chaining, Probing.</p> <p>Lab 8: Sorting – Merge, Quick, Radix, Bucket, and Count. Review of insertion, selection, bubble sort.</p>	2																
5.	Non-Linear Data Structures	<p>Lab 9-10: Trees: Notations & Terminologies, Memory Representation, Binary Trees Types- Complete, Full, Strict. Tree Traversals (Recursive and non-recursive), Binary Search Tree and Basic Operations, Threaded Binary Tree. Balanced BST: AVL Tree, B Tree. Priority Queue using Binary Heaps.</p> <p>Lab 11-12: Graphs: Notations and Terminologies, Memory Representation: Adjacency Matrix and List; Graph Traversal using DFS and BFS.</p>	4																
Total number of Labs			12																
<p>Evaluation Criteria</p> <table border="0"> <thead> <tr> <th style="text-align: left;">Components</th> <th style="text-align: right;">Maximum Marks</th> </tr> </thead> <tbody> <tr> <td>Lab Test -1</td> <td style="text-align: right;">20</td> </tr> <tr> <td>Lab Test -2</td> <td style="text-align: right;">20</td> </tr> <tr> <td>Lab Evaluation-1</td> <td style="text-align: right;">10</td> </tr> <tr> <td>Mini-Project</td> <td style="text-align: right;">20</td> </tr> <tr> <td>Lab Evaluation-2</td> <td style="text-align: right;">15</td> </tr> <tr> <td>Attendance</td> <td style="text-align: right;">15</td> </tr> <tr> <td>Total</td> <td style="text-align: right;">100</td> </tr> </tbody> </table>				Components	Maximum Marks	Lab Test -1	20	Lab Test -2	20	Lab Evaluation-1	10	Mini-Project	20	Lab Evaluation-2	15	Attendance	15	Total	100
Components	Maximum Marks																		
Lab Test -1	20																		
Lab Test -2	20																		
Lab Evaluation-1	10																		
Mini-Project	20																		
Lab Evaluation-2	15																		
Attendance	15																		
Total	100																		

Project Based Learning: Each student in a group of 3-4 will develop one project using some data structures and explaining the real time usage of the developed application. The project is to be assessed based on the data structures involved and mapping it to real time problem. This course will help students grow their technical skills in terms of implementation and in turn will help in employability like web development, algorithms design and efficiency improvement.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1	Dinesh P. Mehta and Sartaj Sahni, Handbook of Data Structures and Applications, 2nd Ed., Chapman and Hall/CRC Computer and Information Science Series, CRC Press
2	R.F Gilberg, and B A Frouzan- “Data Structures: A Pseudocode Approach with C”, Thomson Learning, Second Edition, 2004.
3	Alfred V. Aho, J.E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley Series in Computer Science and Information Processing, 1983
4	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, MIT Press, 3rd Edition, 2009
5	E. Horowitz and S. Sahni, “Fundamentals of Data Structures in C”. Universities Press, Second edition, 2008.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	1			1		1
	Analysis of problems to explain the need of different types of data structures	Analyse real time problems to suggest relevant Data structures	Understand to compare different solutions for a single problem in hand	Explore different offline/online tools available for implementing solutions			Understand the need for learning DS in real life		Understand the role of DS at software level to be embedded as appropriate solution for hardware to work
CO2	2	2	1	1			2		1
	Fundamentals of stack, queue, linked list	Analyse solution using stack, queue and lists	Using Linear DS design solution efficient than brute force	Use different offline/online tools available for implementing solutions using Linear DS			Apply linear DS and map them to different real-life scenarios to understand their impact on betterment of life		Develop solutions using Linear DS at software level to be embedded as appropriate solution for hardware to work
CO3	2	2	1	1			2		1
	Fundamentals of Multi list, tree and graphs	Analyse solution using Multi list, tree and graphs	Using Non-Linear DS design solution efficient than brute force	Use different offline/online tools available for implementing solutions using Non-Linear DS			Apply Non-Linear DS and map them to different real-life scenarios to understand their impact on betterment of life		Develop solutions using Non-Linear DS at software level to be embedded as appropriate solution for hardware to work
CO4	2	2	1	1	2	1	3		1
	Mapping appropriate DS according to problem in hand	Identify which DS is suitable for the problem	Apply DS w.r.t. which a solution can be developed for a problem	Use different offline/online tools available for implementing solutions using various Data structures	Engineer solution to real time problems using appropriate DS/ that's of societal usage	PBL component to apply all learned DS to learn project management and team work	Develop solution to real life applications using combination of different DS		Develop solutions using various DS at software level to be embedded as appropriate solution for hardware to work
CO5	3	3	2	1	3	1	3		1
	Assess different approaches on a single problem	Analyse at DS level using pseudo time/space calculation	Choose best DS w.r.t. which most efficient solution can be proposed	Use different offline/online tools available for implementing and analysing solutions using various Data structures	Engineer effective solution to real time problems using appropriate DS/ that's of societal usage	PBL component to develop the most efficient solution using all learned DS to learn project management and team work	Develop and analyse solution to real life applications using combination of different DS		Assess solutions using various DS at software level to be embedded as appropriate solution for hardware to work

Detailed Syllabus
Lecture-wise Breakup

Course Code	23B61CS122	Semester: EVEN	Semester: II Session: 2023-24 Month from Jan 2024 to July 2024
Course Name	Database Management Systems		
Credits	3-1-0	Contact Hours	4

Faculty (Names)	Coordinator(s)	Noor Mohammad
	Teacher(s) (Alphabetically)	Noor Mohammad, Neetu Singh

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain the basic concepts of database management system and their application in system design.	Understand (Level 2)
CO2	Identify the data models for relevant problems and explain the basics of relational model.	Understand (Level 2)
CO3	Model the real world systems using Entity Relationship Diagrams and convert the ER model into a relational logical schema using various mapping algorithms.	Apply (Level 3)
CO4	Demonstrate the use of SQL commands and relational algebraic expressions for query processing.	Apply (Level 3)
CO5	Simplify databases using normalization process based on identified keys and functional dependencies	Analyse (Level 4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Databases	Overview of data, database, database management system DBMS Architecture, Data Independence , Three Schema architecture, File system vs DBMS, Data models, Schema, Instances, Database states, Role of database administrator, Designers and end users.	4
2.	Relational database And ER Model	Entity and its types, Entity set, Notations for ER Diagram Attributes, Keys, Relationships and its types, Mapping Constraints, Enhanced ER Diagram, Specialization and generalization. ER to relational mapping: Steps to map ER diagram to relational schema	5
3.	Relational Model	<i>Relational Data Models</i> : Relational model terminology domains, Attributes, Tuples, Relations, characteristics of relations, relational constraints domain constraints, key	5

		constraints and constraints on null, Relational DB schema. Codd's Rules. <i>Relational algebra</i> : Basic operations selection and projection. Set Theoretic operations: Union, Intersection, set difference and division (Order, Relational calculus: Domain, Tuple, Well Formed Formula, specification, quantifiers). <i>Join operations</i> : Inner, Outer, Left outer, Right outer, and full outer join.	
5.	Database Design	Functional Dependencies, Armstrong's inference rule, Normalization, First Normal form, Second Normal form, Third Normal Form, BCNF,	6
6.	Structured Query Language	Overview, Characteristics, Advantage of SQL- DDL, DML, DCL, SQL data type, specifying constraints, Basic SQL queries. Logical operators: BETWEEN, IN, AND, OR, NOT, ANY, ALL. Set Comparison operators, Group by and Having Clauses, Nested queries, Joins	9
7.	Procedural Language	PL/SQL: Data types, Stored Procedures, Functions, Exceptions, Cursors and triggers.	5
9.	Transaction and Concurrency Control	Definition of Transactions, ACID properties, Schedules, Serializability, Concurrency Control, Lock-based protocols, Time-stamp based protocols.	6
10.	Database Recovery	System Failure, Backup and recovery Technique, checkpoints, rollback, Deadlock	2
Total number of Lectures			42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance:10, Assignments/Min-Project/Class
Test/Quiz/Tutorial):15	
Total	100

Project Based Learning: Each student in a group of 3-4 will choose a real-life application area. To make a project, the students will analyze and define the need of database systems in terms of functional requirements. Each group will design the Entity Relationship diagram to understand the organizational structure of the application area and implement the database in MySQL. Each group will identify 15-20 typical queries and execute them. For handling the multiple record, they will implement cursors and triggers. Student will design the webpage of the application area and connect with the database.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Henry F Korth, Abraham Silberschatz, S. Sudurshan, Database system concepts, 6 th Edition, McGraw-Hill,2010
2.	RamezElmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 6 th Edition, Pearson

	Education, 2011.
3.	Ramakrishnan, Gehrke, Database Management Systems, Mcgraw-Hill, 3 rd Edition, Addison-Wesley, 2006.
4.	Thomas Connolly, Carolyn Begg, Database Systems-A Practical Approach to design, Implementation and Management, 6 th Edition, Pearson Education, 2015.
7.	“An introduction to database systems” by Bipin C. Desai, West Publishing Company, College & School Division, 1990 - Computers - 820 pages
8.	Christopher J. Date, Database Design and Relational Theory: Normal Forms and All That Jazz, 2012.
9.	Rajiv Chopra, Database Management System (DBMS): A Practical Approach, 5th Edition, 2016, 682 pages.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	2				1		
	It focuses on understanding database management system.	It may not directly involve problem analysis.	Understanding database is necessary for designing systems.				It slightly contributes to lifelong learning.		
CO2	2	1	1				1		1
	It aligns with understanding basic knowledge of data models to identify suitable data model for any problem.	It slightly helps in problem analysis.	It slightly contributes to designing applications that involve data models.				It aligns with lifelong learning.		Slightly, it contributes to database development for web and mobile applications.
CO3	2	2	2	1	1		1		1
	It directly aligns with the basic knowledge to model real world systems..	Modelling involves problem analysis to address challenges related to data.	It involves designing ER model.	It aligns with modern tool usage to create designs.	ER model aligns with data information.		It aligns with lifelong learning.		It contributes to database development for web and mobile applications.
CO4	2	2		2			1		1
	It directly aligns with the basic knowledge of SQL for query processing..	It involves problem analysis.		It uses modern tool for query processing.			It aligns with lifelong learning,		It contributes to database development for web and mobile applications.
CO5	2	2							2
	It directly aligns with the basic knowledge of normalization.	It involves problem analysis to normalize data.							It contributes to database development for web and mobile applications.
Avg.	1.8	1.6	1.67	1.5	1		1		1.25

Detailed Syllabus
Lab-wise Breakup

Course Code	23B65CS125	Semester: EVEN	Semester: II Session : 2023-24 Month from ... to
Course Name	Database Management Systems Lab		
Credits	0-0-1	Contact Hours	2

Faculty (Names)	Coordinator(s)	Noor Mohammad
	Teacher(s) (Alphabetically)	Dhanalakshmi G , Indu Chawla, Noor Mohammad ,Neetu Singh

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Discuss the basic concepts of MySQL commands.	Understand (Level II)
CO2	Execute simple and complex queries using DDL, DML, DCL and TCL.	Apply (Level III)
CO3	Implement SQL Joins, Clauses, and Subqueries.	Apply (Level III)
CO4	Programming PL/SQL including stored procedures, stored functions, cursors, Triggers.	Apply (Level III)

Module No.	Title of the Module	List of Experiments	CO
1.	Introduction to MySQL commands.	MySQL Create command, Data Types, Constraints, Alter, Drop, Rename Statements.	
2.	SQL-DML	Select database, show and describe tables. DML Commands- Select, Insert, Update, Delete.	
3.	Conditions and Logical Operators	Specifying conditions with Where keyword, AND, OR, NOT, BETWEEN, IN, NOT IN etc.	
4.	SQL Aggregate Functions	Date and Time functions, Numeric, String, Conversion functions like Count, Min, Max, Avg, Sum etc.	
5.	SQL Joins	Cross Join, Natural Join, Inner Join, Outer Join.	
6.	SQL Clauses	Sorting Results (ORDER BY Clause), Grouping Results (GROUP BY Clause), ANY and ALL, Combining Result Tables (UNION, INTERSECT, EXCEPT).	
7.	Subqueries	Basic Subqueries, multiple column subqueries, subqueries with Having and group by clause.	

8.	Procedural Language	<ol style="list-style-type: none"> 1. Write PL/SQL program for storing data using procedures. 2. Write PL/SQL program for storing data using stored functions. 3. Write PL/SQL program for storing data using cursors and Triggers 	
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Evaluation Criteria

Components	Maximum Marks
Lab Test-1	20
Lab Test-2	20
Day-to-Day (Project, Lab Assessment, Attendance)	60
Total	100

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Henry F Korth, Abraham Silberschatz, S. Sudurshan, Database system concepts, 7 th Edition, McGraw-Hill,2019
2.	Ramez Elmasri , Shamkant B. Navathe , Fundamentals of Database Systems, 5 th Edition, Pearson Education, 2015.
3.	Ramakrishnan, Gehrke, Database Management Systems, Mcgraw-Hill, 3 rd Edition, Addison-Wesley, 2014.
4.	Thomas Connolly, Carolyn Begg, Database Systems-A Practical Approach to design, Implementation and Management, 6 rd Edition, Addison-Wesley,2015.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1		1				1		
	It focuses on understanding MySQL basics.		Understanding database language is necessary for designing database.				It slightly contributes to lifelong learning.		
CO2	2	2	1	2			1		1
	It aligns with executing queries.	It involves problem analysis to execute complex queries.	It slightly contributes to designing applications that involve database.	It aligns with database management software..			It aligns with lifelong learning.		It contributes to database development for web and mobile applications.
CO3	2	2	1	2			1		1
	It aligns with executing queries..	It involves problem analysis to execute complex queries.	It slightly contributes to designing applications that involve database	It aligns with database management software			It aligns with lifelong learning..		It contributes to database development for web and mobile applications.
CO4	2	2	2	2			1		2
	It align with applying basic knowledge.	It involves problem analysis.	It contributes to designing applications that involve database	It uses modern tool for designing database.			It aligns with lifelong learning		It contributes to database development for web and mobile applications.
Avg.	1.75	2	1.25	2			1		1.33

Detailed Syllabus
Lecture-wise Breakup

Subject Code	23B61CS123	Semester: (specify Odd/Even): Even	Semester: 2nd Session: 2023-24 Month: Jan2024 to June 2024
Subject Name	Python 1		
Credits	2-0-0	Contact Hours	2

Faculty (Names)	Coordinator(s)	Neetu Singh
	Teacher(s) (Alphabetically)	Neetu Singh, Preeti Mittal

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	List reasons why Python is a useful scripting language for developers	Knowledge (level 1)
CO2	Illustrate solution of practical problems using variables, assignment statements, control statements, functions and Sequences	Apply (level 3)
CO3	Solve practical problems using Dictionaries and Sets	Apply (level 3)
CO4	Demonstrate Array Oriented Programming with NumPy and String Handling methods to write scripts	Apply (level 3)
CO5	Practice solving practical problems by writing scripts using file and exception handling and creating data visualization using Matplotlib	Apply (level 3)

Module No.	Subtitle of the Module	Topics in the Module	No. of Lectures for the module
1	Introduction to Python	Language features Current applications of Python Reasons for increasing popularity	1
2	Variables and Assignment Statements	Variables and assignment statements Arithmetic Function print and introduction to single and double quoted Strings Triple quoted strings Getting input from user Objects and dynamic typing	2
3	Control Statements	if, else, if...elseif, else statements while statement for statement Iterables, list and Iterators Built in range function Augmented Assignments Sequence controlled Iteration Formatted Strings Built in function range: A deeper look Using type Decimal for monetary amounts break and continue Statements	3

		Boolean Operators and, or and not	
4	Functions	Defining functions Random Number Python Standard Library math Module Functions Default Parameter Values Keyword Arguments Arbitrary Argument Lists Methods: Functions That Belong to Objects Scope Rules import: A Deeper Look Passing Arguments to Functions: A Deeper Look Recursion Functional-Style Programming Main module, built-in, custom modules Namespaces and scopes in Python	4
5	Sequences: Arrays, Lists and Tuples	Arrays and basic operations on Arrays Matrix Lists Tuples Unpacking Sequences Sequence Slicing del Statement Passing Lists to Functions Sorting Lists Searching Sequences Other List Methods Simulating Stacks with Lists List Comprehensions Generator Expressions Filter, Map and Reduce Other Sequence Processing Functions Two-Dimensional Lists	4
6	Dictionaries and Sets	Introduction to Dictionaries Creating a Dictionary Iterating through a Dictionary Basic Dictionary Operations Dictionary Methods keys and values Dictionary Comparisons Dictionary Method update Dictionary Comprehensions Introduction to Sets Comparing Sets Mathematical Set Operations Mutable Set Operators and Methods Set Comprehensions	4
7	Array-Oriented Programming with NumPy	Creating arrays from Existing Data array Attributes Filling arrays with Specific Values Creating arrays from Ranges List vs. array Performance: Introducing %timeit array Operators NumPy Calculation Methods Universal Functions Indexing and Slicing Views: Shallow Copies Deep Copies	3
8	Strings: A Deeper Look	Formatting Strings Presentation Types Field Widths and Alignment Numeric Formatting	3

		String's format Method Concatenating and Repeating Strings Stripping Whitespace from Strings Changing Character Case Comparison Operators for Strings Searching for Substrings Replacing Substrings Splitting and Joining Strings Characters and Character-Testing Methods Raw Strings Introduction to Regular Expressions re Module and Function fullmatch Replacing Substrings and Splitting Strings Other Search Functions; Accessing Matches	
9	Files and Exceptions	Writing to a Text File: Introducing the with Statement Reading Data from a Text File Updating Text Files Serialization with JSON Additional Notes Regarding Files Handling Exceptions Division by Zero and Invalid Input try Statements Catching Multiple Exceptions in One except Clause What Exceptions Does a Function or Method Raise? What Code Should Be Placed in a try Suite? finally Clause Explicitly Raising an Exception Stack Unwinding and Tracebacks	4
10	Data Visualization	Introduction to Matplotlib Introduction to data visualization Types of charts Steps for creating data visualization	2
Total number of Lectures			30
Evaluation Criteria			
Components		Maximum Marks	
Mid Term (T2)		30	
End Semester Examination		40	
TA		30 (Attendance (5), Assignment/ Mini Project/ Tutorial/	
Quiz (25))			
Total		100	

Project based learning: Create a Python application either individually or in groups of maximum 4 students each, to illustrate the concepts covered in class.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
	Text Books
1	Paul Deitel and Harvey Deitel: <i>Python for Programmers</i> , 1 st Edition, Deitel Developer Series, 2020.
2	Allen Downey: <i>Think Python</i> , 2 nd Edition, O'Reilly, 2015.
	Reference Books

1	Paul Barry: <i>Head First Python</i> , 3 rd Edition, O'Reilly, 2023.
2	Erric Matthes: <i>Python Crash Course</i> , 3 rd Edition, No Starch Press, 2023.

CO-PO and CO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	-	-	-	-	-	-	1	-	-
							Engage in life long learning on new areas where knowledge of Python can be applied	-	
CO2	3	2	2	1	-	-	1	-	1
	Strongly apply fundamental knowledge of variables, assignment statements, control statements, functions and sequences to provide solutions to problems using Python	Conduct a moderate level of analysis of problems and solve them using Python based variables, assignment statements, control statements, functions and sequences	Be able to create and demonstrate Python based applications using variables, assignment statements, control statements, functions and sequences that help resolve various needs of the society at moderate level	Slightly understand the constraints of variables, assignment statements, control statements, functions and sequences in developing applications using Python and apply them where appropriate			Able to engage in lifelong learning of new features introduced with respect to variables, assignment statements, control statements, functions and sequences in Python independently to a slight extent	-	Slightly acquire programming skills by learning usage of variables, assignment statements, control statements, functions and sequences in Python
CO3	2	2	2	1	-	-	1	-	1
	Apply knowledge of Dictionaries and Sets to provide solutions to problems using Python at moderate level	Solve application development use cases by applying the knowledge of Dictionaries and Sets at moderate level	Be able to create and demonstrate Python based applications using Dictionaries and Sets that help resolve various needs of the society at moderate level	Slightly understand the constraints of Dictionaries and Sets in developing applications using Python and apply them where appropriate			Able to engage in lifelong learning of new features introduced with respect to Dictionaries and Sets in Python independently to a slight extent	-	Slightly acquire programming skills by learning usage of Dictionaries and Sets in Python
CO4	2	2	2	1	-	-	1	-	1
	Apply knowledge of Array Oriented Programming with NumPy and String Handling methods to provide solutions to problems using Python at moderate	Solve application development use cases by applying the knowledge of Array Oriented Programming with NumPy and String Handling methods at moderate	Be able to create and demonstrate Python based applications using Array Oriented Programming with NumPy and String Handling methods that help resolve various needs	Slightly understand the constraints of Array Oriented Programming with NumPy and String Handling methods in developing applications using Python			Able to engage in lifelong learning of new features introduced with respect to Array Oriented Programming with NumPy and String Handling methods in	-	Slightly acquire programming skills by learning usage of Array Oriented Programming with NumPy and String Handling methods in

	level	level	of the society at moderate level	and apply them where appropriate			Python independently to a slight extent		Python
CO5	2	2	2	1	1	-	1	-	2
	Apply knowledge of File and Exception handling and data visualization using Matplotlib to provide solutions to problems using Python at moderate level	Solve application development use cases by applying the knowledge of File and Exception handling and data visualization using Matplotlib at moderate level	Be able to create and demonstrate Python based applications using File and Exception handling and data visualization using Matplotlib that help resolve various needs of the society at moderate level	Slightly understand the constraints of File and Exception handling methods and data visualization using Matplotlib in developing applications using Python and apply them where appropriate	Slightly communicate effective reports, design documents and presentations explaining the use of File and Exception handling and data visualization using Matplotlib via Project Based Learning		Able to engage in lifelong learning of new features introduced with respect to File and Exception handling and data visualization using Matplotlib in Python independently to a slight extent	-	Acquire programming skills by learning usage of File and Exception handling and data visualization using Matplotlib in Python at moderate level
Average	1.8	1.6	1.6	0.7	0.2	0	1	0	1

Detailed Syllabus
Lab-wise Breakup

Subject Code	23B65CS126	Semester: (Specify Odd/Even): Even	Semester: 2nd Session: 2023-24 Month: Jan2024 to June 2024
Subject Name	Python 1		
Credits	0-0-1	Contact Hours	2

Faculty (Names)	Coordinator(s)	Kirti Jain
	Teacher(s) (Alphabetically)	Ankita Verma, Kirti Jain, Neetu Singh, Preeti Mittal

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Practice writing Python programs using variables, operators, control statements, functions and sequences	Apply (level 3)
CO2	Solve problems using Dictionaries, Sets, String operations and array-oriented programming with NumPy using Python scripts	Apply (level 3)
CO3	Illustrate usage of File and Exception handling and data visualization using Matplotlib to solve problems using Python scripts	Apply (level 3)
CO4	Experiment creating solutions for practical problems using various python concepts	Analyze (level 4)

Module No.	Subtitle of the Module	Topics in the Module	No. of Labs for the module
1	Variables and assignment statements	Writing your first 'Hello World' Program Python Indentation Python Comments Variables Operators	1
2	Control Statements	Getting input from user Control Statements - if, else, while, for range function break and continue and, or, not operators	2
3	Functions	Recursion Functional-Style Programming	1
4	Sequences: Arrays, Lists and Tuples	Arrays Matrix Lists Tuples Two-Dimensional Lists Sequence Processing Functions	3
5	Dictionaries and Sets	Creating a Dictionary Iterating through a Dictionary	2

		Basic Dictionary Operations Dictionary Methods keys and values Dictionary Comparisons Dictionary Method update Comparing Sets Mathematical Set Operations Mutable Set Operators and Methods																	
6	Strings: A Deeper Look	Formatting Strings Concatenating and Repeating Strings Stripping Whitespace from Strings Changing Character Case Comparison Operators for Strings Searching for Substrings Replacing Substrings Splitting and Joining Strings Regular Expressions Replacing Substrings and Splitting Strings Other Search Functions Accessing Matches	1																
7	Array-Oriented Programming with NumPy	Creating arrays from Existing Data array Attributes Filling arrays with Specific Values Creating arrays from Ranges List vs. array Performance: Introducing %timeit array Operators NumPy Calculation Methods Universal Functions Indexing and Slicing	1																
8	Files and Exceptions	Writing to a Text File Reading Data from a Text File Updating Text Files Serialization with JSON Additional Notes Regarding Files Handling Exceptions Division by Zero and Invalid Input try Statements Catching Multiple Exceptions in One except Clause What Exceptions Does a Function or Method Raise? What Code Should Be Placed in a try Suite? finally Clause Explicitly Raising an Exception Stack Unwinding and Tracebacks	2																
9	Data Visualization	Creating Data Visualization using Matplotlib	1																
Total number of Lectures			16																
Evaluation Criteria <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Components</th> <th style="text-align: left;">Maximum Marks</th> </tr> </thead> <tbody> <tr> <td>Eval 1</td> <td>15</td> </tr> <tr> <td>Eval 2</td> <td>15</td> </tr> <tr> <td>Lab Test 1</td> <td>20</td> </tr> <tr> <td>Lab Test 2</td> <td>20</td> </tr> <tr> <td>PBL members)</td> <td>20 (Students will submit the mini project in a group of 3-4 members)</td> </tr> <tr> <td>Attendance</td> <td>10</td> </tr> <tr> <td>Total</td> <td>100</td> </tr> </tbody> </table>			Components	Maximum Marks	Eval 1	15	Eval 2	15	Lab Test 1	20	Lab Test 2	20	PBL members)	20 (Students will submit the mini project in a group of 3-4 members)	Attendance	10	Total	100	
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Lab Test 1	20																		
Lab Test 2	20																		
PBL members)	20 (Students will submit the mini project in a group of 3-4 members)																		
Attendance	10																		
Total	100																		

Project based learning: Create a Python application either individually or in groups of maximum 4 students each, to illustrate the concepts covered in class.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Text Books

1 Paul Deitel and Harvey Deitel: *Python for Programmers*, 1st Edition, Deitel Developer Series, 2020.

2 Allen Downey: *Think Python*, 2nd Edition, O'Reilly, 2015.

Reference Books

1 Paul Barry: *Head First Python*, 3rd Edition, O'Reilly, 2023.

2 Erric Matthes: *Python Crash Course*, 3rd Edition, No Starch Press, 2023.

CO-PO and CO-PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	1	-	1	1	-	2
	Moderately apply fundamental knowledge of variables, operators, control statements, functions and sequences to develop Python based applications at a moderate level.	Moderately conduct the analysis of problems and solve them using Python variables, operators, control statements, functions and sequences	Be able to create and demonstrate Python based applications using variables, operators, control statements, functions and sequences that help resolve various needs of the society at moderate level	Slightly understand the constraints of variables, operators, control statements, functions and sequences in developing applications using Python and apply them where appropriate		Slightly apply project management principles and act as leader and team member via Project Based Learning	Able to engage in lifelong learning of new features introduced with respect to variables, operators, control statements, functions and sequences in Python independently to a slight extent		Acquire programming skills by learning usage of variables, operators, control statements, functions and sequences in Python at moderate level
CO2	2	2	2	1	-	1	1	-	2
	Moderately apply fundamental knowledge of Dictionaries, Sets and String operations, array-oriented programming with NumPy to develop Python based applications at a moderate level.	Moderately conduct the analysis of problems and solve them using Python Dictionaries, Sets and String operations, array-oriented programming with NumPy	Be able to create and demonstrate Python based applications using Dictionaries, Sets and String operations, array-oriented programming with NumPy that help resolve various needs of the society at moderate level	Slightly understand the constraints of Dictionaries, Sets and String operations, array-oriented programming with NumPy in developing applications using Python and apply them where appropriate		Slightly apply project management principles and act as leader and team member	Able to engage in lifelong learning of new features introduced with respect to Dictionaries, Sets and String operations, array-oriented programming with NumPy in Python independently to a slight extent	-	Acquire programming skills by learning usage of Dictionaries, Sets and String operations, array-oriented programming with NumPy in Python at moderate level
CO3	2	2	2	1	1	2	1	-	2
	Moderately apply fundamental knowledge of File and Exception handling and data visualization using Matplotlib to develop Python based applications at a moderate level.	Moderately conduct the analysis of problems and solve them using Python File and Exception handling and data visualization using Matplotlib	Be able to create and demonstrate Python based applications using File and Exception handling and data visualization using Matplotlib that help resolve various needs of the society at moderate level	Slightly understand the constraints of File and Exception handling and data visualization using Matplotlib in developing applications using Python and apply them where appropriate	Slightly communicate effective reports, design documents and presentations explaining the use of File and Exception handling and data visualization using Matplotlib via Project Based Learning	Moderately apply project management principles and act as leader and team member via Project Based Learning	Able to engage in lifelong learning of new features introduced with respect to File and Exception handling and data visualization using Matplotlib in Python independently to a slight extent	-	Acquire programming skills by learning usage of File and Exception handling and data visualization using Matplotlib in Python at moderate level
CO4	2	2	2	2	2	2	1	-	2

	Moderately apply knowledge of Python concepts to provide solution to problems	Moderately identify and analyze problems and solve them using Python concepts	Design computer applications that meet the various needs of society at moderate level using Python	Moderately understand the constraints of developing applications using Python and apply them where appropriate	Moderately communicate effective reports, design documents and presentations via Project Based Learning using Python concepts	Moderately apply project management principles and act as leader and team member via Project Based Learning using Python concepts	Able to engage in independent and lifelong learning of new features introduced in Python to a slight extent	-	Acquire programming skills using Python at moderate level
Average	2	2	2	1.25	0.75	1.5	1	0	2

Soft Skills-1 (23B31HS112)

Course Description

Course Code	23B31HS112	Semester Even	Semester II Session 2023-24 Month from Jan 2024 to June 2024
Course Name	Soft Skills -1		
Credits	2	Contact Hours	2-0-0
Faculty (Names)	Coordinator(s)	Dr. Nibha Sinha	
	Teacher(s) (Alphabetically)		
COURSE OUTCOMES: After the successful completion of this course, the student will be able to			COGNITIVE LEVELS
CO1	To understand various aspects of soft skills and learn ways to develop personality		Understand Level (C2)
CO2	To apply stress and time management skills to perform as a better professional		Apply Level (C3)
CO3	Analyze leadership skills and styles to survive and excel in professional life		Analyze Level (C4)
CO4	Creating a Decision making, negotiation, and capacity-building using Learn, Unlearn, and relearn approach		Create Level (C6)
Module No.	Title of the Module	Topics in the Module	No. of Lectures
1.	Introduction to Soft Skills	Introduction, Personality Development: Knowing Yourself, Positive Thinking, Emotional Intelligence, Component of Emotional Intelligence, Skills to Develop Emotional Intelligence, SWOT Analysis	5
2.	Stress and Time Management	Stress, Sources of Stress, Ways to Cope with Stress, Time Management, Smart Goal setting and prioritization, Short-term and long-term goals, and Implementing Goals.	4
3.	Decision Making and Negotiation	Introduction to Decision Making, Steps for Decision-Making, Decision-Making Techniques, Negotiation Fundamentals, Negotiation Styles, and Major Negotiation Concepts	7
4.	Leadership and Team Building	Leader and Leadership, Leadership Traits, Culture and Leadership, Leadership Styles and Trends, Team Building, Types of Teams	5
5	Capacity Building: Learn,	Capacity Building, Elements of Capacity Building, Zones of Learning, Ideas for Learning, Strategies for Capacity Building	7

	Unlearn and Relearn		
Total number of Lectures			28
Evaluation Criteria			
Components	Maximum Marks		
Mid Term	30 (Project)		
End Semester Examination	40		
TA	30 (Quiz, Assignments, Project, Class Attendance & Participation)		
Total	100		
PBL Component: The project is to be done in a group of 4-6 students. They will be asked to write a report related to various skills implementation in their workplace.			
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication, etc. (Text books, Reference Books, Journals, Reports, Websites, etc)			
1.	Harold R. Wallace et. al, Personality Development, Cengage Learning India Pvt. Ltd, New Delhi 2006		
2.	Barun K. Mitra, Personality Development & Soft Skills, Oxford University Press, New Delhi, 2012.		
3.	L.U.B. Pandey, Practical Communication, A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi		
4.	Sangeeta Sharma et. al, Communication Skills for Engineers and Scientists, THI Learning Pvt Ltd, New Delhi, 2011		
5.	William S. Pfeiffer, Public Speaking, Pearson, Delhi, 2012		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1					2	1	3		3
CO2					2	1	3		3
CO3					3	3	3		3
CO4					3	3	3		3
Avg					2.5	2	3		3

Detailed syllabus
Lecture-wise Breakup

Subject Code	23B36HS111	Semester: EVEN	Semester 2nd	Session 2023-24
Subject Name	EVERYDAY PSYCHOLOGY			
Credits	2	Contact Hours	2-0-0	
Faculty (Names)	Coordinator(s)	Dr Yogita Naruka		
	Teacher(s) (Alphabetically)	Dr Yogita Naruka		

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Understand human behavior and components that constitute self and social relationships	Understanding Level (C2)
CO2	Apply psychological concepts to understand challenges at the level of self and inter-personal relationships	Applying Level (C3)
CO3	Evaluate the role of social norms and perceptions in shaping our behaviors and thinking	Evaluating Level (C5)
CO4	Understand and analyze the role of various psychological and lifestyle related strategies for promoting living with peace and balance	Analyse Level (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Everyday Psychology	Use and Purpose of psychology in everyday life, Understanding behavior	3
3.	Understanding Self	Basic Human Emotions, Self-esteem Core – Self Evaluation	3
3.	Identity	Identity and its formation, Identity conflict	2
4.	Personality	Personality, types of Personality, Proactive Personality	3
5.	Morality	Development of Moral Reasoning and Moral Dilemmas	2
6.	Social context of Development	Socio-cultural theory, Context of Development – Family, Peers and Schooling, Media	4
7.	Relationships	Family Relationships Relationship Struggles	2
8.	Mental Health	Concept of mental health, taboos around mental issues, mental health concerns - Body Image, Loneliness, Anxiety, Sadness vs Depression, Abuse	5
9.	Coping with Mental health issues	Coping Strategies, Role of counselling, Self-Regulation	4
Total number of Hours			28

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Assignment/Quiz)
Total	100

Project based learning: Based on core-self-evaluation you have done for yourself and types of personalities you have studied, analyze your personality type and list out specific steps that you need to work for achieving a proactive personality in future. Be detailed, reflective about your personal experiences and support you answer from personal life anecdotes that you would like to share.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	W. Weiten, and M. A. Lloyd, Psychology Applied to Modern Life: Adjustment in the 21 st Century, Wadsworth Publishing, 2007
2.	R. Harington, Stress, Health and well-being: Thriving in the 21 st century, Wadsworth Publishing, 2013.
3.	Tavris, C., & Aronson, E. (2007). Mistakes were made (but not by me): Why we justify foolish beliefs, bad decisions, and hurtful acts. Harcourt.
4.	Aronson, E. (1994). The social animal (7 th ed.). W H Freeman/Times Books/ Henry Holt & Co.
5.	Myers, D. G. (1999). <i>Social psychology</i> (6th ed.). McGraw-Hill.

Discrete Mathematics (23B31MA112)

Relations, Equivalence Relations, Partial Ordered Set, Hasse Diagram, Lattice, Functions, Recursively Defined Functions, Generating functions, Z-Transforms, Propositions, Basic Logical Operators, Truth tables, Tautologies and Contradictions. Valid arguments and Fallacy, Propositional Functions and Quantifiers, Graphs, Subgraphs, Eulerian Graph and Konigsberg problem, Hamiltonian graph, Labelled and Weighted graphs. Tree Graphs-Minimum Spanning Tree (Prim's algorithm), Graph Colourings. Four Colour Problem, Trees, Digraphs, Rooted trees, Binary trees, Sequential representation, Adjacency Matrix, Path Matrix, Shortest Path.

Course Description

Course Code	23B31MA112	Semester: Even	Semester - II Session 2023-24 Month from Jan-May 2024
Course Name	Discrete Mathematics		
Credits	3	Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Shashank Goel	
	Teacher(s) (Alphabetically)	Dr. Aradhana Narang, Dr. Shashank Goel	
COURSE OUTCOMES: After the successful completion of this course, the student will be able to			COGNITIVE LEVELS
CO1	recall basics of set theory, functions and relations.		Remembering (C1)
CO2	explain lattices, generating function, propositional calculus, algebraic structure and graphs.		Understanding (C2)
CO3	solve the problems related to Z- transform, propositional calculus and algebraic structures.		Applying (C3)
CO4	analyse different graph theoretic algorithms for solving related problems.		Analyzing (C4)
Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Relations and Lattices	Relations and their composition. Pictorial representation, matrix and graphical representations. Equivalence relations and partitions. Transitive closure and Warshall's algorithm, Partial ordered relations and Hasse diagram. Lattices, Boolean algebra.	10
2.	Functions	Functions and recursively defined functions, generating functions, solution of recurrence relations by generating function. Z transforms, solution of difference equations by Z transform.	10
3.	Propositional Calculus	Propositions- simple and compound. Basic logical operators. Implication. Truth tables. Tautologies and contradictions. Valid arguments and fallacy. Propositional functions and quantifiers.	5

4.	Graphs	Graphs and related definitions, subgraphs, isomorphism, paths and connectivity. Eulerian graph and Konigsberg problem. Hamiltonian graph. Labelled and weighted graphs. Tree Graphs-Minimum spanning Tree (Prim's algorithm). Graph colorings. Four color problem.	7
5.	Directed Graphs	Trees, Digraphs and related definitions. Rooted trees. Binary trees, Sequential representation. Adjacency matrix. Path matrix. Shortest path.	5
6.	Algebraic Structures	Groups- definitions and examples, order of elements, subgroup, condition for subgroups, Rings, integral domains and Fields- definition and examples.	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Quiz, Assignments, Tutorials, PBL)	
Total		100	
Project based learning: A group of 4 to 5 students will be formed. Each group will be assigned a problem related to the diversified applications of graph theory. Each group will submit a report of 6-7 pages.			
Recommended Reading Material:			
1.	Lipschutz, S. and Lipson, M. , Discrete Mathematics, 2 nd Edition, Tata McGraw-Hill, 1997.		
2.	Rosen, K. H. , Discrete Mathematics and its Application, 7 th Edition, Tata McGraw-Hill, 2011.		
3.	Liu, C. L. , Elements of Discrete Mathematics, 2 nd Edition, Tata McGraw-Hill, 1998.		
4.	Kolman, B., Busby, R. C. and Ross, S. , Discrete Mathematical Structures, 6 th Edition, Prentice Hall, 2018.		
5.	Deo, N. , Graph Theory, Prentice Hall, 2004.		
6.	Grimaldi, R.P. , Discrete and Combinatorial Mathematics, 5 th Edition, Pearson Education, 2011.		

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	1				2		
CO2	2	2	1				2	1	
CO3	3	3	1			1	2	1	
CO4	3	3	1			2	2	1	
Avg	2.5	2.25	1			1.5	2	1	