Analysis & Design of Algorithms		Semester	4
Course Code	**BCS401**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- To learn the methods for analyzing algorithms and evaluating their performance.
- To demonstrate the efficiency of algorithms using asymptotic notations.
- To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
- To learn the concepts of P and NP complexity classes.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.

Module-1

INTRODUCTION: What is an Algorithm?, Fundamentals of Algorithmic Problem Solving.

FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms.

BRUTE FORCE APPROACHES: Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.

Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)

Module-2

BRUTE FORCE APPROACHES (contd..): Exhaustive Search (Travelling Salesman probem and Knapsack Problem).

DECREASE-AND-CONQUER: Insertion Sort, Topological Sorting.

DIVIDE AND CONQUER: Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication.

Chapter 3(Section 3.4), Chapter 4 (Sections 4.1,4.2), Chapter 5 (Section 5.1,5.2,5.3, 5.4)
Module-3
TRANSFORM-AND-CONQUER: Balanced Search Trees, Heaps and Heapsort. **SPACE-TIME TRADEOFFS:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm. **Chapter 6 (Sections 6.3,6.4), Chapter 7 (Sections 7.1,7.2)**
Module-4
DYNAMIC PROGRAMMING: Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. **THE GREEDY METHOD:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes. **Chapter 8 (Sections 8.1,8.2,8.4), Chapter 9 (Sections 9.1,9.2,9.3,9.4)**
Module-5
LIMITATIONS OF ALGORITHMIC POWER: Decision Trees, P, NP, and NP-Complete Problems. **COPING WITH LIMITATIONS OF ALGORITHMIC POWER**: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NP-Hard problems (Knapsack problem). **Chapter 11 (Section 11.2, 11.3), Chapter 12 (Sections 12.1,12.2,12.3)**

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.
2. Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computational problems.
3. Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems.
4. Apply greedy and input enhancement methods to solve graph & string based computational problems.
5. Analyse various classes (P,NP and NP Complete) of problems
6. Illustrate backtracking, branch & bound and approximation methods.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally **reduced to 50 marks**

Suggested Learning Resources:

Textbooks

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.

Reference books

1. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
3. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

Web links and Video Lectures (e-Resources):

- Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Promote real-world problem-solving and competitive problem solving through group discussions to engage students actively in the learning process.
- Encourage students to enhance their problem-solving skills by implementing algorithms and solutions through programming exercises, fostering practical application of theoretical concepts.

Assessment Methods -

1. Problem Solving Assignments (Hacker Rank/ Hacker Earth / Leadcode)
2. Gate Based Aptitude Test

MICROCONTROLLERS		Semester	4
Course Code	**BCS402**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab Slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course Objectives:

CLO 1: Understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC.
CLO 2: Familiarize with ARM programming modules along with registers, CPSR and Flags.
CLO 3: Develop ALP using various instructions to program the ARM controller.
CLO 4: Understand the Exceptions and Interrupt handling mechanism in Microcontrollers.
CLO 5: Discuss the ARM Firmware packages and Cache memory polices.

Teaching-Learning Process

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students understanding.
9. Use any of these methods: Chalk and board, Active Learning, Case Studies.

MODULE-1	**No. of Hours: 8**

ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions

Textbook 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5
RBT: L1, L2, L3

MODULE-2	**No. of Hours: 8**

Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants.

Textbook 1: Chapter 3 - 3.1 to 3.6
RBT: L1, L2, L3

MODULE-3	**No. of Hours:8**

C Compilers and Optimization: Basic C Data Types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing, Portability Issues.

Textbook 1: Chapter 5.1 to 5.7 and 5.13
RBT: L1, L2, L3

MODULE-4	No. of Hours:8
Exception and Interrupt Handling: Exception handling, ARM processor exceptions and modes, vector table, exception priorities, link register offsets, interrupts, assigning interrupts, interrupt latency, IRQ and FIQ exceptions, basic interrupt stack design and implementation. **Firmware:** Firmware and bootloader, ARM firmware suite, Red Hat redboot, Example: sandstone, sandstone directory layout, sandstone code structure. **Textbook 1: Chapter 9.1 and 9.2, Chapter 10** **RBT: L1, L2, L3**	
MODULE-5	**No. of Hours:08**
CACHES: The Memory Hierarchy and Cache Memory, Caches and Memory Management Units: CACHE Architecture: Basic Architecture of a Cache Memory, Basic Operation of a Cache Controller, The Relationship between Cache and Main Memory, Set Associativity, Write Buffers, Measuring Cache Efficiency, CACHE POLICY: Write Policy—Writeback or Writethrough, Cache Line Replacement Policies, Allocation Policy on a Cache Miss. Coprocessor 15 and caches. **Textbook 1: Chapter 12.1 to 12.4** **RBT: L1, L2, L3**	

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.No.	Experiments
Module – 1	
1.	Using Keil software, observe the various Registers, Dump, CPSR, with a simple Assembly Language Programs (ALP).
Module – 2	
2.	Develop and simulate ARM ALP for Data Transfer, Arithmetic and Logical operations (Demonstrate with the help of a suitable program).
3.	Develop an ALP to multiply two 16-bit binary numbers.
4.	Develop an ALP to find the sum of first 10 integer numbers.
5.	Develop an ALP to find the largest/smallest number in an array of 32 numbers.
6.	Develop an ALP to count the number of ones and zeros in two consecutive memory locations.
Module – 3	
7.	Simulate a program in C for ARM microcontroller using KEIL to sort the numbers in ascending/descending order using bubble sort.
8.	Simulate a program in C for ARM microcontroller to find factorial of a number.
9.	Simulate a program in C for ARM microcontroller to demonstrate case conversion of characters from upper to lowercase and lower to uppercase.
Module – 4 and 5	
10.	Demonstrate enabling and disabling of Interrupts in ARM.
11.	Demonstrate the handling of divide by zero, Invalid Operation and Overflow exceptions in ARM.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Explain the ARM Architectural features and Instructions.
- Develop programs using ARM instruction set for an ARM Microcontroller.
- Explain C-Compiler Optimizations and portability issues in ARM Microcontroller.
- Apply the concepts of Exceptions and Interrupt handling mechanisms in developing applications.
- Demonstrate the role of Cache management and Firmware in Microcontrollers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the

academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

1. **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
2. On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
3. The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
4. The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
5. Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
6. The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.

Reference Books:

1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication, 2019.
2. Insider's Guide to the ARM7 based microcontrollers, Hitex Ltd.,1st edition, 2005

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

Assign the group task to demonstrate the Installation and working of Keil Software.

DATABASE MANAGEMENT SYSTEM		Semester	4
Course Code	**BCS403**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	
Examination nature (SEE)	Theory		

Course objectives:

- To Provide a strong foundation in database concepts, technology, and practice.
- To Practice SQL programming through a variety of database problems.
- To Understand the relational database design principles.
- To Demonstrate the use of concurrency and transactions in database.
- To Design and build database applications for real world problems.
- To become familiar with database storage structures and access techniques.

Teaching-Learning Process

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

MODULE-1	**No. of Hours: 8**

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.
Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.
Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams,Specialization and Generalization.

Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10
RBT: L1, L2, L3

MODULE-2	**No. of Hours: 8**

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.
Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.
Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

Textbook 1: Ch 5.1 to 5.3, Ch 8.1 to 8.5; Ch 9.1 to 9.2 Textbook 2: 3.5
RBT: L1, L2, L3

MODULE-3	**No. of Hours:8**

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.
SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL
Textbook 1: Ch 14.1 to 14.7, Ch 6.1 to 6.5
RBT: L1, L2, L3

MODULE-4	**No. of Hours:8**

SQL: Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

Textbook 1: Ch 7.1 to 7.3, Ch 20.1 to 20.6
RBT: L1, L2, L3

MODULE-5	**No. of Hours:08**

Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j

Textbook 1:Chapter 21.1 to 21.5, Chapter 24.1 to 24.6
RBT: L1, L2, L3

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Create a table called Employee & execute the following. **Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)** 1. Create a user and grant all permissions to theuser. 2. Insert the any three records in the employee table contains attributes EMPNO,ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. 4. Insert null values to the employee table and verify the result.
2	Create a table called Employee that contain attributes EMPNO,ENAME,JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employeetable. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. 5. Delete the employee whose Empno is 105.
3	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. **Employee(E_id, E_name, Age, Salary)** 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employeetable 3. Find the Maximum age from employee table. 4. Find the Minimum age from employeetable. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees.
4	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. **CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)**
5	Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extrct the values from the cursor. Close the cursor. **Employee(E_id, E_name, Age, Salary)**
6	Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.
7	Install an Open Source NoSQL Data base MangoDB & perform basic CRUD(Create, Read, Update & Delete) operations. Execute MangoDB basic Queries using CRUD operations.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Describe the basic elements of a relational database management system
- Design entity relationship for the given scenario.
- Apply various Structured Query Language (SQL) statements for database manipulation.
- Analyse various normalization forms for the given application.
- Develop database applications for the given real world problem.
- Understand the concepts related to NoSQL databases.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum

passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Mini Project:

- Project Based Learning

Analysis & Design of Algorithms Lab		Semester	4
Course Code	**BCSL404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	2
Examination type (SEE)	Practical		

Course objectives:

- To design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
- To apply diverse design strategies for effective problem-solving.
- To Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

Sl.No	Experiments
1	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.
2	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
3	a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
4	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
5	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.
6	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
7	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
8	Design and implement C/C++ Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.
9	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
10	Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
11	Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
12	Design and implement C/C++ Program for N Queen's problem using Backtracking.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Develop programs to solve computational problems using suitable algorithm design strategy.
2. Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical).
3. Make use of suitable integrated development tools to develop programs
4. Choose appropriate algorithm design techniques to develop solution to the computational and complex problems.
5. Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.

- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- Virtual Labs (CSE): http://cse01-iiith.vlabs.ac.in/

DISCRETE MATHEMATICAL STRUCTURES		Semester	IV
Course Code	**BCS405A**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

1. To help students to understand discrete and continuous mathematical structures.
2. To impart basics of relations and functions.
3. To facilitate students in applying principles of Recurrence Relations to find the generating functions and solve the Recurrence relations.
4. To have the knowledge of groups and their properties to understand the importance of algebraic properties relative to various number systems.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1: Fundamentals of Logic

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. The Use of Quantifiers, Quantifiers, Definitions and the Proofs of Theorems. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: Properties of the Integers

Mathematical Induction, The Well Ordering Principle – Mathematical Induction, Recursive Definitions.

Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition. **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Module-3: Relations and Functions

Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.

Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-4: The Principle of Inclusion and Exclusion

The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.

Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Module-5: Introduction to Groups Theory

Definitions and Examples of Particular Groups Klein 4-group, Additive group of Integers modulo n, Multiplicative group of Integers modulo-p and permutation groups, Properties of groups, Subgroups, cyclic groups, Cosets, Lagrange's Theorem. **(8 Hours)**

(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Apply concepts of logical reasoning and mathematical proof techniques in proving theorems and statements.
2. Demonstrate the application of discrete structures in different fields of computer science.
3. Apply the basic concepts of relations, functions and partially ordered sets for computer representations.
4. Solve problems involving recurrence relations and generating functions.
5. Illustrate the fundamental principles of Algebraic structures with the problems related to computer science & engineering.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. **Ralph P. Grimaldi, B V Ramana: "Discrete Mathematical Structures an Applied Introduction",** 5th Edition, Pearson Education, 2004.
2. **Ralph P. Grimaldi: "Discrete and Combinatorial Mathematics"**, 5th Edition, Pearson Education. 2004.

Reference Books:

1. **Basavaraj S Anami and Venakanna S Madalli: "Discrete Mathematics – A Concept-based approach"**, Universities Press, 2016
2. **Kenneth H. Rosen: "Discrete Mathematics and its Applications"**, 6th Edition, McGraw Hill, 2007.
3. **Jayant Ganguly: "A Treatise on Discrete Mathematical Structures",** Sanguine-Pearson, 2010.
4. **D.S. Malik and M.K. Sen: "Discrete Mathematical Structures Theory and Applications,** Latest Edition, Thomson, 2004.
5. **Thomas Koshy: "Discrete Mathematics with Applications"**, Elsevier, 2005, Reprint 2008.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.
- **http://www.themathpage.com/**
- **http://www.abstractmath.org/**
- **http://www.ocw.mit.edu/courses/mathematics/**

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

GRAPH THEORY		Semester	IV
Course Code	**BCS405B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- Understand the basic concepts of graphs and their properties, and operations of graphs.
- Hamiltonian and Euler graphs, trees and matrix representation of the graph.
- Apply the concepts of a planar graph, matching and colouring in computer science engineering.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1

Introduction to Graphs: Introduction- Basic definition – Application of graphs – finite, infinite and bipartite graphs – Incidence and Degree – Isolated vertex, pendant vertex and Null graph. Paths and circuits – Isomorphism, sub-graphs, walks, paths and circuits, connected graphs, disconnected graphs and components. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

Eulerian and Hamiltonian graphs: Euler graphs, Operations on graphs, Hamiltonian paths and circuits, Travelling salesman problem. Directed graphs – types of digraphs, Digraphs and binary relation. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Trees – properties, pendant vertex, Distance and centres in a tree - Rooted and binary trees, counting trees, spanning trees.

Connectivity Graphs: Vertex Connectivity, Edge Connectivity, Cut set and Cut Vertices, Fundamental circuits. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Planar Graphs: Planar graphs, Kuratowski's theorem (proof not required), Different representations of planar graphs, Euler's theorem, Geometric dual.
Graph Representations: Matrix representation of graphs-Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5:

Graph Colouring: Colouring- Chromatic number, Chromatic polynomial, Matchings, Coverings, Four colour problem and Five colour problem. Greedy colouring algorithm. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the fundamental concepts of properties and representation of graphs.
2. Solve the problems involving characterization and operations on graphs.
3. Apply concepts of trees and graph connectivity to solve real world problems.
4. Apply the concepts of planar graph and graph representations to solve the given problem.
5. Use the concepts of matching and coloring of graphs to solve the real world problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. Narsingh Deo, Graph theory with the applications to engineering & Computer Science, Dovers Publications, 2016
2. J.A. Bondy and U.S.R. Murty. Graph theory with Applications, Springer, 1st edition, 2008.

Reference Books:

1. Garry Chartand and Ping Zhang, Introduction to Graph Theory, Tata McGraw-Hill, 2006.
2. Frank Harary, Graph Theory, Narosa Publishing House, Latest edition.
3. R. Diestel, Graph Theory, free online edition, 2016: diestel-graph-theory.com/basic.html.
4. Douglas B. West, Introduction to Graph Theory, Prentice Hall India Ltd.,2001
5. Robin J. Wilson, Introduction to Graph Theory, Longman Group Ltd.,2010

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

OPTIMIZATION TECHNIQUE		Semester	IV
Course Code	**BCS405C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives: The objectives of the course are to fecilitate the learners to:

- Appreciate the importance of linear algebra in computer science and allied engineering science.
- Gain the knowledge of linear algebra tools and concepts to implememt them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process

Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: VECTOR CALCULUS

Functions of several variables, Differentiation and partial differentials, gradients of vector-valued functions, gradients of matrices, useful identities for computing gradients, linearization and multivariate Taylor series. **(8 hours)**

(RBT Levels: L1, L2 and L3)

Module-2: APPLICATIONS OF VECTOR CALCULUS

Backpropagation and automatic differentiation, gradients in a deep network, The Gradient of Quadratic Cost, Descending the Gradient of Cost, The Gradient of Mean Squared Error.

(8 hours)

(RBT Levels: L1, L2 and L3)

Module-3: Convex Optimization-1

Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent, Sequential search 3-point search and Fibonacci search. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Module-4: Convex Optimization-2

Unconstrained optimization -Method of steepest ascent/descent, NR method, Gradient descent, Mini batch gradient descent, Stochastic gradient descent. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Module-5: Advanced Optimization

Momentum-based gradient descent methods: Adagrad, RMSprop and Adam.
Non-Convex Optimization: Convergence to Critical Points, Saddle-Point methods. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)
At the end of the course, the student will be able to:

1. Apply the concepts of vector calculus to solve the given problem.
2. Apply the concepts of partial differentiation in machine learning and deep neural networks.
3. Analyze the convex optimization algorithms and their importance in computer science & engineering.
4. Apply the optimization algorithms to solve the problem.
5. Analyze the advanced optimization algorithms for machine learning .

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.
2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015.
3. S. Boyd, N. Parikh, and E. Chu," Distributed optimization and statistical learning via the alternating direction method of multipliers", Foundations and Trends in Machine Learning, Now Publishers Inc.

Reference Books:

1. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer, 2020.
2. A. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017.
3. F. Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc.

Web links and Video Lectures (e-Resources):
• https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm • https://www.math.ucdavis.edu/~linear/linear.pdf • https://www.coursera.org/learn/linear-algebra-machine-learning • https://nptel.ac.in/syllabus/111106051/ • https://github.com/epfml/OptML_course • https://www.youtube.com/playlist?list=PL4O4bXkI-fAeYrsBqTUYn2xMjJAqlFQzX
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Quizzes • Assignments • Seminar

LINEAR ALGEBRA		Semester	IV
Course Code	**BCS405D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- To equip the students with standard concepts and tools in Linear algebra which will find them useful in their disciplines.
- Gain the knowledge of linear algebra tools and concepts to implement them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

Teaching-Learning Process
Pedagogy (General Instructions):
These are sample Strategies, teachers can use to accelerate the attainment of the various course
outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: VECTOR SPACES

Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates. **(8 hours)**
(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2: LINEAR TRANSFORMATIONS

Introduction, Linear Mappings, Geometric linear transformation of i2, Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof), Matrix representation of linear transformations, Singular and Non-singular linear transformations, Invertible linear transformations **(8 hours)** **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-3: EIGENVALUES AND EIGENVECTORS	
Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form. **(8 hours)** **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-4: INNER PRODUCT SPACES	
Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error. **(8 hours)** **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5: OPTIMIZATION TECHNIQUES IN LINEAR ALGEBRA	
Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction – Principal component analysis. **(8 hours)** **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Course outcome (Course Skill Set) At the end of the course, the student will be able to: 1. Explain the concepts of vector spaces, subspaces, bases, dimension and their properties. 2. Use matrices and linear transformations to solve the given problem. 3. Compute Eigenvalues and Eigenvectors for the linear transformations 4. Determine orthogonality of inner product spaces. 5. Apply the optimization techniques to solve the problems.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.

Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:
Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)
Text Books:

1. **David C. Lay, Steven R. Lay, Judi J Mc. Donald: "Linear Algebra and its applications**", Pearson Education, 6th Edition, 2021.
2. **Gilbert Strang**: **"Linear Algebra and its applications**", Brooks Cole, 4th edition, 2005.

Reference Books:

1. **Richard Bronson & Gabriel B. Costa**: **"Linear Algebra: An Introduction**", 2nd edition. Academic Press, 2014.
2. **Seymour Lipschutz, Marc Lipso: "Theory and problems of linear algebra",** Schaum's outline series - 6th edition, 2017, McGraw-Hill Education.
3. **Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong**: **"Mathematics for Machine learning"**, Cambridge University Press, 2020.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
- https://www.math.ucdavis.edu/~linear/linear.pdf
- https://www.coursera.org/learn/linear-algebra-machine-learning
- https://nptel.ac.in/syllabus/111106051/
- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

Green IT and Sustainability		Semester	4
Course Code	**BCS456A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	01
Examination type (SEE)	Theory(MCQ)		

Course objectives:

- Understand challenges for Green ICT and the environmental impact.
- Learn different aspects of ICT metrics and Sustainable Cloud Computing.
- Explore effects of software design on the sustainability.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes Critical thinking.
5. Adopt Case study Based Learning (CBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Green ICT -History, Agenda, and Challenges Ahead: Introduction, Industrial Revolution, The Emergence of Information and Communication Technologies, The Agenda and Challenges Ahead.

Module-2

Emerging Technologies and Their Environmental Impact: Introduction, Number of Connected Devices , Increased , Functionality, Increased Number of Separate Functions , Increased Demand for Speed and Reliability , Obsolescence—The Problem of Backward Compatibility, The Other Side of the Balance Sheet, Videoconference as an Alternative to Business Travel, Dematerialization of Product Chain, Travel Advice/Road Traffic Control, Intelligent Energy Metering , Building Management Systems, Saving IT

Module-3

Measurements and Sustainability: Introduction, ICT Technical Measures, Ecological Measures and Ethical Consideration, Systems Engineering for Designing Sustainable ICT-Based Architectures.

Module-4

Sustainable Cloud Computing: Introduction, Challenges in the Use of Cloud Computing As Green Technology, Cloud Computing and Sustainability, Sustainable Applications of Cloud Computing, Technologies Associated With Sustainable Cloud Computing, Future Prospects of Sustainable Cloud Computing, Reflections on Sustainable Cloud Computing Applications.

Module-5

Sustainable Software Design: Overview and Scope, Evaluating Sustainability Effects , Sustainability and the Product Life Cycle , Direct Effects: Sustainability During Use, Runtime Energy Consumption Basics , Analyzing the Energy Consumption of an Application , Energy Consumption Reduction Using Physical Properties of Semiconductors, Optimizing the Energy Consumption of an Application: Compiler Techniques, Optimizing the Energy Consumption of an Application: Runtime Approaches.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Classify the challenges for Green ICT
2. Relate the environmental impact due to emerging technologies.
3. Demonstrate different aspects of ICT metrics.
4. Compare the various parameters related to Sustainable Cloud Computing.

5. Interpret the effects of software design on the sustainability.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Green Information Technology – A Sustainable Approach, Mohammad Dastbaz Colin Pattinson, Babak Akhgar, Elsevier, 2015 Inc.
2. San Murugesan; G. R. Gangadharan, Harnessing Green IT: Principles and Practices, Wiley-IEEE Press

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=kvn_-mJ2tSo
- https://www.youtube.com/watch?v=kxngsYn5N3Y
- https://www.youtube.com/watch?v=EgdFi3sCgzU
- https://www.brightest.io/sustainability-measurement
- https://www.youtube.com/watch?v=S2m49Op25Zw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Literature survey/review

Capacity Planning for IT		Semester	4
Course Code	**BCS456B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	01
Examination type (SEE)	Theory (MCQ)		

Course objectives:

- Understand requirement and measurements for capacity planning, measurement and monitoring.
- Measurement of data for prediction towards the planning process.
- Understand concepts related to deployment, installation, configuration, and management.
- Role of virtualization and cloud services in capacity planning.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes Critical thinking.
5. Adopt Case study Based Learning (CBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Goals, Issues, and Processes: capacity planning, Quick and Dirty Math, Predicting When Your Systems Will Fail, Make Your System Stats Tell Stories, Buying Stuff: Procurement Is a Process, Performance and Capacity: Two Different Animals, The Effects of Social Websites and Open APIs.
Setting Goals for Capacity: Different Kinds of Requirements and Measurements, Architecture Decisions.

Module-2

Measurement: Units of Capacity: Aspects of Capacity Tracking Tools, Applications of Monitoring.

Module-3

Measurement: API Usage and Its Effect on Capacity, Examples and Reality.
Predicting Trends: Riding Your Waves.

Module-4

Predicting Trends: Procurement, The Effects of Increasing Capacity, Long-Term Trends, Iteration and Calibration.
Deployment: Automated Deployment Philosophies, Automated Installation Tools, Automated Configuration.

Module-5

Virtualization and Cloud Computing: Virtualization, Cloud Computing, Computing Resource Evolutions, Mixed Definitions, Cloud Capacity, Use it or lose it (your wallet),Measuring the clouds, Cloud Case Studies, Cloud Use Case: Anonymous Desktop Software Company.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Identify the requirement and measurements for capacity planning by considering the goal, issues, and processes.
2. Explain capacity measurement and monitoring.
3. Make use of measurement data for prediction towards overall planning process.
4. Explain the concepts related to deployment, installation, configuration, and management.
5. Demonstrate how the virtualization and cloud services fit into a capacity plan.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of

Suggested Learning Resources:

Books

1. John Allspaw, The Art of Capacity Planning, 2008, O'Reilly

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=w0cD26CLBA0
- https://www.youtube.com/watch?v=5-hhfBXykec
- https://www.youtube.com/watch?v=9e4IohiFmZ8&t=63s
- https://www.youtube.com/watch?v=qj4ziswxupE
- https://www.youtube.com/watch?v=jTW79ofC6Go
- https://www.youtube.com/watch?v=_pPlanX5wQY

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Tool demonstration

UI/UX		Semester	4
Course Code	**BCS456C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	14	Total Marks	100
Credits	01	Exam Hours	01
Examination type (SEE)	Theory (MCQ)		

Course objectives:

- Understand user experience design requirements, with design goals, metrics and targets.
- Explore different prototyping methods, UX design principles with case examples.
- Understand the role of design thinking concepts and mental models in UX design.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes Critical thinking.
5. Adopt Case study Based Learning (CBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Usability to user experience, Emotional impact as part of user experience, User experience needs a business case.

Extracting Interaction Design Requirements: Needs & Requirements, Formal requirement extraction, Methods for requirement extraction.

Module-2

Design Thinking, Ideation, and Sketching: Design Thinking, Design Perspectives, User Personas, Ideation, Sketching.

Mental Models and Conceptual Design: Storyboards, Design influencing user behaviour.

Module-3

Design Production: Detailed Design, Wireframes.

UX Goals, Metrics and Targets: UX Goals, UX Measures, Measurement instruments, UX Metrics.

Module-4

Prototyping: Depth & breadth of a prototype, Fidelity of prototypes, Paper prototypes.

Connections with Software Engineering: Foundations for success in SE-UX development, The challenge of connecting SE and UX.

Module-5

UX Design Guidelines: Using and interpreting design guidelines, Human memory limitations, UX design guidelines & examples, Planning, Translation, Physical action, Outcomes, Assessment, Overall.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Explain the user experience design requirements.
2. Relate design thinking concepts and mental models to UX design.
3. Illustrate UX design in line with design goals, metrics and targets.
4. Demonstrate different prototyping in relation with software engineering.

5. Explain UX design principles with case examples.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component (CCE) of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assessment methods mentioned in the 22OB2.4, if an assessment is project-based then only one assessment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. REX HARTSON and PARDHA S. PYLA, The UX Book-Process and Guidelines for Ensuring a Quality User Experience, Morgan Kaufmann, Elsevier, 2012.

Web links and Video Lectures (e-Resources):

- https://www.freecodecamp.org/news/ui-ux-design-tutorial-from-zero-to-hero-with-wireframe-prototype-figma/
- https://www.edureka.co/blog/ui-ux-design-tutorial/
- https://www.udemy.com/course/introtoux/

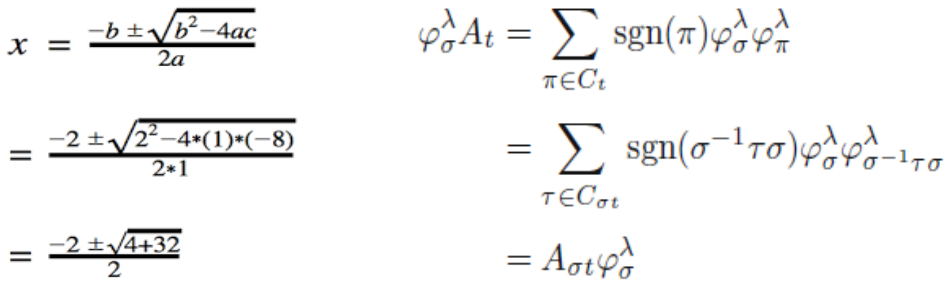
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- UI design demonstrations covering different UX design principles/concepts (specified in the syllabus) using UI/UX tools like Lunacy, framer, penpot, visily etc.

Technical Writing using LaTeX		Semester	4
Course Code	**BCSL456D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	01	Exam Hours	02
Examination type (SEE)	**Practical**		

Course objectives:

- To introduce the basic syntax and semantics of the LaTeX scripting language
- To understand the presentation of tables and figures in the document
- To illustrate the LaTeX syntax to represent the theorems and mathematical equations
- To make use of the libraries (Tikz, algorithm) to design the diagram and algorithms in the document

<table>
<tr><th>Sl.NO</th><th>Experiments</th></tr>
<tr><td>1</td><td>Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.</td></tr>
<tr><td>2</td><td>Develop a LaTeX script to create a document that displays the sample Abstract/Summary</td></tr>
<tr><td>3</td><td>Develop a LaTeX script to create a simple title page of the VTU project Report [Use suitable Logos and text formatting]</td></tr>
<tr><td>4</td><td>Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]</td></tr>
<tr><td>5</td><td>Develop a LaTeX script to create a document that contains the following table with proper labels.
<table>
<tr><th rowspan="2">S.No</th><th rowspan="2">USN</th><th rowspan="2">Student Name</th><th colspan="3">Marks</th></tr>
<tr><th>Subject1</th><th>Subject2</th><th>Subject3</th></tr>
<tr><td>1</td><td>4XX22XX001</td><td>Name 1</td><td>89</td><td>60</td><td>90</td></tr>
<tr><td>2</td><td>4XX22XX002</td><td>Name 2</td><td>78</td><td>45</td><td>98</td></tr>
<tr><td>3</td><td>4XX22XX003</td><td>Name 3</td><td>67</td><td>55</td><td>59</td></tr>
</table></td></tr>
<tr><td>6</td><td>Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept</td></tr>
<tr><td>7</td><td>Develop a LaTeX script to create a document that consists of the following two mathematical equations

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$
$$= \frac{-2 \pm \sqrt{2^2-4*(1)*(-8)}}{2*1}$$
$$= \frac{-2 \pm \sqrt{4+32}}{2}$$
$$\varphi_\sigma^\lambda A_t = \sum_{\pi \in C_t} \operatorname{sgn}(\pi) \varphi_\sigma^\lambda \varphi_\pi^\lambda$$
$$= \sum_{\tau \in C_{\sigma t}} \operatorname{sgn}(\sigma^{-1}\tau\sigma) \varphi_\sigma^\lambda \varphi_{\sigma^{-1}\tau\sigma}^\lambda$$
$$= A_{\sigma t} \varphi_\sigma^\lambda$$</td></tr>
</table>

8	Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document
9	Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section
10	Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library
11	Develop a LaTeX script to present an algorithm in the document using algorithm/algorithmic/algorithm2e library
12	Develop a LaTeX script to create a simple report and article by using suitable commands and formats of user choice.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Apply basic LaTeX command to develop simple document
- Develop LaTeX script to present the tables and figures in the document
- Illustrate LaTeX script to present theorems and mathematical equations in the document
- Develop programs to generate the complete report with citations and a bibliography
- Illustrate the use of Tikz and algorithm libraries to design graphics and algorithms in the document

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners

jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

- **BOOK:** A Short Introduction to LaTeX BY FIRUZA KARMALI (AIBARA), A book for beginners, 2019
- **BOOK:** Formatting Information: A Beginner's Introduction to Typesetting with LaTeX, BY PETER FLYNN, Comprehensive TeX Archive Network (2005)
- LaTeX TUTORIAL: [https://latex-tutorial.com/tutorials/]
- LaTeX TUTORIAL: [https://www.javatpoint.com/latex]