RN SHETTY TRUST ®

RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi
Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade
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Dr. R N Shetty
Founder

ESTD.: 2001
An Institute with a Difference



25 RNSIT

DEPARTMENT OF CSE - DATA SCIENCE

BACHELOR OF ENGINEERING

Scheme and Syllabus of III & IV Semesters

2025 SCHEME

INSTITUTION'S INNOVATION COUNCIL

www.rnsit.ac.in

Scheme and Syllabus
Batch 2025 - 2029

(As per NEP-2020)
(Effective from the academic year 2025 – 26)

About RNSIT

RNS Institute of Technology, familiar as RNSIT was established in the year 2001. It is the brainchild of Dr. R. N. Shetty, a well-known industrialist, and a great philanthropist. The institution was established with the sole purpose of imparting quality education in Engineering, Technology and Management. Being one of the premier engineering colleges in the country RNSIT is marching towards placing itself in the global map by excelling in academics and placements.

Lush green campus, state of the art infrastructure, well equipped laboratories, hundreds of activities, numerous new initiatives, consistent VTU ranks, path breaking placements, cultural extravaganza, Sports events, 5600+ students and 300 + faculty – with all these RNSIT has become dream destination for engineering aspirants across the country.

Vision

Building RNSIT into a World Class Institution

Mission

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality Students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class Professionals with social responsibility
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research & Development
- Providing freedom of action and choice for all the Stakeholders with better visibility

About CSE (Data Science)

Data Science is an offshoot of the Computer Science domain and its relevance and importance in solving today's technologically complex problems has been exponentially growing. With the present high-volume data and unstructured in many cases that is generated across domains, there is a strong need to train students in developing involved techniques in data analytics and derive intelligent inferences from these complex data. To cater to this demand, the CSE (Data Science) department was established in the academic year 2021-22. Presently, the department has an annual intake of 180 students. The department has highly qualified faculty from premier institutes in India. Many of the faculty have a very rich industry and R&D experience from within India and abroad. Students have an opportunity to involve in research during their UG and PG studies and this will pave the way for research-based career avenues for them. The high calibre teaching faculty and the excellent infrastructure creates a stimulating ambience for students to graduate to high quality data engineers and scientists.

Vision

Empowering students to solve complex real-time computing problems involving high volume multi-dimensional data.

Mission

- Provide quality undergraduate education in both theoretical and applied computer science to solve real world problems.
- Conduct research to develop algorithms that solve complex problems involving multi-dimensional high volume data through intelligent inferencing.
- Develop good linkages with industry and research organizations within India and abroad to expose students to global problems and find optimal solutions.
- Creating confident Graduates who can contribute to the nation through high levels of commitment following ethical practices and with integrity.

Programme Educational Objectives

A Graduate of CSE (Data Science) will be able to:

- Develop graduates who acquire knowledge and skills to apply the principles of Mathematics, basic Science and core computer science including data-driven analytics to solve real world inter-disciplinary problems.
- Develop graduates to pursue careers that help them to excel in the Data Science areas, to pursue entrepreneurship and also take up higher studies, all towards life-long learning.

- Develop graduates to inculcate cross-cultural appreciation, professional ethics and high levels of communication skills to apply their knowledge to solve problems of societal need.

Program Outcomes (Revised)

1. **PO1: Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **PO2: Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **PO3: Design/Development of Solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **PO4: Conduct Investigations of Complex Problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5. **PO5: Engineering Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **PO6: The Engineer and The World**: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **PO7: Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO8: Individual and Collaborative Teamwork**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: Communication**: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
10. **PO10: Project Management and Finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **PO11: Life-Long Learning**: Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Programme Specific Outcomes (PSOs)

The CSE (Data Science) graduates will have

1. Graduates will develop proficiency in logical and analytical skills to solve data intensive real world problems that encompass structured and unstructured high volume data.
2. Graduates will develop abilities to analyze and unearth the inter-relationships between data elements to come up with analytical/empirical models to develop intelligent Decision Support Systems.
3. Graduates will develop expertise in the Data Science areas that help in the development of intelligent algorithms to solve real world problems

B.E. in CSE (Data Science): Autonomous Scheme and Syllabus 3rd Semester

Sl. No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)s	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW & SL	# TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
1	ASC	25BCSTH301	STATISTICS AND PROBABILITY DISTRIBUTIONS	MATHEMATICS / CSE-CD	45	30	0	45	120	3	50	50	100	4
2	IPCC	25BCSIC302	OBJECT ORIENTED PROGRAMMING USING JAVA	CSE-CD	45	0	30	45	120	3	50	50	100	4
3	PCC	25BCSTH303	LOGIC DESIGN AND COMPUTER ORGANIZATION	CSE-CD	45	30	0	45	120	3	50	50	100	4
4	PCC	25BCSTH304	DATA STRUCTURES & APPLICATIONS	CSE-CD	45	0	0	45	90	3	50	50	100	3
5	PCC	25BCSTH305	OPERATING SYSTEMS	CSE-CD	45	0	0	45	90	3	50	50	100	3
6	PCCL	25BCSLB306	DATA STRUCTURES LABORATORY	CSE-CD	0	0	30	00	30	3	50	50	100	1
7	AEC	25BCDAE307X	(BUCKET LIST B)	CSE-CD	0	0	30	00	30	3	50	50	100	1
8	SDC	25BCBPR308	COMMUNITYPROJECT (PROJECT-BASEDLEARNING) / SOCIETAL PROJECT	CSE-CD	0	0	0	30	30	3	50	50	100	1
9	NCMC	25BNSSP309	NATIONAL SERVICE SCHEME	Campus: NSS coordinator	0	0	0	30	30	--	100	-	100	PP
		25BPEDU309	PHYSICAL EDUCATION	Physical Education Director										
		25BYOGA309	YOGA	Yoga Teacher										
		25BMUSK309	MUSIC	Music Teacher										
Total									**660**		**500**	**400**	**900**	**21**
10	NCMC	25BMADP310	ADDITIONAL MATHEMATICS I (FOR LATERAL ENTRY STUDENTS)	TD - MATHS DEPT	14	0	0	14	28	–	100	—	100	PP
Total									**688**		**600**	**400**	**1000**	**21**
11	SKLAB	25BCDSL001	SKILL LAB (BUCKET LIST SDL)	CSE-CD	0	0	30	0	30	3	50	50	100	1

AEC — 25BCSAE307X — BUCKET LIST B	
25BCSAE307A	PROJECT MANAGEMENT WITH GIT
25BCDAE307B	DATA ANALYTICS WITH R
25BCSAE307C	AI TOOLS AND APPLICATIONS
25BCDAE307D	DATA VISUALIZATION

B.E. in CSE (Data Science):Autonomous Scheme and Syllabus 4th Semester

Sl. No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)	Teaching & Learning Scheme					Examination				Credits
					CI		LI	# TW & SL	TH/S	Duration in hours	CIE	SEE Marks	Total Marks	
					L	T	P							
1	ASC	25BCSTH401	DISCRETE MATHEMATICS AND GRAPH THEORY	TD/PSB: CSE-CD/MATHS	45	30	0	45	120	3	50	50	100	4
2	IPCC	25BCSIC402	DATABASE MANAGEMENT SYSTEMS	CSE-CD	45	0	30	45	120	3	50	50	100	4
3	PCC	25BCSTH403	DESIGN AND ANALYSIS OF ALGORITHMS	CSE-CD	45	30	0	45	120	3	50	50	100	4
4	PCC	25BCDTH404	FOUNDATIONS OF DATA SCIENCE	CSE-CD	45	30	0	45	120	3	50	50	100	4
5	PCCL	25BCSLB405	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY	CSE-CD	0	0	30	00	30	3	50	50	100	1
6	AEC	25BXXAE406X	(BUCKET LIST C)	CSE-CD	0	0	30	00	30	3	50	50	100	1
7	BSC	25BFETH407	BIOLOGY FOR ENGINEERS	TD:CHEMISTRY/BIOTECH/ CSE-CD	30	0	0	30	60	2	50	50	100	2
8	SDC	25BESPR408	ENVIRONMENTAL SCIENCE PROJECT	RESPECTIVE ENGINEERING DEPT.	0	0	0	30	30	3	50	50	100	1
9	NCMC	25BNSSP409	NATIONAL SERVICE SCHEME (NSS)	Campus: NSS coordinator	0	0	0	30	30	--	100	---	100	PP
		25BPEDU409	PHYSICAL EDUCATION (PE)	Campus: Physical Education Director										
		25BYOGA409	YOGA	Campus: Yoga Teacher										
		25BMUSK409	MUSIC	Campus: Music Teacher										
Total									**660**		**500**	**400**	**900**	**21**
10	NCMC	1BMADP410	ADDITIONAL MATHEMATICS II (FOR LATERAL ENTRY STUDENTS)	TD - MATHS DEPT	14	0	0	14	28	–	100	—	100	PP
Total									**688**		**600**	**400**	**1000**	**21**
11	SKLAB	25BCDSL002	SKILL LAB (BUCKET LIST SDL)	CSE-CD	0	0	30	0	30	3	50	50	100	1

AEC - 25BCSAE406X - BUCKET LIST C	
25BCDAE406A	MONGODB
25BCSAE406B	MOBILE APP DEVELOPMENT
25BCSAE406C	ADVANCED JAVA
25BCDAE406D	JULIA

III SEMESTER

B.E. (CSE and Allied Branches)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	STATISTICS AND PROBABILITY DISTRIBUTIONS		
Course Code	25BCSTH301	**CIE Marks**	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	**SEE Marks**	50
Credits	4	**Exam Hours**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply curve fitting, correlation, regression analysis, and sampling techniques to solve engineering and data analysis problems.
2. Analyze probability concepts and probability distributions to model and interpret un-certainty in engineering systems.
3. Familiarize with the fundamental concepts of probability theory and probability distributions to build a strong foundation for engineering and data analysis applications.
4. Solve engineering problems involving random phenomena using stochastic processes and probabilistic modelling techniques.

Module-1 **9 Hours**

Curve Fitting, Correlation and Regression Analysis: Curve fitting by the method of least squares fitting curves of the form $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.
Correlation and regression: Karl Pearson's coefficient of correlation and rank correlation problems. Regression analysis, lines of regression problems.

Textbook 1: Chapter 24 (24.3 - 24.6(1), 24.8), Chapter 25 (25.12 - 25.14, 25.16)

Module-2 **9 Hours**

Sampling Theory: Introduction to sampling theory, standard error, Type-I and Type-II errors. Test of hypothesis for means- Z test, student's t- test, chi-square test of goodness of fit.

Textbook 1: Chapter 27 (27.1 - 27.8, 27.12 - 27.18)

Module-3 **9 Hours**

Probability Theory: Definition of Probability, Mutually exclusive and Independent events, Addition law of Probability, Independent events- Multiplication law of probability, Conditional Probability, Bayes' Theorem and Problems.

Textbook 1: Chapter 26 (26.1 - 26.6)

Module-4 **9 Hours**

Probability Distribution: Random variable, discrete and continuous probability distribution, expectation, mean and variance Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution, (Derivation for Mean and Standard Deviation of Binomial and Poisson Distribution only).

Textbook 1: Chapter 26 (26.7 - 26.10, 26.14 – 26.17, 26.19(6))

Module-5	9 Hours
Stochastic Process: Joint Probability Distribution (Discrete Random Variable only), Stochastic process, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains (Finite, discrete only), higher transition probability. **Textbook 2: Chapter 31**	

Course Outcomes

After successfully completing the course, the student will be able to:

CO1	Employ correlation and regression methodologies to model complex relationships.
CO2	Integrate statistical tools and inferential methods to analyze engineering systems and make data-driven decisions with quantified confidence.
CO3	Develop probabilistic models using discrete and continuous distributions to quantify uncertainty.
CO4	Apply probabilistic models and statistical reasoning to analyze random phenomena.
CO5	Compute joint probability distributions, determine state transition probabilities in Markov chains and apply stochastic modelling methods for decision-making and forecasting.

ASSESSMENT AND EVALUATION REGULATIONS OF ASC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE Theory (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, 2017.
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill, 2006.
3. Montgomery, D. C. & Runger, G. C., Applied Statistics and Probability for Engineers, 7th Edition, Hoboken, NJ: John Wiley & Sons, 2018.

Reference Books:

1. Gupta, S. C., Fundamentals of Statistics, Himalaya Publishing House, 8th Edition, 2023.
2. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th Edition, 2018.
3. N. P. Bali and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, 10th Edition, 2022.
4. Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 3rd Edition, 2016.
5. J. K. Blitzstein and J. Hwang, Introduction to Probability, 2nd Edition, Boca Ra-ton, FL, USA: CRC Press, 2019.

Web links:

1. http://academicearth.org/
2. VTU e-Shikshana Program
3. VTU EDUSAT Program
4. https://nptel.ac.in/courses/111105160
5. https://nptel.ac.in/courses/127106019
6. https://sl1nk.com/rb8fcyk
7. https://sl1nk.com/ooolb6f

Activity-Based Learning:

8. Programming Assignment
9. Tool/Software Exploration
10. Problem-Based Learning (PBL)
11. Assignments

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	OBJECT ORIENTED PROGRAMMING USING JAVA		
Course Code	25BCSIC302	**CIE MARKS**	50
(L : T : P) + SL	(3:0:2)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	4	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Identify and recall core object-oriented programming (OOP) concepts and Java language features.
2. Construct Java programs using methods, exception handling, string manipulation, and object-oriented features to solve programming problems.
3. Develop multithreaded Java applications using synchronization methods.
4. Implement efficient data management using Java Collections Framework, including Lists, Sets, Maps, Iterators, and related interfaces.

Module-1	**9 Hours**

Introducing Classes: Class fundamentals, declaring objects, assigning object reference variables, Introducing methods, Constructors, this keyword, Garbage collection.
Methods and Classes: Overloading methods, Objects as parameters, Argument passing, returning objects, Recursion, Access control, understanding static, Introducing final, Introducing nested and inner classes.
Textbook 1 : Chapter 6 (6.1 - 6.7), Chapter 7 (7.1 - 7.7, 7.9)

Module-2	**9 Hours**

Inheritance: Inheritance basics, Using super, Creating a multilevel hierarchy, Constructor execution, Method overriding, Dynamic method dispatch, Abstract classes, Using final with inheritance, Local variable type inference, The Object class.

Interfaces: Defining interfaces, Implementing interfaces, Extending interfaces.

Textbook 1 : Chapter 8, Chapter 9 (9.4.1 - 9.4.2, 9.4.6)

Module-3	**9 Hours**

Exceptions: Exception-handling fundamentals, Exception types, try and catch, Multiple catch clauses, throw, throws, finally, User-defined exception subclasses.
Multithreaded Programming: Main thread, Creating threads, Multiple threads, Using isAlive() and join(), Synchronization.
Textbook 1: Chapter 10 (10.1, 10.2, 10.4, 10.5, 10.7 - 10.9, 10.11),
Chapter 11 (11.2 - 11.5, 11.7)

Module-4	**9 Hours**

String Handling: String constructors, String length, Special string operations, Character extraction, String comparison, Searching strings, Modifying strings, Changing case of characters, Joining strings, Data conversion using valueOf(), StringBuffer, StringBuilder.

Textbook 1 : Chapter 18 (18.1 - 18.10, 18.12, 18.13)

Module-5	**9 Hours**

The Collections Framework: Collections overview, The Collection interface, List and Set interfaces, Collection classes: ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet, Accessing a collection via an Iterator, The RandomAccess interface, Working with Maps. **Textbook 1 : Chapter 20 (20.1, 20.2.3 - 20.2.4, 20.3.1 - 20.3.5, 20.4, 20.8)**

PRACTICAL COMPONENTS OF IPCC

Program 1: Matrix Addition Using Command-Line Arguments
A university is developing a utility program for performing matrix operations. The pro-gram should accept the size of a square matrix N × N from the command-line arguments. After receiving the value of N, the program should read two matrices from the user, compute their sum and display the resulting matrix.
Program 2: Implementation of Stack Using Arrays
A software application requires the implementation of a stack data structure to store integer values. The stack should have a maximum capacity of 10 integers. The system must support standard stack operations such as push, pop and display and demonstrate the functionality using a Java main method.
Program 3: Employee Management Using Classes and Objects
A company maintains employee records for its staff members. Each employee has details such as ID, name and salary. The system should allow increasing an employee's salary by a given percentage using a method called raiseSalary(percent) and display the updated employee details.
Program 4: Implementation of Abstract Classes for Geometric Shapes
A software system is being developed to handle different geometric shapes. Each shape should be able to calculate its area and perimeter, but the formula differs for each shape. Therefore, a common abstract class is required to define the structure, while specific implementations are provided by individual shape classes like Circle and Triangle.
Program 5: Implementation of Interfaces Using a Rectangle Class
A graphics software system is being developed where different shapes need to be dynamically resized. The system requires a common contract that allows resizing of width and height for shapes. A class representing a Rectangle should implement this contract and allow modification of its dimensions.
Program 6: Demonstration of Inner Classes in Java
A software system is designed to demonstrate the concept of inner classes in Java. The system contains an outer class and an inner class and both classes define a method named display(). The program should demonstrate how both methods are executed separately to show the difference between outer and inner class behavior.
Program 7: Custom Exception Handling for Division by Zero
A calculator application is being developed where division operations are performed by users. The system must ensure that division by zero is not allowed. If a user attempts to divide a number by zero, a custom exception (DivisionByZero) should be raised and handled using try, catch, throw and finally blocks.
Program 8: Multithreading Using the Runnable Interface

A system is being developed to demonstrate multithreading in Java using the Runnable interface. The program should create a thread, execute a task inside the run() method, start the thread using start() and pause execution using sleep(500) to simulate time delay between outputs.
Program 9: String Manipulation Using Java String Methods
A text processing system is being developed to demonstrate various built-in String operations in Java. The program should perform character extraction, string comparison, string searching and string modification using standard String methods.
Program 10: Palindrome Validation Using SOLID Principles
A software system is being designed to validate strings based on different rules. One such rule is to check whether a given string is a palindrome. The application should be designed using SOLID principles so that each class has a single responsibility and the system is easy to extend and maintain.
Program 11: String Compression Using Run-Length Encoding
A text processing application is being developed to optimize storage of strings by compressing repeated consecutive characters. For example, repeated characters in a string should be replaced with the character followed by its count.
Program 12: Managing Unique Student Records Using Java Collections (HashSet)
A college is organizing a technical seminar and maintains a list of students who have registered for the event. During registration, some students may accidentally register more than once. The system must ensure that each student is stored only once in the list. Therefore, a suitable collection that does not allow duplicate entries is required to store and display the list of unique student names.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand Java classes with appropriate data members and methods to address specified scenarios.
CO2	Apply the concept of inheritance to model and solve real-world programming problems.
CO3	Construct Java programs using multithreading and exception handling techniques to manage concurrency and runtime exceptions.
CO4	Demonstrate the use of string handling methods to manipulate and process textual data in Java.
CO5	Implement the Java Collections Framework using Collection interfaces, Lists, Sets, Maps, Iterators, Comparators and user-defined objects for efficient data management.

ASSESSMENT AND EVALUATION REGULATIONS OF IPCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one assessment method as per 24RNBE4.2, scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of tests and assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for weekly conduction of experiments and sub-mission of laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of two tests, each conducted for 100 marks covering all experiments, scaled to 8 marks.
Total CIE Practical (C)	20	8	Marks of experiments, record and test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A+B+C)	50	20	CIE evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE+SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in components A, B, C and D.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the ESC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Textbooks:

1. Herbert Schildt, The Complete Reference, 12th Edition, McGraw-Hill. 2021.

Reference Books:

1. E. Balagurusamy, Programming with Java, 6th Edition, McGraw-Hill,2019.
2. Bruce Eckel, Thinking in Java, 4th Edition, Prentice Hall,2006.

Web Links:

1. https://www.youtube.com/watch?v=5gWpVJc0UG4
2. https://www.youtube.com/watch?v=-HafzawNlUo
3. https://www.youtube.com/watch?v=K3g4srbkUNM
4. https://www.youtube.com/watch?v=iUzvdDuAeSQ

Self-Study Topics:

1. SOLID Principles (GeeksforGeeks)

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	LOGIC DESIGN AND COMPUTER ORGANIZATION		
Course Code	25BCSTH303	**CIE MARKS**	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	4	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

After completing this course, the learner will be able to:

1. Simplify digital circuits by applying the principles of Boolean algebra, fundamental logic gates and advanced gate-level minimization techniques.
2. Design, synthesize and analyze basic combinational and sequential digital circuits, including arithmetic units, data routers, latches, flip-flops and registers.
3. Comprehend basic computer architecture by evaluating functional unit interactions, bus structures, instruction sequencing and performance metrics.
4. Formulate efficient input/output strategies and memory hierarchies by analyzing interrupt handling, Direct Memory Access (DMA) and cache mapping operations.
5. Examine internal processing unit dynamics by tracking the step-by-step execution of complete instructions alongside basic pipelining concepts.

Module-1 **9 Hours**

Digital Systems and Binary Numbers: Binary Logic.

Boolean Algebra and Logic Gates: Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates.

Gate Level Minimization: Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Exclusive-OR Function.

Textbook 1: Chapter 1 (1.9), Chapter 2 (2.3 - 2.5, 2.8), Chapter 3 (3.1, 3.2, 3.3, 3.5, 3.6, 3.8)

Module-2 **9 Hours**

Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decimal Adder, Decoders, Encoders, Multiplexers.
Synchronous Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Storage Elements: Flip- Flops.
Registers and Counters: Registers, Shift Registers, Ripple Counters, Synchronous Counters
Chapter 4 (4.1, 4.2, 4.4, 4.5, 4.6, 4.9, 4.10, 4.11) Chapter-5 (5.1 - 5.4), Chapter-6 (6.1 - 6.4)

Module-3 **9 Hours**

Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structures, Performance.

Machine Instructions and Programs: Memory Locations and Addresses, Memory Operations, Instruction and Instruction Sequencing, Addressing Modes.

Textbook 2: Chapter-1 (1.2 - 1.4, 1.6(1.6.1 - 1.6.2, 1.6.4, 1.6.7)), Chapter-2 (2.2 - 2.5)

Module-4	9 Hours
Input/output Organization: Accessing I/O Devices, Interrupts, Direct Memory Access. **The Memory System:** Semiconductor RAM memories, Read Only Memories, Cache Memories, Virtual Memories, Memory Management Requirements. **Textbook 2 : Chapter 4(4.1, 4.2.(4.2.1 - 4.2.3), 4.4), Chapter 5(5.2 - 5.3, 5.5(5.5.1), 5.7, 5.8)**	
Module-5	**9 Hours**
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction. **Pipelining:** Basic Concepts, Data Hazards. **Textbook 2: Chapter 7 (7.1 - 7.2), Chapter 8 (8.1 - 8.2)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply Optimize digital circuits utilizing Boolean theorems, Karnaugh maps (K-maps)and universal gate implementations (NAND/NOR).
CO2	Design Construct functional combinational and sequential logic components to fulfill specific arithmetic, data transfer and data storage requirements.
CO3	Analyze Deconstruct computer architectures by mapping operational functional units, identifying addressing modes and parsing instruction sequencing.
CO4	Evaluate Implement optimized I/O management and memory architectures through structured interrupts, Direct Memory Access (DMA) controllers and multi-level cache memory mapping.
CO5	Demonstrate Apply practical engineering knowledge to trace instruction executions within a basic processor and operate physical and virtual memory configurations.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of the two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one assessment method as per 24RNBE4.2, scaled to 20 marks.
Total CIE Theory (A+B)	50	20	Marks of tests and assignments awarded for a maximum of 30.

SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE+SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. with minimum 40% scored in every component of CIE.			

Textbooks:

1. M. Morris Mano and Michael D. Ciletti, Digital Design with an Introduction to Verilog Design, 5th Edition, Pearson Education, 2013.
2. Carl V. Hamacher, Zvonko G. Vranesicand Safwat G. Zaky, Computer Organization, 5th Edition, Tata McGraw–Hill, 2002.

Reference Books:

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, 3rd Edition, McGraw-Hill Education, 2013.
2. William Stallings, Computer Organization and Architecture: Designing for Performance, 11th Edition, Pearson Education, 2022.
3. John L. Hennessy, David A. Patterson and Christos Kozyrakis, Computer Architecture: A Quantitative Approach, 7th Edition, Morgan Kaufmann, 2025.

Web links:

1. https://www.youtube.com/watch?v=iUzvdDuAeSQ
2. https://www.coursera.org/
3. https://www.coursera.org/
4. https://onlinecourses.nptel.ac.in/
5. https://matlabacademy.mathworks.com/?page=1 &sort=featured
6. https://in.mathworks.com/products/simulink.html

Self-Study Topics:

1. Analyze Hardware Accelerators and Parallel Architectures.
2. Compare Modern Memory Hierarchies and Performance Bottlenecks.
3. Study Edge Computing and Embedded Hardware Deployment.

Experimental Learning	
1	Realization and Minimization of Combinational Logic: MATLAB Execution: Use the Simulink Library, Logic and Bit Operations. Drag and drop fundamental logic gates (AND, OR, NOT, XOR) into a canvas.
2	Design of Arithmetic Circuits (Adder/Subtractor): MATLAB Execution: Build a 1-bit Full Adder subsystem in Simulink out of standard gates. Cascade four of these subsystems to create a structural 4-bit Binary Adder/Subtractor.
3	Data Routing Blocks (Multiplexers and Decoders): MATLAB Execution: Build an 8x1 Multiplexer subsystem using native conditional blocks or discrete logic gates. Alternatively, utilize MATLAB's Truth Table block inside Simulink.
4	Sequential Logic & Counter Design: MATLAB Execution: Open Simulink Stateflow or use the standard memory/flip-flop delay blocks (D Flip-Flop or Memory block).
5	Memory Mapping & Cache Performance Analysis: MATLAB Execution: Write a native MATLAB App / Script (.m file) that simulates CPU interactions with Cache memory.
6	Basic Processing Unit Instruction Execution Simulation: MATLAB Execution: Build a minidatapath model inside Simulink using Simulink Buses and Registers (Unit Delay blocks) acting as the accumulator, program counter (PC) and ALU.

Activity Based Learning:

1. Skill-based certifications through NPTEL, NVIDIA Deep Learning Institute and Coursera.
2. Case studies on real-world AI systems used in industry.

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	DATA STRUCTURES AND APPLICATIONS		
Course Code	25BCSTH304	**CIE MARKS**	50
(L : T : P) + SL	(3:0:0)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	3	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Explain the fundamental concepts, classifications and operations of data structures.
2. Implement arrays, pointers and strings for efficient data representation and manipulation.
3. Apply linear data structures such as stacks, queues and linked lists to solve problems.
4. Construct and traverse non-linear data structures including trees and graphs.
5. Utilize advanced data structures such as hashing and balanced trees to design optimized solutions.

Module-1	**9 Hours**

Introduction to Data Structures: Data structures, classifications (primitive and non-primitive), data structure operations, review of pointers and dynamic memory allocation.

Arrays and Structures: Arrays, sorting using arrays (insertion sort, radix sort), dynamically allocated arrays, structures and unions, polynomials, sparse matrices, representation of multidimensional arrays, strings.

Textbook 1: Chapter 2 (2.4 - 2.5)

Textbook 2: Chapter 2 (2.1 - 2.3), Chapter 3 (3.1 - 3.13), Chapter 4 (4.1 - 4.4), Chapter 5 (5.1 - 5.8), Chapter 14 (14.8 - 14.12)

Module-2	**9 Hours**

Stacks: Stacks, stacks using dynamic arrays, evaluation and conversion of expressions, recursion.

Queues: Queues, circular queues using dynamic arrays, priority queue, multiple stacks and queues.

Textbook 1: Chapter 3 (3.1 - 3.7)

Module-3	**9 Hours**

Linked Lists: Singly linked lists and chains, representing chains in C, linked stacks and queues, polynomials, additional list operations, sparse matrices, doubly linked lists.

Textbook 1: Chapter 4 (4.1 - 4.5, 4.7 - 4.8)

Module-4	9 Hours
Trees: Introduction, binary trees, binary tree traversals, threaded binary trees, binary search trees, selection trees, forests. **Textbook 1: Chapter 5 (5.1 - 5.3, 5.5, 5.7 - 5.9)**	
Module-5	**9 Hours**
Multiway Search Trees: B-trees, B+ trees. **Graphs:** Graph abstract data types, elementary graph operations. **Hashing:** Introduction, static hashing, dynamic hashing. **Textbook 1: Chapter 6 (6.1 - 6.2), Chapter 8 (8.1 - 8.3), Chapter 11 (11.2,11.3)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Implement fundamental data structures and perform operations using arrays, pointers and strings.
CO2	Apply stacks and queues to evaluate expressions and solve linear data structure problems.
CO3	Develop memory-efficient programs using singly and doubly linked lists.
CO4	Analyze tree-based structures to model hierarchical relationships.
CO5	Design solutions using graphs, balanced trees and hashing techniques to address real-world computational problems.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two assessment methods as per 24RNBE4.2 (if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE evaluation is done for a maximum of 50 marks.

SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in components A, B and C.
The minimum marks to be secured in CIE are 20 (40%) out of allotted 50 marks to appear for SEE, with a minimum of 40% scored in every component of CIE.			

Textbooks:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2014.
2. Reema Thareja, Data Structures Using C, 2nd Edition, Oxford Press, 2014.

Reference Books:

3. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Edition, Mc-Graw Hill, 2014.
4. Gilberg and Forouzan, Data Structures: A Pseudo-code Approach with C, 2nd Edition, Cengage Learning, 2014.
5. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Edition, McGraw Hill, 2013.
6. A. M. Tanenbaum, Data Structures Using C, PHI, 1989.

Web Links:

1. https://youtu.be/S47aSEqm_0I?si=34alu47wCWGdsxwN
2. https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
3. https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
4. https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
5. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
6. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
7. https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/

Self-Study Topics:

1. Recursion
2. AVL Trees
3. Red-Black Trees

B.E. (CSE and Allied Branches)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	OPERATING SYSTEMS		
Course Code	25BCSTH305	**CIE MARKS**	50
(L : T : P) + SL	(3:0:0)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	3	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts and architecture of operating systems, including system structure, services, and system calls.
2. Analyse and apply concepts of processes, threads, and CPU scheduling, along with inter-process communication and synchronization techniques.
3. Explain and evaluate memory management strategies, including paging, segmentation, and virtual memory techniques.
4. Demonstrate knowledge of file systems, storage structures, and protection mechanisms, and use relevant system-level commands and APIs for managing operating system resources.

Module-1 **9 Hours**

Introduction to Operating Systems: What operating systems do, Computer system organization, Computer system architecture, Operating system structure, Operating system operations.

System Structures: User Operating System interface, System calls, Types of system calls, System programs, Operating system design and implementation, Operating system structure.

Textbook 1 : Chapter 1 (1.1–1.5), Chapter 2 (2.2–2.7)

Module-2 **9 Hours**

Process Management: Process concept, Process scheduling, Operations on processes, Inter-process communication.

Multi-threaded Programming: Overview, Multithreading models, Thread libraries, Threading issues.

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling.

Textbook 1 : Chapter 3 (3.1–3.4), Chapter 4 (4.1–4.4), Chapter 5 (5.1–5.3,5.5)

Module-3 **9 Hours**

Synchronization: Background, The critical section problem, Solution, Synchronization hardware, Semaphores, Classical problems of synchronization. **Deadlocks:** System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock. **Textbook 1 : Chapter 6 (6.1–6.6), Chapter 7 (7.1–7.7)**
Module-4 **9 Hours**
Memory Management: Memory management strategies: Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. **Virtual Memory Management:** Background, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Textbook 1 : Chapter 8 (8.1–8.6), Chapter 9 (9.1–9.6)**
Module-5 **9 Hours**
File System and Implementation of File System: File system: File concept, Access methods, Directory and disk structure. **Implementing File System:** File system structure, File system implementation, Di-rectory implementation, Allocation methods, Free space management. **Secondary Storage Structure:** Overview of mass storage structure, Disk structure, Disk attachment, Disk scheduling. **System Protection:** Goals of protection, Principles of protection, Domain of protection, Access matrix. **Textbook 1 : Chapter 10 (10.1–10.3), Chapter 11 (11.1–11.5), Chapter 12 (12.1–12.4), Chapter 14 (14.1–14.4)**

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Interpret the fundamental concepts, architecture, services, and design principles of operating systems.
CO2	Analyze process management techniques and resource allocation strategies for efficient system operation.
CO3	Apply synchronization and coordination mechanisms to manage concurrent processes and system resources effectively.
CO4	Analyze memory management strategies to optimize resource utilization and system performance.
CO5	Examine storage management, file systems, and security mechanisms in operating systems.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any one assessment method as per 24RNBE4.2, scaled to 10 marks.
Total CIE Theory (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in components A, B,and C
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Con-cepts, 8th Edition, Wiley-India, 2015.

Reference Books:

- P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice, 4th Edition, PHI (EEE), 2014.
- William Stallings, Operating Systems: Internals and Design Principles, 6th Edition, Pearson.
- A.S. Tanenbaum and H. Bos, Modern Operating Systems, 4th Edition, Prentice-Hall of India, New Delhi, 2014.

Web Links:

- https://pages.cs.wisc.edu/~remzi/OSTEP/
- https://www.geeksforgeeks.org/operating-systems/
- https://www.tutorialspoint.com/operating_system/index.htm
- https://www.scaler.com/topics/operating-system/
- https://www.youtube.com/watch?v=yKl1uBHPdp30
- https://www.youtube.com/watch?app=desktop&t=1s&v=dOiA2nNJpc0

Self-Study Topics:

1. **Virtual Machines:** Study the concept of virtualization, including the architecture and functionality of virtual machines (VMs), and understand how VMs help in efficient resource utilization and system isolation.
2. **Basic Linux Commands:** Gain hands-on experience with essential Linux terminal commands used for file management, user permissions, process control, and system monitoring.

    a. Multithreading Demonstration using Programming Languages: Implement and compare multithreading concepts using:

    b. Java using the Thread class and Runnable interface.

    c. Python using the threading module.

    d. C Programming using POSIX Threads (pthreads): Implement multithreading using POSIX threads (pthreads).

    e. Overview of Different Operating Systems: Compare the architecture, scheduling, memory management, and file systems of Linux, Windows, Unix, Android, macOS, iOS, RTOS, Chrome OS, Solaris, Haiku OS, and TinyOS.

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	DATA STRUCTURES LABORATORY		
Course Code	25BCSLB306	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand and implement dynamic memory management techniques in C.
2. Apply linear data structures (stacks, queues, linked lists) to solve computational problems.
3. Analyze and utilize non-linear data structures such as trees and graphs for applications.
4. Design practical solutions to real-world problems using suitable data structures.

Program 1 – Weekly Planner

A student needs a simple Weekly Planner System to keep track of their weekly schedule. For each day, the planner should store: name of the day (e.g., Monday, Tuesday. . .), date of the day (numeric format) and the activity planned for that day (e.g., class, event, meeting).

Develop a C program to implement this weekly planner using the following functions.

a. create() to initialize the weekly planner.

b. read() to input the details (day name, date, activity) from the user.

c. display() to generate and print the Weekly Activity Report on screen.

Program 2 – Pattern Matching

A publishing company is developing a simple tool to edit documents by replacing certain words or phrases. Design a C program that performs find-and-replace operations on text without using built-in string functions.

a. Read a main string (STR), a pattern string (PAT)and a replacement string (REP) from the user.

b. Search the main string for all occurrences of PAT.

c. Replace every occurrence of PAT in STR with REP.

d. If PAT does not exist in STR, display an appropriate message.

Program 3- Parcel Storage System

A courier office needs a simple Parcel Storage System to manage parcels efficiently. Each parcel is assigned an integer ID for identification. Design a C program that supports the following operations:

a. push() – Add a parcel ID onto the stack when a new parcel arrives.

b. pop() – Remove the last parcel ID from the stack when a parcel is taken out.

c. display() – Show all parcel IDs currently stored in the stack.

d. Display suitable messages when the stack is full (overflow) or empty (underflow).

Program 4 - Calculator Application

In modern calculators, mathematical expressions are usually entered in infix notation, where operators are written between operands (e.g., 3 + 4 * 2). However, calculators and computer systems evaluate these expressions more efficiently in postfix notation, where operators follow operands (e.g., 3 4 2 * +).

To simulate this process, develop a C program that converts any valid infix expression into its equivalent postfix expression. The program should support alphanumeric operands and the following operators: -, +, *, /, %, ^.

Program 5 - Call Center Help Desk

A call center assigns a ticket number to every incoming call. Since only a limited number of calls can be handled at a time, the calls are placed in a queue. When a representative becomes free, the next call in the queue is served.

Design and implement a C program to simulate this system using a circular queue. The program should support the following operations:

a. Add a new call to the queue (enqueue)

b. Serve the next call (dequeue)

c. Display all waiting calls

The program must also handle queue overflow and underflow conditions properly.

Program 6 - Student Information Management System

A university wants to maintain a dynamic record of its students for academic and administrative purposes. Each student record contains the following details: USN, Name, Programme, Semester and Phone Number. Since the number of students may vary frequently due to admissions and withdrawals, a singly linked list (SLL) is chosen for efficient memory usage and flexible data management.

To simulate this system, develop a menu-driven C program that performs the following operations on the student database:

a. Create a Singly Linked List of N student records using front insertion.

b. Display all student records and count the number of nodes in the list.

c. Insert or delete a student record at the end of the list.

d. Insert or delete a student record at the front of the list (demonstrating stack operations).

Program 7 - Employee Record Management System

A company maintains details of its employees for administrative and payroll purposes. Each employee record contains the following fields: SSN, Name, Department, Designation, Salary and Phone Number. Since employees may frequently join, leave, or change positions, a Doubly Linked List (DLL) provides a flexible way to manage these records efficiently in both directions.

To simulate this process, design and implement a menu-driven C program that performs the following operations on the employee database:

a. Create a Doubly Linked List of N employee records using end insertion.

b. Display all employee records and count the total number of nodes.

c. Insert or delete an employee record at the end of the list.

d. Insert or delete an employee record at the front of the list.

e. Demonstrate how the DLL can be used as a Double Ended Queue (Dequeue).

Program 8 – Library Book Management System

Design and implement a menu-driven C program to manage a Library Book Database using a Binary Search Tree (BST). Each record should store the following details: ISBN Number and Book Title.

The program should support the following operations:

a. Insert a new book into the BST

b. Traverse the BST using Inorder, Preorder and Postorder

c. Search for a book by its ISBN number and print the title.

Program 9 - City Connectivity using Graph Traversal

In a city transportation system, each city can be represented as a node and the direct roads between them as edges of a graph. To analyse connectivity, it is important to know which cities can be reached from a given starting city.

Develop a C program to:

a. Represent N cities using an Adjacency Matrix

b. Display all cities reachable from a specified city using DFS or BFS traversal.

Program 10 - Collision Handling in Vehicle Registration System

In a vehicle registration system, each vehicle is assigned a unique 4-digit registration number. To support quick storage and retrieval, these records are organized in a hash table with m storage locations.

Develop a C program to:

1. Store vehicle registration numbers in the hash table using linear probing and quadratic probing for collision handling.

2. Display the final state of the hash table after all insertions.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Implement and demonstrate operations on fundamental data structures.
CO2	Develop programs to solve problems using linear and non-linear data structures.
CO3	Apply dynamic allocation and optimizing resource usage.
CO4	Design and implement practical solutions for real-world problems using appropriate data structures.

ASSESSMENT AND EVALUATION REGULATIONS OF PCCL

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	PROJECT MANAGEMENT WITH GIT		
Course Code	25BCSAE307A	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. To familiarise with basic commands of Git.
2. To create and manage branches.
3. To understand how to collaborate and work with Remote Repositories.
4. To familiarise with various controlling commands.

Sl. No.	EXPERIMENTS
1	Setting Up and Basic Commands Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	Creating and Managing Branches Create a new branch named feature-branch. Switch to the master branch. Merge the feature-branch into master.
3	Creating and Managing Branches Write the commands to stash your changes, switch branches and then apply the stashed changes.
4	Collaboration and Remote Repositories Clone a remote Git repository to your local machine.
5	Collaboration and Remote Repositories Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	Collaboration and Remote Repositories Write the command to merge feature branch into master while providing a custom commit message for the merge.
7	Git Tags and Releases Write the command to create a lightweight Git tag named v1.0 for a commit in your local repository.
8	Advanced GIT Operations Write the command to cherry-pick a range of commits from source-branch to the current branch.
9	Analysing and Changing Git History Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date and commit message?.
10	Analysing and Changing Git History Write the command to list all commits made by the author John Doe between 2023-01-01 and 2023-12-31.
11	Analysing and Changing Git History Write the command to display the last five commits in the repository's history.

12	Analysing and Changing Git History Write the command to undo the changes introduced by the commit with the ID abc123.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Use the basics commands related to GIT repository, Create and manage the branches.
CO2	Apply commands related to Collaboration and Remote Repositories.
CO3	Use the commands related to Git Tags, Releases and advanced GIT operations.
CO4	Analyse and change the GIT history.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – CIE Practical (A)	30	-	Marks awarded for weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests. each conducted for 100 marks covering all experiments , scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.

The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Web links:

Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger. Released October 2022. Publisher(s): O'Reilly Media, Inc.

Pro Git book, written by Scott Chacon and Ben Straub, published by Apress.

- https://git-scm.com/book/en/v2
- https://infyspringboard.onwingspan.com/.../overview
- https://infyspringboard.onwingspan.com/.../overview

B.E. (CSE Data Science) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	DATA ANALYTICS WITH R		
Course Code	25BCDAE307B	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. To Gain the knowledge of R Programming Concepts
2. To Explain the concepts of Data Visualization
3. To Work with R charts and Graphs
4. To Explain the concept of Statistics in R.
5. To construct machine learning workflows using R.

Sl. No.	EXPERIMENTS
1	Program 1. Introduction to R Programming: Data Types, Operations, and Basic Data Structures Problem: Demonstrate the steps for installation of R and R Studio. Perform the following: a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. b) Demonstrate Arithmetic and Logical Operations with simple examples. c) Demonstrate generation of sequences and creation of vectors. d) Demonstrate Creation of Matrices e) Demonstrate the Creation of Matrices from Vectors using Binding Function. f) Demonstrate element extraction from vectors, matrices and arrays. Objective: To understand R programming basics by performing data type assignments, operations, and manipulating core data structures.
2	Program 2. Financial Performance Analysis in R using Vectors: Monthly Profit Evaluation and Reporting Problem: Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics: a. Profit for each month. b. Profit after tax for each month (Tax Rate is 30%). c. Profit margin for each month equals to profit after tax divided by revenue. d. Good Months – where the profit after tax was greater than the mean for the year. e. Bad Months – where the profit after tax was less than the mean for the year. f. The best month – where the profit after tax was max for the year. g. The worst month – where the profit after tax was min for the year.

<table>
<tr><td>3</td><td>Program 3. Matrix Operations in R: Implementation of Basic Arithmetic and Transpose on 3x3 Matrices
Problem: Develop a program to create two 3 X 3 matrices A and B and perform the following operations
a) Transpose of the matrix
b) addition
c) subtraction
d) multiplication
e) Division</td></tr>
<tr><td>4</td><td>Program 4: Implement different String Manipulation functions in R.
Problem: To demonstrate the use of various string manipulation functions in R such as concatenation, substring, case conversion, pattern matching, and replacement.</td></tr>
<tr><td>5</td><td>Program 5: Correlation Analysis and Visualization Using the 'mammals' Dataset in R
Problem: The built-in data set mammals contain data on body weight versus brain weight.
Develop R commands to: a) Find the Pearson and Spearman correlation coefficients. Are they similar?
b) Plot the data using the plot command.
c) Plot the logarithm (log) of each variable and see if that makes a difference.</td></tr>
<tr><td>6</td><td>Program 6. Data Frame Creation, Sub-setting, and Merging in R for Inventory Analysis
Problem: Develop R program to create a Data Frame with following details and do the following operations.
a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.
b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”
c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames
<table>
<tr><th>itemCode</th><th>itemCategory</th><th>itemPrice</th></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table></td></tr>
<tr><td>7</td><td>Program 7. Customized Histogram Visualization in R Using the 'airquality' Dataset
Problem: Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.
a) Assigning names, using the air quality data set.
b) Change colors of the Histogram
c) Remove Axis and Add labels to Histogram
d) Change Axis limits of a Histogram e) Add Density curve to the histogram</td></tr>
<tr><td>8</td><td>Program 8. Employee Data Analysis in R: Importing, Filtering, and Exporting CSV Files
Problem: Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the</td></tr>
</table>

	following analysis. a) Find the total number rows & columns b) Find the maximum salary c) Retrieve the details of the employee with maximum salary d) Retrieve all the employees working in the IT Department. e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file "output.csv".
9	Program 9: Descriptive Statistics and Correlation Analysis of the 'mtcars' Dataset in R Problem: Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors Develop R program, to solve the following: a) What is the total number of observations and variables in the dataset? b) Find the car with the largest hp and the least hp using suitable functions c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness? d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations. e) Which pair of variables has the highest Pearson correlation?
10	Program 10: Simple Linear Regression in R: Modeling Salary Progression with Experience Problem: Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	**Apply** R programming constructs and data structures to build foundational programs for analytical computing.
CO2	**Develop** data cleaning and preparation workflows using R for real-world datasets.
CO3	**Use** R's graphical and visualization packages to represent and interpret data patterns effectively.
CO4	**Perform** statistical analysis and predictive modeling using R to extract insights from data.
CO5	**Construct** machine learning workflows using R for clustering, classification, and pattern discovery.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – CIE Practical (A)	30	-	Marks awarded for weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests. each conducted for 100 marks covering all experiments , scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Web Links

1. https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. http://www.tutorialspoint.com/r/r_tutorial.pdf 3

B.E. (CSE Data Science)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	AI TOOLS AND APPLICATIONS		
Course Code	25BCSAE307C	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Use Generative AI tools like ChatGPT, Canva, and Gamma. app for accelerating the creation of content, interactive simulations and assessments, to transform the raw material into structured, ready-to-use assets viz., content documents, presentations or visual handouts effortlessly.
2. Understand Precision Prompting: Scholarly Question Design for Reliable AI Outputs.
3. Use practical methods for leveraging Artificial Intelligence (AI) to enhance the productivity and effectiveness of academic research—specifically in ideation, literature review, and visualization of research connections.
4. Craft Adaptive Architectures for Personalised Learning Pathways using AI tools.

Sl. No.	EXPERIMENTS
1	**Create high quality, structured course content Using Generative AI tools (Use ChatGPT).** Example: Create a lecture on looping statements in Python, World War II, etc.
2	**Demonstrate the Canvas mode in ChatGPT** Example 1: Show the Interactive Editing of Documents using prompt-based modifications. Apply a prompt like: "Make this shorter", "Add an analogy here", "Convert this into bullet points". Example 2: Write a paragraph on if-else statements, select it, and prompt: "Explain this with a real-life analogy for beginners."
3	**Demonstrate the usage of Notion (knowledge management platform) which is a smart, flexible Google Doc with extra features such as Nested pages, Toggle sections, Visual blocks (tables, images, embeds), Easy rearrangement.** Example: Create or demonstrate how to: • Paste GPT-generated content into Notion • Break it into pages or collapsible sections • Prepare content for sharing or lesson delivery
4	**Demonstrate the use of Canva Docs and Canva Magic Tools.** Example: Demonstrate how to take the AI-generated lesson (on looping Statements in Python) and copy it directly into Canva Docs, which is Canva's version of a dynamic document editor. Paste GPT/Notion Content into Canva Docs using Canva Magic Tools. Create a visually enhanced handout or lesson packet that students can download, read on mobile, or print. After generating the topic breakdown with ChatGPT: • Use Canva Docs to format each cause as a section • Add relevant photos from Canva Elements • Include a "Key Takeaway" block after each section

<table>
<tr><td></td><td>

- Attach a short 2-question quiz at the end

</td></tr>
<tr><td>5</td><td>

Demonstrate the use of Magic Suite-Magic Eraser/Replace, Magic transform, etc.
Example:

a. Demonstrate the Magic Write feature. Say, Right-click on a paragraph, then choose actions like: “Rewrite this”, “Make it more concise”, “Fix grammar”, “Expand this with an example”, “Custom prompt” (e.g., “Explain this in simple language”)
b. Demonstrate the Magic Eraser / Replace feature which is Primarily used in images. Say, Erase unwanted objects (e.g., a watermark or irrelevant icon), Replace an item in an image (e.g., change a laptop to a chalkboard)
c. Demonstrate the Magic Transform feature which can be used to instantly convert the above created document into multiple formats.

</td></tr>
<tr><td>6</td><td>

Demonstrate the use of Gamma.app-AI-Powered presentation builder.
Show the following Customizations for the document created in above examples.

<table>
<tr><th>Feature</th><th>Example</th></tr>
<tr><td>Slide Title/Text</td><td>Edit headings or simplify slide copy</td></tr>
<tr><td>Image Replacement</td><td>Use AI to regenerate more suitable visuals</td></tr>
<tr><td>Content Rewrite</td><td>Prompt: "Make this slide simpler for high school students"</td></tr>
<tr><td>Layout Editing</td><td>Rearrange card structure or duplicate/delete cards</td></tr>
</table>

</td></tr>
<tr><td>7</td><td>

Generate Questions from Content (CTRL Method). CTRL is a powerful method for precision prompting.
Example: Python Conditional Statements

- Prompt Example 1: Create 3 Multiple Choice Questions (MCQs) on Conditional Statements in Python for college students who are beginners. Keep the tone formal and straightforward.
- Prompt Example 2: Generate 2 Match-the-columns questions on Python Conditional Statements. Keep the questions beginner-friendly and formal.
- Demo Examples:
- Using PDF as Content Source:
  - ✓ I've uploaded a PDF on "Introduction to Sociology" (provide link). Generate 5 MCQs for undergraduate students. Maintain academic tone, moderate complexity.
- Using Web Link:
  - ✓ Use the content from the following web link (provide actual URL here) and create 3 MCQs on Photosynthesis suitable for high-school biology students.

</td></tr>
<tr><td>8</td><td>

Demonstrate the Parsons Method for Interactive Problem Statements.
Parson’s Method enhances problem-solving skills by giving students code fragments or sentences they must put in the correct logical order, proven to improve conceptual understanding.

Live Demonstration Prompt:
Generate a Parson’s Problem using Python conditional statements for beginner-level students. Provide shuffled code blocks for a simple "if-else" structure.

</td></tr>
</table>

9	**Demonstrate the usage of AI Tools for Creating and Delivering Tests.** Tools available are: Quizizz AI, ClassMarker, Formative, Google Forms + AI (Form Presenter) Demonstrate a Use case of AI Tools for Creating and Delivering Tests. Once questions are created (Q7), automate their conversion into online tests for ease of deployment and analysis. Use Quizizz AI for Automated MCQs, grading and analytics.
10	**Demonstrate the use of AI-Driven Research Ideation (ChatGPT + Search)** Live Demonstration Example: Example Prompt given to ChatGPT: Suggest 3 novel research angles on the topic: 'Impact of Social Media on Mental Health' relevant to Psychology researchers.
11	**Deploy Elicit (elicit.com) for Rapid Literature Discovery.** To overcome manual search limitations, use Elicit, an AI-driven tool specialized in academic literature discovery. Example: Topic provided: "What is the impact of mindfulness techniques on anxiety among university students?" Analyzing Search Results: Elicit automatically generates a structured table of scholarly papers directly related to your query. It quickly provides: Paper titles, Abstracts (automatically summarized), Methodologies, Participants/sample sizes, Year published, citations count, and study types. The student should Customize Table Columns: say, Click "Columns" →Select additional details to view: Population studied, Intervantion details, Outcomes measured, Research methods Show the Advanced Filtering techniques: Say • Filter results by: Publication date, Study type (e.g., randomized control trials, observational studies), Citations count (to identify influential papers)
12	**Using Consensus for Quick Expert Insights (consensus.app).** The Consensus AI tool summarizes academic research consensus clearly and visually. Example: Enter your research query.: "Does social media use negatively impact teenagers' mental health?" Understand the Results: "Consensus Meter" summarizing expert agreement, Conduct In-depth Exploration of each summarized statement, do Advanced Filtering (Narrow down by year, relevance, study type, or agreement level.
13	**Visualizing Research Connections with Litmaps (app.litmaps.com)** Litmaps, a visualization tool that simplifies understanding complex academic citation networks visually Example: Enter your core research paper or DOI (Digital Object Identifier). Explore the Visual Citation Map (Connected papers represented visually, indicating citation relationships clearly. Papers connected via arrows showing who cites whom). Interactivity and Exploration: Click on any paper node to: Quickly see its abstract, authors, citations. Explore further connections expanding research context. Refine the Map: Filter the visualizations by: Year, Citations, Keywords, Publication type
14	**Explore how Generative AI can be applied in education to enable personalised learning experiences and support learners across various tasks. Use AI Tools such as Khanmigo, QuestionWell (For generating questions aligned to standards) or Diffit (For creating differentiated instructional materials).** • Example Prompt 1: "Act as a backend software development interviewer. Ask questions about

	JavaScript, React, Node.js, SQL, AWS, and System Design. Provide feedback based on a rubric." • Example Prompt 2: "Act as a Python Developer. Create a learning plan for someone transitioning from another programming language. Ask clarification questions before proceeding." • Example Prompt 3: "Provide constructive feedback on the student's answer based on the rubric. Mention 2 strengths, 2 areas for improvement, and suggestions. Use a positive tone." Tools You Can Explore: Brisk (Chrome extension for Google Docs), MagicSchool.ai (AI assistant for teachers).

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	**Apply** Generative AI tools such as ChatGPT, Canva, and Gamma.app to create structured content, simulations, and assessments.
CO2	**Transform** raw information into well-structured academic or professional outputs using AI tools like Canva Docs and Gamma.app.
CO3	**Design** precision prompts to generate reliable scholarly content and evaluation questions using advanced prompting strategies.
CO4	**Utilize** AI-powered platforms (e.g., Elicit, Consensus, Litmaps) to enhance productivity in research ideation, literature review, and visualization.
CO5	**Create** adaptive and personalized learning pathways using AI tools to support differentiated instruction and learner engagement.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
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Web links:

- OpenAI Prompt Engineering Guide: https://platform.openai.com/docsguides/prompt-engineering
- Effective Few-shot prompting examples : https://learnprompting.org/docs/basics/few_shot_prompting
- Parsons Problems Explained (Research-backed) : https://computinged.wordpress.com/2017/06/05/parsons-problems-have-same-learning-gains-as-writing-or-fixing-code-with-less-frustration-and-more-fun/
- Example Parsons Problem Online Tool : https://parsons.problemsolving.io/
- Edutopia on AI Writing Feedback : https://www.edutopia.org/article/ai-writing-feedback-students/#:~:text=As%20a%20writing%20teacher%20I,I%20like%20them%20a%20lot

Tool	Link
ChatGPT (Canvas)	https://chat.openai.com
Notion	https://notion.so
Canva Docs	https://www.canva.com
Gamma.app	https://gamma.app
Genially	https://www.genial.ly
Quizizz AI	https://quizizz.com
H5P	https://h5p.org
AI Tutor	https://chatgpt.com/share/68358dc1-0748-8006-a2bf-c50023cc280f
Khanmigo	https://www.youtube.com/watch?v=rnIgnS8Susg&t=119s
Elicit	https://elicit.com/
Consensus	https://consensus.app/
Litmaps	https://app.litmaps.com/

B.E. CSE (Data Science)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title:	DATA VISUALIZATION		
Course Code:	25BCDAE307D	**CIE MARKS**	**50**
(L: T: P) +SL	0:0:2	**SEE MARKS**	**50**
Credits:	1	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Understand the Importance of Data Visualization for business intelligence and decision making.
2. Learn different approaches to understand the importance of visual perception.
3. Learn different data visualization techniques and tools.
4. Gain knowledge of effective data visuals to solve workplace problems.

Experiment 1. Introducing Power BI, Querying Data from CSV and Text file.

Introducing Power BI –Components and the flow of work. Power BI Desktop Interface - five main areas of the Report.
Querying Data from CSV - Query Editor, Connecting the data from the Excel Source and Text file, Cleaning, and Transforming the data.
Remove a column
Rename a column
Split columns
Merge two columns
Change Data type

Experiment 2. Creating Reports, Visualizations, Filters, and Dashboards in Power BI

Creating Reports & Visualizations - Different types of charts, Formatting charts with Titles, and Colors.
Dashboards - Filters in Power BI, Formatting dashboards.

Experiment 3. Build a Power BI report in Power BI Desktop

Power BI report on Global Superstore Dataset:
i) Import data from an Excel spreadsheet.
ii) Establish relationships between tables.
iii) Format the colors used in a bar chart.
iv) Apply a Play button to a clustered column chart.
v) Apply a title to a visual.
vi) Prepare a report for mobile view.
vii) Publish a report to Power BI service.

Experiment 4. DAX in Power BI Student Marks Analysis Dataset

Simple DAX Program on Student Marks Analysis Dataset:
i)Import the Dataset into Power BI
ii)Create Calculated Columns using DAX for Pass/Fail Status
iii)Create Measures using DAX to count Total Students, Average Score, Pass Count, and Pass Percentage.
iv)Create Card Visuals: Show Total Students, Average Score, Pass Percentage
v)Plot Bar Chart: Name vs Scores
vi) Pie Chart: Distribution of Pass/Fail (Result)
vii)Column Chart: Hours studied vs Scores

Experiment 5. Tableau Workspace, Tableau terminologies, basic functionalities

Getting Started - Tableau Workspace, Tableau terminologies, basic functionalities.
Connecting to Data Source – Importing dataset in Tableau, Different types of Tableau Joins.

Experiment 6. Creating a View & Dashboard Design and Storytelling

Creating a View - formatting charts, adding filters, creating calculated fields, and defining parameters.
Dashboard Design and Storytelling Analysis of revenue in sales dataset– Components of Dashboard, understanding how to place worksheets in Containers, Action filters, and their types.

Experiment 7. Analysis of revenue in sales dataset using Tableau

Analysis of revenue in sales dataset:
i) Create a choropleth map (fill the map) to spot the special trends to show the state which has the highest revenue.
ii) Create a line chart to show the revenue based on the month of the year.
iii) Create a bin of size 10 for the age measure to create a new dimension to show the revenue.
iv) Create a donut chart view to show the percentage of revenue per region by creating zero access in the calculated field.
v) Create a butterfly chart by reversing the bar chart to compare female & male revenue based on product category.
vi) Create a calculated field to show the average revenue per state & display profitable & non-profitable state.
vii) Build a dashboard.

Experiment 8. Analysis of GDP dataset using Tableau

Analysis of GDP dataset:
i) Visualize the countries data given in the dataset with respect to latitude and longitude along with country name using symbol maps.
ii) Create a bar graph to compare GDP of Belgium between 2006 – 2026.
iii) Using pie chart, visualize the GDP of India, Nepal, Romania, South Asia, Singapore by the year 2010.
iv) Visualize the countries Bhutan & Costa Rica competing in terms of GDP.
v) Create a scatter plot or circle views of GDP of Mexico, Algeria, Fiji, Estonia from 2004 to 2006.
vi) Build an interactive dashboard.

Experiment 9. Analysis of HR Dataset using Power BI

Analysis of HR Dataset:
i) Create KPI to show employee count, attrition count, attrition rate, active employees, and average age.
ii) Create a Lollipop Chart to show the attrition rate based on gender category.
iii) Create a pie chart to show the attrition percentage based on Department Category- Drag department into colours and change automatic to pie. Entire view, drag attrition count to angle. Label attrition count, percent change, add total also, edit label.
iv) Create a bar chart to display the number of employees by Age group,

v) Create a highlight table to show the Job Satisfaction Rating for each job role based on employee count. vi) Create a horizontal bar chart to show the attrition count for each Education field. Education field-wise attrition – drag the education field to rows, sum the attrition count to the column. vii) Create multiple donut charts to show the Attrition Rate by Gender for different Age groups.
Experiment 10. Analysis of Amazon Prime Dataset using Tableau
Analysis of Amazon Prime Dataset: i) Create a Donut chart to show the percentage of movies and TV shows ii) Create an area chart to show by release year and type iii) Create a horizontal bar chart to show the Top 10 genres iv) Create a map to display total shows by country v) Create a text sheet to show the description of any movie/movies. vi) Build an interactive Dashboard.
Experiment 11. Analysis of Student Performance Dataset using Power BI
Analysis of Student Performance Dataset i) Create KPIs to show average math score, reading score, writing score, and count of total students. ii) Create a stacked column chart to display average scores by gender across all subjects. iii) Create a clustered bar chart to show the number of students by parental level of education. iv) Create a pie chart to show the distribution of test preparation course completion. v) Create a heat map or matrix showing the average score in each subject categorized by gender and lunch type. vi) Create a horizontal bar chart to show average reading scores based on race/ethnicity. vii) Create a scatter plot to explore the correlation between math and writing scores, color-coded by gender.
Program 12. Analysis of Netflix Movies and TV Shows using Tableau
Analysis of Netflix Movies and TV Shows i) Create a pie chart or donut chart to show the share of Movies vs TV Shows. ii) Create a timeline (line/area chart) showing the number of releases per year. iii) Create a bar chart to show the Top 10 directors by the number of shows directed. iv) Create a map to visualize the distribution of content by country. v) Build an interactive dashboard combining filters by genre, country, type, and release year.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Conceptualize the fundamentals of Tableau and Power BI, including interfaces, terminologies, and basic functionalities.
CO2	Demonstrate proficiency in data integration using Tableau and Power BI by connecting and importing data from various sources.
CO3	Design the experiment to create basic charts and graphs using Tableau and Power BI.
CO4	Develop the solution for the given real-world problem.
CO5	Analyze and infer the results.

ASSESSMENT DETAILS (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details

CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
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• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Web links and Video Lectures (e-Resources):

1. https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorialhome.htm
2. https://www.tutorialspoint.com/tableau/index.htm
3. https://www.simplilearn.com/tutorials/power-bi-tutorial/power-bi-vs-tableau

B.E.(CSE and Allied Branches) Outcome Based Education(OBE)and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title	**Community Project/Societal Project(Project-Based Learning)**		
Course Code	25CBPR308	**CIE Marks**	50
(L : T : P) + SL	0:0:0:30:30	**SEE Marks**	50
Credits	1	**Exam Hours**	3

Course Objective:

The Community Project / Societal Project is a practical, project-based learning course that builds students' awareness on Educational Social Responsibility(ESR).It focuses on real issues such has the adaptation of technology for rural and urban development, the application of tools for enhanced governance in civic societies, and sustainable technological solutions for better living. Students may work individually or in groups of up to four, including interdisciplinary topics,and assessment is based on the prescribed rubrics.

Course outcome(Course Skill Set):

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

CO1(L2–Understand):Identify and analyze societal problems through field interaction and technical assessment.

CO2(L3– Apply):Develop skills in project planning, field survey, data collection, implementation, documentation, and reporting.

CO3(L3–Apply):Apply principles of social responsibility in engineering practice through community-oriented interventions

CO4(L4–Analyze):Exhibit multi disciplinary learning, problem-solving ability, and communication skills based on collected data(requirements),stake holder feedback, and base line conditions.

CO5(L5– Evaluate):Choose feasible societal problem statements and solutions considering practical constraints and sustainability aspects.

CO6(L6– Create):Create a product by collaborating with stakeholder sand within the team to deliver a product / project to the intended community /organization.

Restrictions and professional conduct:

1. Societal projects should be academic, socially responsible, technically focused, and politically neutral. Students and faculty must maintain professionalism, ethical conduct, and respect while working with communities and stake holders and avoid any political, ideological, commercial, or disruptive activities. Projects should also consider practical constraints such as cost, resources, safety, social impact, and stake holder cooperation.

SET OF PROJECT ACTIVITIES(TW/SL=30HOURS)

Methods for project identification:

Students may identify the project topic using one or more of the following methods (not limited to):Interaction with local rural or urban stakeholders such as local leaders, corporation /municipality /Panchayath officers, NGOs, etc.; review of issues highlighted in print and electronic media and social networks. After selecting abroad topic, collect data and requirements, conduct a feasibility survey, estimate timelines and resources, approximate expenditure(if applicable),and define the problem statement with objectives clearly.

List of Project Topics/Titles(Not Limited):

Sl. No.	Broad Areas/Project titles	Measurable engineering outcome	Specific POs	SDGs
1	Computer-Based Learning Tool for Mentally Challenged Students	Design and develop a web/browser-based learning tool as per the Requirements of the special school.	5,6	4

2	Medication management system for an old-age home.	Design and develop a web-based application to monitor the administration of medicine to senior citizens residing at an old-age home.	6	3
3	Virtual Labs for Learning Science	Design and Development simulation environment to do the experimentation List in Physics/Chemistry/Biology for high school in a rural area	5,6	4
4	Local Skill Development and Employment Information Portal	Design and develop a web-based portal that provides information on local skill development programs, vocational training, internships, and employment opportunities for youth in the community.	6	4,8
5	Digital Complaint Portal for Gram Panchayat	Design and develop a web-based complaint portal(Specific nature)for Gram Panchayat	6	16
6	Plant Care Reminder Application	Implement a reminder mechanism that generates timely notifications for watering, fertilizing, pruning, and other plant-care activities.	6	13,15
7	Basic Crop Recommendation System	Develop a basic crop recommendation system that recommends suitable crops based on user-provided parameters such as soil type, season, rainfall, and water availability	6	2,13,15
8	Lost and Found Application	Develop a Lost and Found Application that enables users to report, search, and manage lost and found items	6	11,16
9	Campus Navigation System	Develop a campus navigation system that enables users to locate important campus facilities and obtain directions between selected locations, which provides a simple digital map and location information for important Facilities on campus.	6	15
10	Public Waste Collection Monitoring System	Design and develop a web/mobile application that enables citizens to report uncollected garbage with geo-tagged photos, track complaint status, and assist local municipal authorities in monitoring waste collection and Sanitation services.	6	3,11,16
11	Volunteer Management System for NGOs	Develop a web-based system to manage volunteer registration, event scheduling, attendance ,and activity Reporting for NGOs.	6	16

12	Local Farmer Market Information System	Design and develop a digital platform that connects farmers directly with consumers by providing crop availability, prices, and contact information.	6	2,8,12
13	Government scheme awareness for betterment of livelihood	Design a UI in the native language for people in rural areas to make best Utilization of the government scheme.	6	11
14	Community Renewable Energy Awareness and Management Portal	Design and develop a web/mobile portal to provide information on renewable Energy resources and estimate energy savings with in the community.	6	7,11,13
15	Digital Learning Platform for Rural Government Schools	Design and develop a digital learning platform(Tool)that provides interactive learning content and activity-based learning materials in regional languages for rural and small village govt schools(primary govt. schools often lack interactive learning tools)	5,6	4
16	Digital Heritage Preservation and Cultural Information Portal	Develop a digital platform to document, preserve, and promote local Heritage sites, cultural events, and historical information	6	11,16
17	Community Disaster Preparedness and Emergency Information System	Design and develop a web/mobile application for disaster preparedness and emergency alerts during natural disasters.	6	11,13
18	Pesticide Usage Advisory and Organic Farming Awareness System	Design and develop an application that provides recommendations on appropriate pesticide usage, promotes organic farming practices, and suggests suitable organic alternatives based on Soil test reports and crop information.	6	2,3,15
19	Cyber Security Awareness Platform for Phishing, Digital Arrest Scams, and Malicious Applications	Create a simple web app where users paste suspected text /links to get a risks core based on known phishing patterns, deceptive URLs, and high-risk keywords	5,6	16
20	Local Public Transportation Information and Route Assistance System	Design and develop a web or mobile application that provides location-based information on available public transportation services, route maps, estimated travel options, and near by transport facilities to improve accessibility and promote the use of Public transportation.	6	11,15

21	Digital Inventory and Sales Management System	Design and develop a web-based inventory, billing, and sales analytics system for small businesses with Dashboard reports and low-stock alerts.	6	8,9
22	Smart Financial Literacy and Budget Planner for public	Develop a mobile / web application that helps users manage house hold budgets, savings, government schemes, and financial planning through support.	6	1,8
23	Local Business Promotion and Market Analytics Portal	Design a digital platform that enables local vendors and small businesses to Advertise products, analyze customer trends, and improve digital visibility.	6	8,9
24	Blood Donor and Emergency Blood Availability Portal	Develop a web/mobile platform to connect blood donors, hospitals, and Patients with real-time blood availability information.	6	3
25	Women Safety and Emergency Alert Application	Develop a mobile application with SOS alerts, live location sharing, emergency contacts, and near by police station information.	6	5,11,16
26	Public Grievance and Civic Issue Reporting System	Develop a web / mobile application that allows citizen store port civic issues such a spot holes, street light failures, and drainage problems and monitor Complaint resolution status.	6	11,15,16
27	Digital Public Library and Book Exchange System	Design and develop a web-based plat form that enables community members or schools to manage book donations, borrowing, returns, and Book exchange activities.	6	4
28	Community Water Quality Reporting and Awareness Portal	Design and develop a web-based portal for citizens to report drinking water issues, records implement water quality observations, and provide awareness on safe water practices through Educational resources.	6	3,6
29	Community Blood Donor Registry and Emergency Request System	Design and develop a web/mobile application that maintains a local blood donor database, enables emergency blood requests, and notifies eligible donors based on blood group and location.	6	3,11
30	Smart Community Health Camp Management System	Design and develop a web/ mobile application to manage community health camps by facilitating online patient registration & doctor scheduling / digital health record Maintenance /medicine inventory tracking.	6	3

31	Food Waste Reduction and Food Donation Platform	Develop a platform connecting restaurants, hotels, and households with NGOs to donates ur plus food Before it is wasted.	6	2,12
32	Community Tree Plantation and Green Cover Monitoring Portal	Develop a web/mobile application to record tree plantation activities.	6	13,15
33	Career Guidance and Information Portal	Develop an app to get information on Aptitude tests, Course/scholarship alerts/placement information	6	4,8
34	NGO Donation and Resource Management System	Develop a web application to manage donations, inventory, volunteers, and financial transparency for NGOs.	6	16
35	Smart Local Tourism Business Portal	Develop a web platform promoting local tourism, home stays, guides, and cultural businesses with booking facilities.	6	8,11,15
36	Local Artisan and Handicraft Market place	Design and develop a platform promoting local artisans and traditional handicraft products.	6	8,11
37	Waste Recycling Marketplace	Develop a digital platform connecting House holds, recyclers, and scrap collectors with pickup scheduling.	6	11,12
38	Digital Accessibility Evaluation and Improvement for Public Websites	Evaluate the accessibility of atleast 10 government or public-service websites using WCAG guidelines, develop accessibility improvement recommendations, and implement a prototype demonstrating compliance improvements.	6	16
39	Digital Library and Knowledge Sharing Platform for Government Schools	Develop a multilingual digital library with e-books, educational videos, and quizzes to improve access to learning resources.	6	4
40	Community Renewable Energy Awareness and Management Portal	Design and develop a web / mobile portal to provide information on renewable energy resources and promote the adoption of sustainable energy practices with in the community.	6	7,11,15
41	Local Business Digital Marketplace	Web portal on boarding of at least 25 local vendors and product catalog	6	8,12

42	Community Blood Donor and Emergency Volunteer Network	Web /mobile application connecting donors and volunteers	6	3
43	Mental Health Awareness and Helpline Directory App	Develop an application providing verified helpline contacts, self-help resources, and stigma-reducing content.	6	3
44	Diet & Nutrition Awareness Tool for Anganwadi Children	Develop an application to track and Suggest balanced meal plans for children under a nutrition scheme.	5,6	2,3
45	Digital Literacy Portal for Elderly Citizens	Develop a simplified, accessible web application teaching basic smart phone and internet skills to senior citizens.	6	4,11
46	Scholarship & Government Scheme Eligibility Checker	Develop a Web tool matching students to eligible scholarships and welfare schemes based on entered criteria.	5,6	4
47	Digital Record-Keeping System for Self-Help Groups	Develop a Ledger and record-keeping application to help women's SHGs	6	5,8
48	Elderly Companion & Wellness Check-In App	Develop an application enabling family /volunteers to schedule and log Wellness check-ins for the elderly living lone.	6	3
49	Old-Age Home Volunteer Coordination Portal	Develop a Platform matching volunteers with old-age homes for Scheduled visits. events, and support activities.	6	3,11
50	Local Job & Skill Matching Portal for Daily-Wage Workers	Develop a Web application connecting Unskilled and semi-skilled workers with near by job opportunities.	6	8
51	Street Vendor Digital Registry and Support Portal	Develop an application for the registry helping street vendors to access Municipal registration information and gain customer visibility.	6	8
52	Micro loan and Repayment Tracker for Small Vendors	Develop an application helping small vendors track micro-loans, repayments, and daily sales.	6	8

53	Rain water Harvesting Feasibility & Awareness Tool	Develop a tool estimating roof to rain water harvesting potential based On roof are a and local rain fall data.	5,6	6,13
54	Water Quality Reporting System for a Village/Ward	Develop a Web/ mobile application for Citizens to report water contamination issues and track resolution status.	6	6
55	Community Skill-Building Workshop Registration and Tracker App	Develop an application to register participants and track attendance for community skill-building workshops such as tailoring, computer usage, and first-aid.	6	4,11
56	Local Event & Festival Information Aggregator App	Develop an application aggregating community event and festival Schedules for at own or ward.	6	11
57	Community Sports Ground/Facility Booking App	Develop an application for local youth To check availability and book shared sports grounds or courts.	6	3,11
58	Talent Scouting Platform for Rural Sports Players	Develop a platform where local sports talent can register profiles and gain visibility to coaches and scouts.	6	3
59	Youth Skill Development and Internship Finder App	Develop an application listing local internships ,apprenticeships, and skill-Training programs for youth.	6	4,8
60	Financial Literacy Awareness App for Rural Households	Develop an application teaching basic banking, savings, and fraud-avoidance Concepts with local-language support.	6	4,8
61	Legal Aid & Rights Awareness Portal	Develop a portal listing free legal aid contacts with simplified explanations of common citizen legal rights.	6	16
62	Digital Insurance /Pension Scheme Awareness Tool	Develop a tool helping unorganized-sector workers check eligibility and enrolling over insurance/pension schemes.	5,6	8
63	Live stock Health Record and Vaccination Tracker	Develop an application to record cattle and live stock health history and vaccination schedules for farmers.	6	15

64	Soil Testing Appointment & Report Access Portal	Develop a portal letting farmers book soil-testing slots and access digital test reports.	6	15
65	Power Outage Reporting and Tracking App for a Locality	Develop an application allowing Resident store port and track power outages to the local utility board.	6	7,11
66	Community Bore well / Water Tanker Scheduling App	Develop an application to schedule and track water tanker deliveries for water-scarce localities.	6	6,11
67	Cyber Safety and Digital Fraud Awareness App	Develop an application educating students and senior citizens on common on line scams and safe digital practices.	6	16
68	Adult Literacy Program Registration and Progress Tracker	Develop an application to register learners and track attendance and Progress in a community adult-literacy drive.	6	4
69	Inclusive Learning Content tool for Differently Abed Students	Develop a tool delivering audio/visual learning content adapted for students with visual or hearing impairments.	5,6	4
70	School Drop out Tracking and Follow-up System	Develop an application for teachers to record attendance trends and flag/follow up on students at risk of Dropping out.	6	4
71	Public Park/ Garden Maintenance Complaint Tracker	Develop an application for citizens to report maintenance issues in public parks and garden sand track resolution.	6	11,15
72	Digital Suggestion Box for Local Governance	Develop an application allowing citizens to submit suggestions and feed back to local governing bodies on Civic matters.	5,6	16
73	Community Health Screening Camp Scheduler	Develop an application to schedule and manage attendance for community blood-pressure/diabetes screening camps.	6	3
74	Digital Queue Management System for Health Camps	Develop a token-based appointment and queue management system/app	6	3

75	Street light Fault Reporting System	Develop an application for citizens to report faulty street lights using photo graphs and GPS location.	6	11
76	Village Asset Mapping System	Develop a GIS-enabled or map-based application to document community assets such as schools, hospitals, water tanks, and roads.	6	11
77	Food Waste Reduction & Expiry Management System	Design and develop a web/ mobile application to record food items, monitor expiry dates, provide expiry reminders, and maintain food Inventory to help reduce food wastage.	6	2,12
78	Community Hall Booking & Management System	Design and develop a web-based platform to manage community hall bookings, track hall availability, process booking requests, schedule maintenance, and maintain booking records.	6	11
79	Public Infrastructure Asset Monitoring System	Design and develop a web-based platform to maintain records of public infrastructure assets, report maintenance issues, assign maintenance requests, and track their status.	6	9,11

Week /Phase	**Teaching–Learning Activity**	**Faculty Role**	**Student Activity**	**Output/Evidence**
1	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2	Community problem identification and topic selection	Guide Topic Framing and Feasibility	Identify local issues through discussion and observation	Short listed project topic
3	Stake holder interaction and preliminary survey	Demonstrate survey methods and stake holder engagement	Collect initial data from community/users	Survey notes, interview record
4	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5	Literature/case study review and base line analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Base line analysis summary

6	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan/Gantt chart
7	Feasibility analysis and solution brain storming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note/design outline
9	Data processing/calculations/ sizing/mapping	Support Computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10	Prototype/model/audit/ DPR/app development	Monitor progress and correct technical l issues	Develop the selected output	Working model/draft DPR/map/app
11	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results/revised output
12	Field implementation /demonstration/awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13	Documentation of out comes, feedback, and impact	Review report structure and completeness	Compile findings, stake holder feedback, and observations	Draft report
14	Presentation prep ration and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck
15	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation(CIE)–50 marks

- Students, in batches of 3–4,shall undertake at least one project(or a combination of two related activities)aiming, as far as possible, at a logical implemented or implement able outcome.
- CIE will be conducted by a departmental committee (HoD / nominee, guide and one senior faculty)using the following rubrics totaling 50 marks:

CIE pass requirement:

A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.

- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE)–100 marks(scaled to 50)

- Examination duration:2 hours.
- Maximum examination marks:100 (enter 100 in the VTU portal; the ITI-SMU module automatically scales 100 → 50 for result processing).
- The SEE shall be conducted batch-wise by a committee of three faculty: project guide, one faculty from the same department and one from a different department.

SEE pass requirement and overall passing rule:

- For a passing SEE, a student shall secure minimum 35 marks out of 100.

- For declaration of a passgrade,the sum of CIE marks(out of 50)and scaled SEE marks(out of 50)shall be ≥ 40; otherwise, the student is awarded grade F (Fail).

CIE Rubric—Continuous Internal Evaluation(Total 50 marks):

Criterion	Weight(marks)	Excellent(Full marks)	Good	Fair	Needs Improvement
Problem identification &relevance to society/environment	8	Problem clearly identified with strong evidence of relevance and well-defined scope.(8)	Relevant problem with clear scope and adequate evidence. (6)	Problem defined but justification is weak. (4)	Problem un clear or not relevant.(2)
Formation of problem statement; engineering approach, innovation & feasibility	10	Precise statement; sound, innovative, feasible approach. (10)	Adequate statement; feasible with minor gaps.(8)	Partial statement ;marginal feasibility.(5)	Missi ng or infeas ible.(2)
Interaction with stake holders; data collection, analysis & interpretation	8	Thorough engagement; comprehensive data and well-interpreted analysis.(8)	Good engagement; adequate data and analysis.(6)	Limited engagement ; incomplete data and super financial analysis.(4)	Little or no stake holder contact; no data/analysis.(2)

Project documentation; clarity, organization & problem-solving demonstrated	10	Complete, well-organized, analytical, and strong problem-solving.(10)	Complete and clear with some analytical content.(8)	Basic with omissions; problem-solving limited.(5)	Missing/ poorly organized; no clear problem-solving.(2)
Communication & presentation skills	6	Confident, structured, and answers queries fully; visuals effective.(6)	Clear and satisfactory; responds to most queries. (5)	Acceptable but lacks clarity or confidence; weak responses.(3)	Poor or absent; unable to respond. (2)
Contribution & benefit to society(impact, sustainability)	8	Clear, demonstrable societal benefit and realistic sustainability path.(8)	Benefit plausible; sustainability considered with minor gaps.(6)	Limited or unclear benefit; sustainability weak.(4)	No evident benefit or sustainability.(2)

Notes for CIE rubric:

- Minimum CIE pass requirement: 20/50 to be eligible for SEE.[Use departmental committee (HoD /guide +senior faculty)to apply the rubric and record marks.]

SEE Rubric—Semester End Examination(Enter marks out of 100;scaled to 50 later):

Criterion	Weight(marks)	Excellent(Full marks)	Good	Fair	Needs Improvement
Problem identification & relevance to society/environment	16	Clearly articulated with strong evidence and context.(16)	Clear with reason able evidence.(12)	Problem stated but evidence/context weak.(8)	Poorly defined or irrelevant.(4)
Formation of problem statement; engineering approach, innovation& feasibility	20	Precise; demonstrates engineering depth, novelty And feasibility. (20)	Technically Sound and Feasible with minor limitations. (15)	Basic; limited technical depth or feasibility concerns.(10)	Nonviable engineering approach or infeasible plan.(5)
Interactionwithstakeholders;datacollection,analysis&interpretation	16	Excellent engagement; rigorous data collection and insightful analysis.(16)	Good engagement and acceptable analysis. (12)	Super ficial data collection and limited analysis.(8)	In adequate or no data; poor analysis. (4)
Project documentation; clarity, technical rigor &problem-Solving demonstrated		Comprehensive, technically rigorous, and systematic. (20)	Complete and technically correct with Minor gaps. (15)	Lacks technical depth or has not able omissions.(10)	Missing key Elements or technically incorrect. (5)

Communication, presentation &viva-voice responses	12	Presents expertly, defends work persuasively and answers all queries correctly.(12)	Good presentation and satisfactory answers to Most queries.(9)	Adequate but fails to answer some technical questions. (6)	Poor presentation and unable to defend work.(3)
Contribution & benefit to society; impact assessment &sustainability	16	Clear, evidence-based impact assessment with scaling recommendations.(16)	Reasonable impact discussion and sustainability considerations. (12)	Limited evaluation of impact or sustainability. (8)	No coherent assessment of impact or sustainability.(4)

SEE pass rule:

- Student must secure atleast35/100 in SEE it self to be eligible for pass consideration.
- Final passing is based on CIE(out of 50)+SEE(scaled to 50)>=40.Otherwise,grade F(Fail)is awarded.

Suggested implementation notes(for BoS/exam committees):

- Use numerical scores from the rubric and keep brief evaluator comments for each criterion.
- For team projects: record individual contribution with in the documentation and adjust individual marks using a peer-evaluation sheet or guide's assessment.
- Maintain evidence(field notes, photos, questionnaires, DPRs, reports) as annexures for SEE moderation.

Use standardized score sheet(spread sheet) mapping rubric items to columns for easy aggregation and archival.

- Awareness Campaign on Single-Use Plastic and E-Waste Management

Suggested Learning Resources:

Reference Books:

1. Phadke ,N.D., Community Engagement and Social Innovation, Oxford University Press, New Delhi.
2. Garg,N.R.,Project-BasedLearninginEngineeringEducation,PearsonIndiaEducationServices,Noida.
3. Gupta, A. and P. Singh, Service Learning and Community Projects, McGraw-Hill Education(India),New Delhi.
4. Wilson ,G., Practical Guide to Community Development Projects, Routl edge, London.

Weblinks and Video Lectures(e-Resources):

1. VTU e-Learning Centre :http://elearning.vtu.ac.in
2. NPTEL courses on Project-Based Learning and Social Innovation.
3. SWAYAM courses on community engagement and sustainability.
4. UN Sustainable Development Goals portal.
5. My Gov India and local civic body portals for community initiatives.
6. YouTube resources on design thinking, social innovation, and community service learning.
7. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Assessment Structure:

Continuous Internal Evaluation (CIE) shall be conducted by the Departmental Project Review Committee consisting of a Senior Professor,the Project Guide, and one additional faculty member nominated by the Head of the Department .Semester End Evaluation (SEE) shall be conducted by university-appointed examiners. The evaluation shall be based on rubrics designed to assess the attainment of NBA-defined graduate attributes, including problem analysis investigation, design of solutions, communication, team work, and professionalism**.**

The weight age of marks for CIE and SEE is 50%each.

Pass Criteria: A candidate shall secure a minimum of 40% of the total marks prescribed for Project Work, subject to the required minimum in Continuous Internal Evaluation and Semester End Evaluation as per VTU regulations.

B.E. (Common to All Branches)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	NATIONAL SERVICE SCHEME		
Course Code	25BNSSP309	**CIE MARKS**	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	–
Credits	–	**EXAM HOURS**	–

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Identify the needs and problems of the community and participate in problem-solving activities.
2. Develop a sense of social and civic responsibility and utilize knowledge to find practical solutions to individual and community problems.
3. Develop the competencies required for group living and sharing responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Module-1
Introduction to NSS, Life Competencies, Youth Leadership and NSS
Module-2
Social connect and responsibilities
Module-3
Activities-1 (Choose from Activity List)
Module-4
Activities-2 (Choose from Activity List)
Module-5
Activities-3 (Choose from Activity List)

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Communicate effectively with the community and with the officials.

ACTIVITY LIST	
Plantation Drive: Adopt a Tree	Developing and managing an efficient garbage disposal system.
Food Preservation and Packaging Awareness	Tourism Promotion: Innovative Ap-proaches.
Facilitating 100% digitized money transactions	Contribution to any national-level initiative of the Government of India, e.g., Digital India, Skill India, Swachh Bharat Internship, etc.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Web Links:

1. https://nss.gov.in/

B.E. (Common to All Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	PHYSICAL EDUCATION		
Course Code	25BPEDU309	**CIE MARKS**	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	—
Credits	—	**EXAM HOURS**	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness.
2. Familiarization of health-related Exercises, Sports for overall growth and development.
3. Participate in the competition at regional/state / national / international levels.
4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Module-1	**3 Hours**

Title: Athletics-Track Events-110 and 400 Mtrs Hurdles 110 Mtrs and 400Mtrs:
Hurdling Technique: Lead leg Technique, Trail leg Technique
Crouch start (its variations) use of Starting Block.

Module-2	**3 Hours**

Title: Athletics -Jump
High Jump
Approach Run
Take-off
Bar Clearance (Straddle)
Landing

Module-3	**3 Hours**

Title: Athletics - Throws
Discus Throw

a) Holding the Discus
b) Initial Stance Primary Swing
c) Rotation
d) Release and Recovery (Rotation in the circle)

Module-4	3 Hours
Title: Football Fundamental skills Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick. Trapping: Trapping the Rolling ball and the Bouncing ball with sole of the foot. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot. Heading: In standing, running and jumping condition. Throw-in: Standing throw-in and Running throw-in. Tackling: Simple Tackling, Slide Tackling. Goal Keeping: Collection of Ball, Ball clearance—kicking, throwing and deflect-ing. Game practice with application of Rules and Regulations.	
Module-5	**3 Hours**
Title: Hockey Fundamental skills Passing: Short pass, Long pass, Push pass, Hit. Trapping.)Dribbling and Dozing. Penalty stroke practice. Penalty corner practice. Tackling: Simple Tackling, Slide Tackling. Goal Keeping: Ball clearance, kicking and deflecting. Game practice with application of Rules and Regulations.	
iii. Rules and their interpretation and duties of the officials	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand and demonstrate fundamental techniques of track events including 110m and 400m hurdles, with proper use of starting blocks and hurdling skills.
CO2	Apply technical knowledge of athletic jumps, particularly high jump, including approach run, take-off, bar clearance and landing techniques.
CO3	Develop skills and perform throwing events, specifically discus throw, with correct techniques such as grip, stance, rotation, release and recovery.
CO4	Demonstrate fundamental skills of football such as kicking, trapping, dribbling, heading, throw-in, tackling and goalkeeping along with understanding rules and officiating.
CO5	Exhibit basic skills and techniques in hockey, including passing, trapping, dribbling, tackling, penalty strokes/corners and understand rules and duties of officials.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each con-ducted for 30 marks.
Project (B)	40	-	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Health and Physical Education by V.K. Sharma
2. Introduction to Physical Education, Fitnessand Sport by Daryl Siedentop
3. Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means

Reference Books:

1. Saraswati Health and Physical Education Textbook
2. Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest

B.E. (Common to All Branches)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title	YOGA		
Course Code	25BYOGA309	**CIE MARKS**	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	—
Credits	—	**EXAM HOURS**	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Physical, Mental and Spiritual objectives of Yoga.
2. Explain the meaning of Yoga.
3. Discuss the importance of Yoga and its scope.
4. Describe the aims and objectives of Yoga.
5. Clarify the misconceptions on Yoga.

Module-1 **3 Hours**

Suryanamaskar 12 count 6 rounds

a) Suryanamaskar prayer.
b) Meaning, need & importance.
c) Benefits of Suryanamaskara.

Module-2 **3 Hours**

a) Meaning and definition.
b) Brief introduction of yogic practices for the common man.
c) Rules and regulations.
d) Misconceptions of Yoga.

Module-3 **3 Hours**

Title: Asanas - Sitting & Standing

Need and importance of different Asanas, meaning by name, technique, precautionary measures and benefits of each asana.

Sitting

a) Ardha Ushtrasana.
b) Yogamudra in Padmasana.

Standing

a) Hastapadasana.
b) Utkatasana.

Module-4	3 Hours

Title: Asanas - Supine line

Need and importance of different Asanas, meaning by name, technique, precautionary measures and benefits of each asana.

Supine line

a) Sarvangasana.

b) Chakraasana.

Module-5	3 Hours

Title: Pranayama

a) Kapalabhati - Revision of practice 40 strokes/min - 3 rounds.

b) Pranayama:

i) Ujjayi.

ii) Sheetali.

c) Meaning, Need, importance of Pranayama, Different types, Meaning by name, technique, precautionary measures and benefits of each Pranayama.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, definition, scope and objectives of Yoga and its role in physical, mental and spiritual well-being.
CO2	Demonstrate Suryanamaskara (12 counts, 6 rounds) with correct technique and understand its importance and benefits.
CO3	Apply knowledge of yogic practices, rules and regulations while identifying and correcting common misconceptions of Yoga.
CO4	Perform sitting, standing and supine Asanas with proper technique, precautions and awareness of their benefits.
CO5	Practice Pranayama techniques (Kapalabhati, Ujjayi, Sheetali) to improve breathing control, concentration and overall health.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	—	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. The Yoga Sutras of Patanjali by Sri Swami Satchidananda.
2. Light on Yoga by B.K.S. Iyengar.

Reference Books:

1. The Heart of Yoga by T.K.V. Desikachar.
2. Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.

B.E. (Common to All Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	MUSIC		
Course Code	25BMUSK309	**CIE MARKS**	100
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	—
Credits	—	**EXAM HOURS**	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the origin, evolution and fundamental concepts of Indian classical music.
2. Familiarize themselves with the basic forms of Carnatic and Hindustani music compositions and appreciate their musical structure and significance.
3. Identify and classify the major musical instruments used in Carnatic and Hindustani music and understand their construction and performance characteristics.
4. Recognize the contributions of eminent Indian composers and musicians to the development and preservation of Indian classical music.
5. Develop an appreciation for India's rich musical heritage, fostering creativity, cultural awareness and lifelong interest in music.

Module-1	**3 Hours**
Origin of the Indian Music: Evolution of the Indian music system, understanding of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela.	
Module-2	**3 Hours**
Compositions: Introduction to the few types of compositions in Carnatic Music—Geethe, Swarajathi, Varna and Madhyama Kala Kriti.	
Module-3	**3 Hours**
Compositions: Introduction to the few types of compositions in Hindustani Music Khayal, Drupad, Tarana.	
Module-4	**3 Hours**
Music Instruments: Classification and construction of string instruments, wind instrurnents, percussion instruments in both Carnatic and Hindustani Music.	
Module-5	**3 Hours**
Composers: Biography and contributions of of the following eminent personalities Purandaradasa, Thyagaraja, Mysore Vasudevacharya. Pt. Mallikarjun Mansur, Vidhushi Gangubhai Hangal.	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution and fundamental concepts of Indian classical music.

CO2	Compare and distinguish the characteristics of selected Carnatic and Hindustani music compositions.
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music.
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each con-ducted for 30 marks.
Project (B)	40	—	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Vidushi Vasantha Madhavi, Theory of Music, Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana-Vol. 1 (English), Shreenivaas Prakaashana, 2018.
3. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Government of India, New Delhi.

Reference Books:

1. Lakshminarayana Subramaniam, Viji Subramanaim, Classical Music of India: A Practical Guige, Tranqueber 2018.
2. R. Rangaramanuja Ayyangar, History of South Indian (Carnatic) Music, Vipanci Charitable Trust; Third edition, 2019.
3. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai.

B.E. (Common to All Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title	ADDITIONAL MATHEMATICS-I		
Course Code	25BMADP310	**CIE MARKS**	100
(L : T : P) + SL	(1:0:0)+(14 Hours/Sem)	**SEE MARKS**	–
Credits	–	**EXAM HOURS**	–

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply the fundamental concepts of complex trigonometry, vector algebra and differential and integral calculus to analyze mathematical and engineering problems.
2. Apply the principles of vector differentiation and solve first-order ordinary differential equations in relevant scientific and engineering contexts.

Module-1	**9 Hours**

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).

Vector Algebra: Scalars and vectors. Addition, subtraction and multiplication of vec-tors. Dot and Cross products, Problems.

Module-2	**9 Hours**

Differential Calculus: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-illustrative examples.

Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

Module-3	**9 Hours**

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.

Module-4	**9 Hours**

Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof)and evaluation of these with standard limits-Examples.

Module-5	**9 Hours**

Ordinary Differential Equations (ODEs): Introduction-solutions of first order and first-degree differential equations: Exact differential equations, Linear differential equa-tions, Equations reducible to exact differential equations and Bernoulli's equation.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply concepts of complex numbers and vector algebra to analyze the problems arising in related areas.
CO2	Apply derivatives and partial derivatives to calculate the rate of change of multivariate functions.
CO3	Solve problems involving position, velocity and acceleration in two and three dimensions using vector-valued functions.
CO4	Apply the fundamental techniques of elementary integration to solve standard integrals.
CO5	Identify and solve first-order ordinary differential equations.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each con-ducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Textbook:

1. Higher Engineering Mathematics: B. S. Grewal, Khanna Publishers, 43rd Edition, 2015.

Reference Books:

1. Advanced Engineering Mathematics: E. Kreyszig, John Wiley & Sons, 10th Edition, 2015.
2. Engineering Mathematics: N. P. Bali and Manish Goyal, Laxmi Publishers, 7th Edition, 2007.
3. Engineering Mathematics Vol. I: Rohit Khurana, Cengage Learning, 1st Edition, 2015.

IV SEMESTER

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	DISCRETE MATHEMATICS AND GRAPH THEORY		
Course Code	25BCSTH401	**CIE MARKS**	50
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	4	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply the principles of mathematical logic and relations to analyze and solve discrete mathematical problems.
2. Analyze counting techniques and the principle of counting to solve combinatorial problems.
3. Familiarize with the fundamental concepts of the principle of inclusion and exclusion to build a strong foundation in discrete mathematics.
4. Solve engineering problems using graph-theoretic techniques.

Module 1	**9 Hours**
Fundamentals of logic: Basic connectives and Truth tables, Tautologies, Logical Equivalence The laws of logic, Logical implications, Rules of inference, Proof and disproof. **Textbook 1: Chapter 2 (2.1 - 2.3, 2.5)**	
Module 2	**9 Hours**
Relations: Cartesian Products and Relations, Properties of Relations, Zero-One Matrices and Directed Graphs, Equivalence Relations and Partitions, Partial Orders Hasse Diagrams, Lattices. **Textbook 1: Chapter 5 (5.1), Chapter 7 (7.1 – 7.4)**	
Module 3	**9 Hours**
Fundamental Principles of Counting : The Rules of Sum and Product, Permutations, Combinations, Binomial and multinomial theorems, Combinations with Repetition. **Textbook 1: Chapter 1 (1.1 – 1.4)**	
Module 4	**9 Hours**
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, the Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. **Textbook 1: Chapter 8 (8.1 – 8.4)**	
Module-5	**9 Hours**

Introduction to Graph Theory: Definitions and Examples, vertex degree, Complete graph, Regular graph, Peterson graph, bipartite graph, complete bipartite graph, Sub-graphs, Regular graphs, Wheels, Subgraphs, Proper subgraphs, Spanning subgraphs, Induced sub graphs, Isomorphism of graphs, Konigsberg bridge problem, Trees, Binary trees, prefix code and merge-sort.

Textbook 1: Chapter 10 (10.1, 10.2), Chapter 12 (12.3, 12.4)

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply Mathematical logic to validate propositions.
CO2	Implement properties of relations in theoretical algorithms.
CO3	Model and solve computer science problems by applying combinatorial methods.
CO4	Solve counting problems involving finite sets using the principle of inclusion and exclusion.
CO5	Apply graph-theoretic concepts to develop solutions for network design problems.

ASSESSMENT AND EVALUATION REGULATIONS OF ASC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
CIE: Theory + Prac-tical (A + B)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, con-ducted for 100 marks and scaled down to 50 marks. Exam dura-tion shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks:

1. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson Addison Wesley, 2004.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, 1974.

Reference Books:

1. Chandrasekharaiah, D. S., Discrete Mathematical Structures, 5th Edition, PRISM Books Pvt. Ltd., Bengaluru, 2018.
2. Chandrasekharaiah, D. S., Graph Theory and Combinatorics, 4th Edition, PRISM Books Pvt. Ltd., Bengaluru, 2012.
3. Kenneth H. Rosen, Discrete Mathematics and Its Applications, 6th Edition, McGraw Hill, 2007.
4. Basavaraj S. Anami and Venakanna S. Madalli, Discrete Mathematics – A Concept Based Approach, Universities Press, 2016.

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	DATABASE MANAGEMENT SYSTEMS		
Course Code	25BCSIC402	**CIE MARKS**	50
(L : T : P) + SL	(3:0:2)+(45 Hours/Sem)	**SEE MARKS**	50
Credits	4	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts, architecture and advantages of Database Management Systems and their role in data handling.
2. Design and model database schemas using Entity-Relationship (ER) diagrams and map conceptual designs to relational models.
3. Write efficient SQL queries for data definition, manipulation and retrieval and understand NoSQL databases and their applications.
4. Apply normalization techniques to design well-structured relational database schemas and eliminate redundancy.
5. Comprehend transaction processing, concurrency control and recovery techniques to ensure data integrity and reliability in database systems.

Module-1 **9 Hours**

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.

Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER Diagrams, Naming Conventions and Design Issues.

Textbook 1: Chapter 1 (1.1 - 1.7), Chapter 2 (2.1 - 2.2, 2.5, 2.6), Chapter 3 (3.1 - 3.7)

Module-2 **9 Hours**

Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping.

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.).

Chapter 9 (9.1), Chapter 5 (5.1 - 5.3), Chapter 8 (8.1 - 8.4)	
Module-3	**9 Hours**
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. **More SQL: Complex Queries, Triggers, Views and Schema Modification:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL. **NOSQL Databases and Big Data Storage Systems:** Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB. **Textbook 1: Chapter 6 (6.1 - 6.5), Chapter 7 (7.1 - 7.3), Chapter 24 (24.1 -24.3)**	
Module-4	**9 Hours**
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 Nor-mal Forms, Boyce-Codd Normal Form. **Relational Database Design Algorithms:** Functional Dependencies: Inference Rules, Equivalence and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, About Nulls, Dangling Tuples. **Textbook 1: Chapter 14 (14.1 - 14.5), Chapter 15 (15.1 - 15.2)**	
Module-5	**9 Hours**
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. **Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering. **Textbook 1: Chapter 20 (20.1 - 20.6), Chapter 21 (21.1, 21.2)**	

PRACTICAL COMPONENT OF IPCC

Sl. No.	EXPERIMENTS
1	Consider the following schema for a Library Database: BOOK (Book id, Title, Publisher Name, Pub Year) BOOK AUTHORS (Book id, Author Name) PUBLISHER (Name, Address, Phone) BOOK COPIES (Book id, Branch id, No-of Copies) BOOK LENDING (Book id, Branch id, Card No, Date Out, Due Date) LIBRARY BRANCH (Branch id, Branch Name, Address) BORROWER (Card no, Name, Address, Phone) Write SQL queries to a. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. b. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017. c. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. d. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. e. Create a view of all books and its number of copies that are currently available in the Library.
2	Consider the following schema for an Order Database: SALESMAN (Salesman id, Name, City, Commission) CUSTOMER (Customer id, Cust Name, City, Grade, Salesman id) ORDERS (Ord No, Purchase Amt, Ord Date, Customer id, Salesman id) Write SQL queries to a. Count the customers with grades above Bangalore's average. b. Find the name and numbers of all salesmen who had more than one customer. c. List all the salesmen and indicate those who have and don't have customers in their cities (Use UNION operation). d. Create a view that finds the salesman who has the customer with the highest order of a day. e. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.

3	Consider the following schema for a Movie Database: ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir id, Dir Name, Dir Phone) MOVIES (Mov id, Mov Title, Mov Year, Mov Lang, Dir id) MOVIE CAST (Act id, Mov id, Role) RATING (Mov id, Rev Stars) Write SQL queries to a. List the titles of all movies directed by 'Hitchcock'. b. Find the movie names where one or more actors acted in two or more movies. c. List all actors who acted in a movie before 2000 and also in a movie after 2015 (use JOIN operation). d. Find the title of movies and number of stars for each movie that has at least one rating and find the highest number of stars that movie received. Sort the result by movie title. e. Update the rating of all movies directed by 'Steven Spielberg' to 5.
4	Consider the following schema for a College Database: STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to a. List all the student details studying in fourth semester 'C' section. b. Compute the total number of male and female students in each semester and in each section. c. Create a view of Test1 marks of student USN '1RN25CS100' in all subjects. d. Calculate the FinalIA (average of the best two test marks) and update the corresponding table for all students. e. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA ¡ 12 then CAT = 'Weak'. Give these details only for 8th semester A, B and C section students.

5	Consider the following schema for a Company Database: EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) DLOCATION (DNo, DLoc) PROJECT (PNo, PName, PLocation, DNo) WORKS ON (SSN, PNo, Hours) Write SQL queries to a. Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project. b. Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise. c. Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salaryand the average salary in this department. d. Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator). e. For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 6,00,000.
6	Installation of an Open-Source NoSQL Database MongoDB and perform basic CRUD (Create, Read, Update and Delete) operations. Download MongoDB Community Server from: https://www.mongodb.com/try/download/community

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Define the fundamentals of DBMS architecture, data models and ER modelling concepts.
CO2	Construct ER diagrams into relational schemas and apply relational algebra operations.
CO3	Formulate SQL queries and differentiate between SQL and NoSQL databases.
CO4	Apply normalization techniques to design relational schemas up to BCNF.
CO5	Analyse transaction processing and implement concurrency control and recovery techniques.

ASSESSMENT AND EVALUATION REGULATIONS OF IPCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	30	12	Marks of Tests and Assignments awarded for a maximum of 30.
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	20	8	Marks of Experiments, Record and Test awarded for a maximum of 20 marks.
CIE: Theory + Practical (A + B + C)	50	20	CIE Evaluation is done for a maximum of 50 marks.
SEE (D)	50	18	SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C+D)	100	40	Final marks shall be the sum of marks scored in Components A, B, C and D.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.			

Textbooks:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.

Reference Books:

1. Database Management Systems, Ramakrishnan and Gehrke, 3rd Edition, 2014, McGraw Hill.
2. Silberschatz Korth and Sudharshan, Database System Concepts, 6th Edition, Mc-Graw Hill, 2013.

Web Links:

1. https://www.youtube.com/playlist?...PLJwqWlxkbMhdAM5pv3Yfx5CWkm83tZy0s

2. https://www.youtube.com/playlist?...PLxCzCOWd7aiFAN6I8CuViBuCdJgiOkT2Y

3. https://www.youtube.com/watch?v=c5HAwKX-suM

4. https://www.geeksforgeeks.org/dbms/dbms/

Self-Study topics:

1. Module 3: (Chapter 24.4 – 24.6)
   NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.
2. Module 4: (Chapter 14.6 – 14.7)
   Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.
3. Module 5: (Chapter 21.3 – 21.5)
   Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.

Mini Project:

1. https://www.hackerrank.com/domains/sql
2. Case Study based Flip Class

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	25BCSTH403	**CIE MARKS**	**50**
(L : T : P) + SL	(3:2:0)+(45 Hours/Sem)	**SEE MARKS**	**50**
Credits	4	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Learn the methods for analysing algorithms and evaluating their performance.
2. Demonstrate the efficiency of algorithms using asymptotic notations.
3. 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.
4. Learn the concepts of P and NP complexity classes.

Module-1 **9 Hours**

Fundamentals: 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 and Exhaustive search: Selection Sort, Bubble Sort, Sequential Search and String Matching, Closest Pair points and Convex-Hull problems, Travelling Salesman Problem, Assignment Problem, Knapsack Problem.

Textbook 1: Chapter 2 (2.1 - 2.4), Chapter 3 (3.1 - 3.4)

Module-2 **9 Hours**

Decrease-and-Conquer: Topological Sorting, Fake Coin problem, Interpolation Search.

Divide-and-Conquer: Merge Sort, Quicksort.

Divide-and-Conquer: Max Min Algorithm.

Textbook 1: Chapter 4 (4.2, 4.4, 4.5), Chapter 5 (5.1 - 5.2)

Textbook 2: Chapter 3 (3.3)

Module-3 **9 Hours**

Transform and Conquer: Balanced Search Trees (AVL trees,2-3 trees), Heaps and Heapsort.

Greedy Technique: Prim's Algorithm, Kruskals Algorithm, Dijkstra's Algorithm, Huff-man Trees, Knapsack Problem, Job sequencing with deadlines.

Textbook 1: Chapter 2 (2.1 - 2.4), Chapter 3 (3.1 - 3.4)

Module-4	9 Hours
Dynamic Programming: Multistage graph, The Knapsack Problem and Memory functions, Warshall's Algorithm, Floyd's Algorithms, Reliability Design. **Space and Time Trade-offs:** Input Enhancement in String Matching: Horspool's algorithm, Boyer Moore's Algorithm. **Textbook 1: Chapter 8 (8.2 - 8.4), Chapter 7 (7.2)** **Textbook 2: Chapter 5 (5.2 - 5.8)**	
Module-5	**9 Hours**
Backtracking: n-Queens Problem, Hamiltonian Circuit problem, Subset-Sum Problem, Graph coloring. **Branch and Bound:** Assignment Problem, Knapsack Problem, Traveling Salesman Problem. **Problem Complexity:** Limitations of Algorithm Power, P, NP and NP-Complete Problems, Approximation algorithms for NP Hard (Knapsack, Travelling Salesman Problem). **Textbook 1: Chapter 12 (12.1 - 12.3), Chapter 11 (11.3)** **Textbook 2: Chapter 7 (7.4)**	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the fundamentals of algorithm analysis, asymptotic notations, brute-force techniques and analyze the efficiency of sorting algorithms such as Selection Sort, Merge Sort and Quick Sort.
CO2	Apply divide-and-conquer, decrease-and-conquer, transform-and-conquer, greedy and graph algorithms (Topological Sort, Dijkstra's, Floyd's, Warshall's, Kruskal's and Prim's) to solve optimization and scheduling problems.
CO3	Apply dynamic programming, backtracking and branch-and-bound techniques to design efficient solutions for optimization and combinatorial problems.
CO4	Analyze and compare the time and space complexities of different algorithmic paradigms to evaluate their suitability for solving various computational problems.
CO5	Analyze computational complexity classes (P, NP, NP-Complete) and implement exact, approximation and backtracking algorithms to solve computation-ally hard problems such as the N-Queens problem.

ASSESSMENT AND EVALUATION REGULATIONS OF PCC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	20	CIE Evaluation is done for a maximum of 50 marks
SEE (C)	50	18	SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 (40%) out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Textbooks:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, 3rd Edition, Pearson 2017.
2. Ellis Horowitz, Satraj Sahni, Rajasekharam, Fundamentals of Computer Algo-rithms, 2nd Edition 2019.

Reference Books:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein Introduc-tion to Algorithms, 4th MIT Press 2009.
2. Padma Reddy, Analysis and Design of Algorithms, 1st Sri Nandi Publications 2009.

B.E. (CSE Data Science) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER –IV			
Course Title:	FOUNDATIONS OF DATA SCIENCE		
Course Code:	25BCDTH404	**CIE MARKS**	**50**
(L: T: P) + SL	(3:0:2)+(45 Hours / Sem)	**SEE MARKS**	**50**
Credits:	4	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts of data science.
2. Explain statistical and probabilistic concepts such as data types, sampling techniques, probability distributions, and inferential statistics for data-driven decision making.
3. Apply the data science methodology and analytics life cycle to solve real-world problems through structured stages like data discovery, preparation, modelling, and result communication.
4. Analyse and implement core machine learning techniques such as regression, classification, clustering, and evaluation methods.
5. Explore and apply text mining and basic natural language processing techniques

Module-1	**9 Hours**
Introduction to Data Science: Importance of Data Science, Need for Data Science, What Is Data Science, Data Science Process, Business Intelligence and Data Science, Prerequisites for a Data Scientist, Components of Data Science, Tools and Skills Needed. **Textbook 1: Chapter 1**	
Module-2	**9 Hours**
Statistics and Probability: Data Types, Variable Types, Statistics, Sampling Techniques and Probability, Information Gain and Entropy, Probability Theory, Probability Types, Probability Distribution Functions, Bayes' Theorem, Inferential Statistics **Textbook 1: Chapter 2**	
Module-3	**9 Hours**
Data Science Methodology: Analytics for Data Science, Examples of Data Analytics, Data Analytics Life Cycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, operationalization **Textbook 1: Chapter 4**	
Module-4	**9 Hours**
Data ScienceMethods and Machine Learning: Regression Analysis,Linear Regression, Logistic regression, Multimodal logistic regression, Time-series model, Machine Learning: Decision trees, naive bayes, support vector, machines, nearest neighbour learning, clustering, Confusion matrix **Textbook–1: Chapter 5**	
Module-5	**9 Hours**
Data Analysis and Text Mining: Text Analytics: Text analytics subtasks, Cleaning and parsing, searching and retrieval, Text mining, Part-of-speech tagging, Stemming, Lemmatization, Basic text analysis steps, Introduction to Natural Language Processing.. **Textbook-1: Chapter 6**	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Identify the essential components, tools, and technologies used in Data Science workflows.
CO2	Interpret statistical results and evaluate their significance in the context of data-driven decision-making.
CO3	Apply the Data Analytics Life Cycle, including data discovery, data preparation, model planning, and model building to address analytical problems.
CO4	Analyze model performance using evaluation metrics such as the confusion matrix and interpret the results to assess predictive accuracy.
CO5	Demonstrate the ability to use basic Natural Language Processing (NLP) techniques and tools for real-world text analysis applications.

ASSESSMENT DETAILS (Both CIE and SEE)

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	50	18	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	50	20	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

Textbooks:

1. Sanjeev J. Wagh, Manisha S. Bhende, and Anuradha D. Thakare, "Fundamentals of Data Science", 1st Edition, 2021, CRC press.

2. Cathy O Neil, Rachel Schutt, "Doing Data Science-Straight Talk from the Frontline", 2013, O'Reilly Media.

Reference Books:

1. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

2. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists", 2017, O'Reilly

Web links and Video Lectures (e-Resources):

1. https://www.udemy.com/course/data-science-for-the-beginner/?couponCode= PMNVD2025

2. https://www.oreilly.com/library/view/doing-data science/9781449363871/toc01.html

3. https://docs.python.org/3/tutorial/

4. nptel.ac.in/courses/106106212

Self-Study Topics:

1. Difference between Data Science vs Business Intelligence vs AI

2. Central Limit Theorem .

3. CRISP-DM vs Data Analytics Life Cycle

4. Comparison of ML algorithms (when to use what?)

5. Analyze a dataset and present insights

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY		
Course Code	25BCSLB405	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Learn the methods for analysing algorithms and evaluating their performance to demonstrate the efficiency of algorithms using asymptotic notations.
2. Demonstrate the efficiency of algorithms using asymptotic notations.
3. 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.
4. Learn the concepts of P and NP complexity classes.

Program 1 - Selection Sort – Sorting Student IDs

Design and implement a C program to sort a list of student roll numbers from a university database using the Selection Sort algorithm.

Objective: Record and compare the time taken for sorting as the number of student records increases (n Grerater 5000).

Application: Helps in managing ordered student data efficiently for attendance systems or result generation.

Program 2 - Merge Sort – Organizing Medical Reports

Design and implement a C program to sort large sets of patient report IDs using Merge Sort.

Objective: Track execution time for datasets with n ¿ 5000 and plot time vs data size.

Application: Efficient sorting of medical records in a hospital management system.

Program 3 - Quick Sort – E-Commerce Order Sorting

Design and implement a C program to sort customer order IDs based on timestamps using Quick Sort.

Objective: Measure performance on dataset size > 5000 and plot the performance graph.

Application: Fast processing of online orders in an e-commerce platform.

Program 4 - Topological Sort – Task Scheduling in Project Management
Implement a C program to find the topological ordering of tasks in a project where some tasks depend on the completion of others. Application: Automating task scheduling tools like Jira or Trello where dependencies exist.
Program 5 - Bellman-Ford Algorithm – Dynamic Routing in Unstable Networks
Objective: Implement a C/C++ program to find the shortest paths from a single source vertex to all other vertices in a directed graph that may contain negative edge weights using the Bellman-Ford algorithm, including negative cycle detection. Application: Optimizing autonomous delivery or logistics routes where certain pathways pass through energy-harvesting zones (recharging grids represented as negative weights), while ensuring the system flags infinite battery-draining loops (negative cycles).
Program 6 - Greedy Knapsack – Stock Refill Strategy
Implement a C/C++ program to solve discrete and fractional knapsack problems using greedy methods to choose items for shelf restocking in a supermarket based on value-to-weight ratio. Application: Inventory management and optimization.
Program 7 - Dijkstra's Algorithm – GPS Navigation System
Implement a C/C++ program to find shortest paths from a given location to all other locations in a city's road network. **A**pplication: GPS systems like Google Maps, for calculating the shortest routes.
Program 8a - Floyd's Algorithm – Travel Time Optimization Problem
Implement a C/C++ program to find the shortest paths between all pairs of cities in a country using Floyd's algorithm. Application: Railway or airline scheduling and route planning.
Program 8b - Warshall's Algorithm – Webpage Reachability
Implement a C/C++ program to determine reachability between all webpages using Warshall's algorithm on a hyperlink graph. Application: Search engines identifying which pages link to others.
Program 9 - Kruskal's Algorithm – Designing Network Layouts
Implement a C/C++ program to find the Minimum Cost Spanning Tree of a network using Kruskal's algorithm. Application: Laying cables (like fiber optic) for minimum cost in a connected campus or city.

Program 10 - Prim's Algorithm – Power Grid Optimization
Implement a C/C++ program to build the minimum cost electricity network using Prim's algorithm. Application: Designing cost-effective electricity distribution networks.
Program 11 - Subset Sum – Payment Combinations
Implement a C/C++ program to find all payment combinations using a set of coin or currency denominations that sum up to a required amount. Application: ATM cash dispensing or vending machines.
Program 12 - N-Queens – Security Camera Placement
Implement a C/C++ program to solve the N-Queens problem to place security cameras in a museum grid such that no two cameras cover the same row, column, or diagonal. Application: Surveillance system optimization.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Analyse and implement sorting algorithms such as Selection Sort, Merge Sort and Quick Sort to solve domain-specific problems.
CO2	Apply graph-based algorithms such as Topological Sort, Dijkstra's, Floyd's, Warshall's, Kruskal's and Prim's algorithms to solve real-time optimization and scheduling problems.
CO3	Design and develop efficient solutions using Dynamic Programming techniques for combinatorial problems.
CO4	Solve resource allocation problems using Greedy algorithms and demonstrate their effectiveness in constrained environments.
CO5	Implement backtracking techniques to solve constraint satisfaction problems such as the N-Queens problem.

ASSESSMENT AND EVALUATION REGULATIONS OF PCCL

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.

CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Web links:

1. https://cse01-iiith.vlabs.ac.in/

B.E. CSE (Data Science)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – IV

Course Title:	MONGODB		
Course Code:	25BCDAE406A	**CIE MARKS**	50
(L :T : P) + SL	(0:0:2)	**SEE MARKS**	50
Credits:	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES:

CO1: Understand basic MongoDB functions, operators and types of operations in MongoDB
CO2: Demonstrate the use of Indexing, Advanced Indexing in MongoDB.
CO3: Apply the aggregation and Map Reduction in MongoDB.
CO4: Demonstrate text searching on collections in MongoDB.

Experiments

1. a. Illustration of Where Clause, AND, OR operations in MongoDB.

b. Execute the Commands of MongoDB and operations in MongoDB: Insert, Query, Update, Delete and Projection. (Note: use any collection)

2. a. Develop a MongoDB query to select certain fields and ignore some fields of the documents from any collection.

b. Develop a MongoDB query to display the first 5 documents from the results obtained in a. [use of limit and find]

3. a. Execute query selectors (comparison selectors, logical selectors) and list out the results on any collection

b. Execute query selectors (Geospatial selectors, Bitwise selectors) and list out the results on any collection

4. Create and demonstrate how projection operators ($, $elematch and $slice) would be used in the MongoDB.

5. Execute Aggregation operations ($avg, $min,$max, $push, $addToSet etc.). students encourage to execute several queries to demonstrate various aggregation operators)

6. Execute Aggregation Pipeline and its operations (pipeline must contain $match, $group, $sort, $project, $skip etc. students encourage to execute several queries to demonstrate various aggregation operators)

7. a. Find all listings with listing_url, name, address, host_picture_url in the listings and Reviews collection that have a host with a picture url

b. Using E-commerce collection write a query to display reviews summary.

8. a. Demonstrate creation of different types of indexes on collection (unique, sparse, compound and multikey indexes)

b. Demonstrate optimization of queries using indexes

9. a. Develop a query to demonstrate Text search using catalog data collection for a given word.

b. Develop queries to illustrate excluding documents with certain words and phrases

10. Develop an aggregation pipeline to illustrate Text search on Catalog data collection.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Make use of MongoDB commands and queries.
CO2	Illustrate the role of aggregate pipelines to extract data.
CO3	Demonstrate optimization of queries by creating indexes.
CO4	Develop aggregate pipelines for text search in collections.

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Textbooks

1. MongoDB: The Definitive Guide", Kristina chodorow, 2nd ed O'REILLY, 2013.

Web links and Video Lectures (e-Resources):

- Installation of MongoDB Video: https://www.youtube.com/watch?v=dEm2AS5amyA
- Video on Aggregation: https://www.youtube.com/watch?v=vx1C8EyTa7Y
- MongoDB in action book Code download URL: https://www.manning.com/downloads/529
- MongoDB Exercise URL: https://www.w3resource.com/mongodb-exercises/

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	MOBILE APP DEVELOPMENT		
Course Code	25BCSAE406B	**CIE MARKS**	**50**
L : T : P	(0:0:2)	**SEE MARKS**	**50**
Credits	1	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

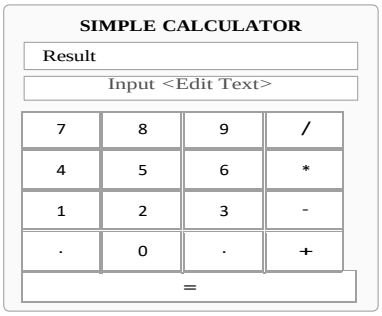
1. Develop basic Android applications by applying fundamental programming concepts and techniques.
2. Configure and use Android Studio IDE for designing, coding and testing mobile applications.
3. Design and implement user interfaces using Android UI components such as layouts, widgets and event handlers.
4. Create and manage local databases using SQLite for data storage and retrieval within Android apps.
5. Demonstrate data sharing techniques by implementing services, content providers and inter-process communication in Android.

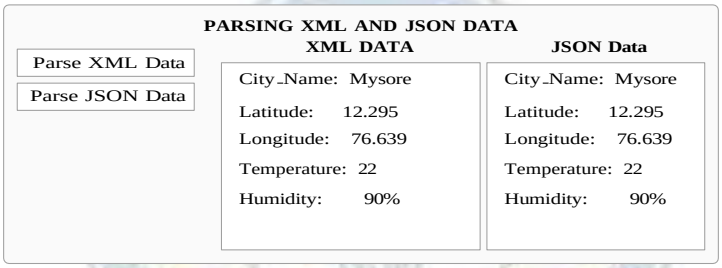
EXPERIMENTS

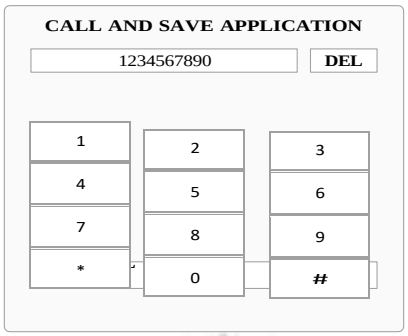
PART A

1. A company wants to create a digital visiting card for its employees to be displayed in its Android application. The card should present the company's branding along with the employee's professional details in a clear and organized format. Design an Android application that displays the visiting card as per the given requirements.

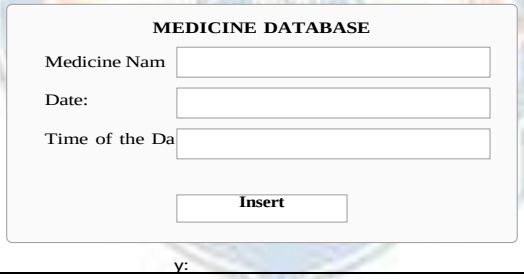
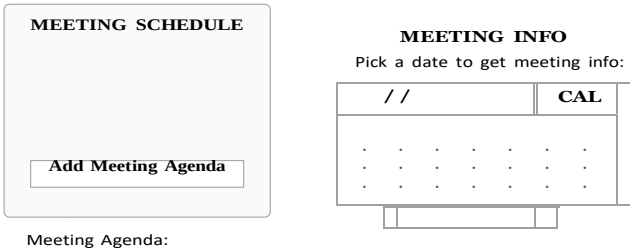


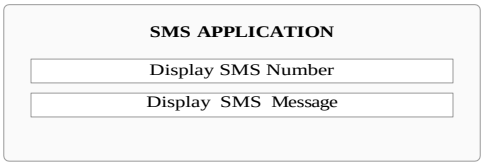
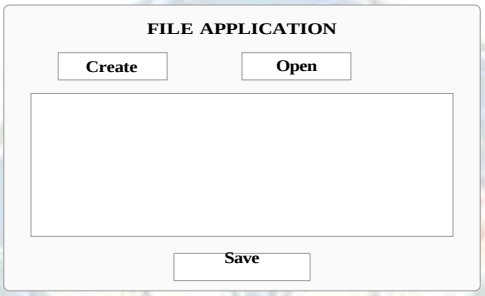
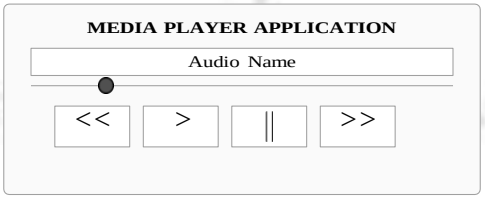
2	A tuition center wants a simple Android application that allows students to perform basic arithmetic calculations during practice sessions. Design an Android application using TextView, EditText, and Button controls to create a calculator that supports Addition, Subtraction, Multiplication, and Division operations. 
3	A company is developing an Android application that requires users to create an account before accessing its services. Design an application with Sign Up and Login activities, where the password is validated based on security requirements. After successful registration, allow users to log in using the created credentials. If the login is successful, display a ”Successful Login” message; otherwise, display appropriate error messages. Restrict users to two login attempts, after which the Sign In button should be disabled. Use a Bundle to transfer the registered user information between activities. 
4	A mobile personalization company wants to develop an Android application that automatically changes the device wallpaper to enhance the user experience. Design an application that allows the user to set wallpapers, where clicking a button starts changing the wallpaper randomly every 30 seconds. 

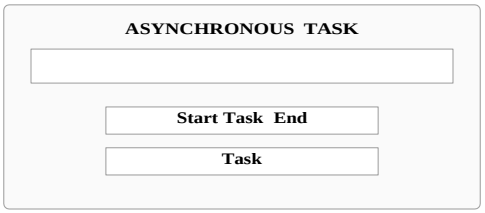
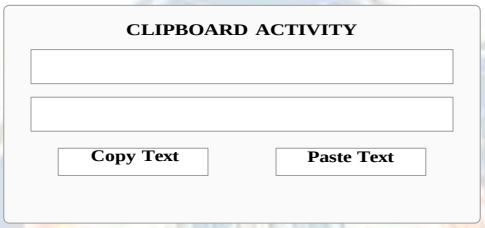
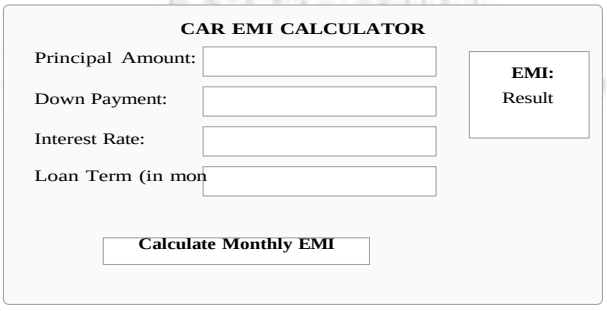
5	A fitness application requires a simple counting feature to help users keep track of repetitions during workouts. Design an Android application with START and STOP buttons, where pressing START begins counting from 1 and continuously updates the count in a TextView until the STOP button is pressed. 
6	A weather monitoring company wants an Android application to compare weather data stored in different file formats. Design an application that reads weather infor-mation from both XML and JSON files. When the respective buttons are clicked, the application should parse the files and display the City Name, Latitude, Longitude, Temperature, and Humidity side by side for easy comparison. 
7	An educational mobile application aims to help users listen to written content for improved accessibility and learning. Design an Android application with an EditText for user input and a ”Convert Text to Speech” button that converts the entered text into spoken audio using the device’s Text-to-Speech feature. 

8	A mobile service provider wants to develop a simple Android dialer application that enables users to quickly make phone calls and save important contact numbers. Design an application with a phone dialer interface containing CALL and SAVE buttons, where the CALL button initiates a phone call to the entered number and the SAVE button stores the number in the device's contacts. 

PART B

1	A healthcare center wants to develop an Android application that helps patients remember to take their medicines on time. Design an application that allows users to enter the Medicine Name, Date, and Time of the Day (Morning, Afternoon, Evening, or Night), store the details in an SQLite database, and automatically trigger an alarm at the scheduled time to display the medicine name as a reminder.  y:
2	A company wants to develop an Android-based meeting management system to help employees organize and access meeting schedules efficiently. Design two Android applications using a Content Provider: one application should allow users to enter and store the Meeting Date, Time, and Meeting Agenda in an SQLite database, while the second application should retrieve and display the Meeting Agenda for a selected date using a Date Picker. If no meeting is scheduled for the selected date, display a toast message stating "No Meeting on this Date.". 

3	A mobile communication company wants to develop an Android application that notifies users whenever they receive a new SMS. Design an application that displays a notification for incoming SMS messages, and when the user taps the notification, the sender's phone number and the message content should be displayed on the screen. Use the Android emulator to simulate sending an SMS to the application. 
4	A note-taking application allows users to create, edit, and manage text files on their device. Design an Android application with a TextBox and Create, Save, and Open buttons. The application should allow users to create a text file, save updates to the same file, and open previously stored content. If the user attempts to save the text before creating a file, display a toast message stating "First Create a File.". 
5	A music streaming company wants to develop a simple Android audio player that provides users with essential playback controls. Design an application that allows users to Play, Pause, Forward, and Backward an audio track. The application should also include a SeekBar that enables users to move to any position in the audio by dragging the progress indicator. 

6	A digital advertising company wants to display promotional messages as a scrolling banner in its Android application without affecting the app's responsiveness. Design an application that demonstrates the use of Asynchronous Tasks by scrolling the banner message "Demonstration of Asynchronous Task" from right to left when the Start Task button is pressed, and stopping the scrolling when the Stop Task button is pressed. 
7	A document editing application requires a feature that allows users to quickly copy and paste text between input fields. Design an Android application using the Clipboard Framework with two EditText controls and Copy and Paste buttons to demonstrate text copying and pasting functionality. 
8	A car dealership wants to develop an Android application that helps customers estimate their monthly car loan repayments before purchasing a vehicle. Design an application that uses an AIDL service to calculate the Car Loan EMI after deducting the down payment from the principal amount. The application should accept the Prin-cipal Amount, Down Payment, Interest Rate, and Loan Term (in months) as inputs, and display the calculated Monthly EMI when the "Calculate Monthly EMI" button is clicked. Additionally, evaluate how the EMI changes for different loan terms and interest rates. 

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Analyze the architecture and components of the Android operating system for mobile application development.
CO2	Develop Android applications using Android Studio by applying appropriate development tools and project structures.
CO3	Analyze the integration of user interface elements and layouts to enhance application usability.
CO4	Implement application navigation and communication using activities, intent
CO5	Execute the testing procedures on Android applications using emulators and real devices.

Descriptions:

1. The installation procedure of the Android Studio/Java software must be demonstrated and carried out in groups.
2. Students should use the latest version of Android Studio/Java/Kotlin to execute these programs. Diagrams given are for representational purposes only, students are expected to improvise on them.
3. Part B programs should be developed as an application and are to be demonstrated as a mini project in a group by adding extra features or the students can also develop their application and demonstrate it as a mini-project. (Projects/programs are not limited to the list given in Part B).

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
Alternate Assessment (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.

SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.
The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40% scored in every component of CIE.			

Textbooks:

1. Google Developer Training Team android Developer Fundamentals Course – Concept Reference, Google Developer Training, 1st Edition, 2017.
2. https://google-developer-training.github.io/...course-concepts/
3. Erik Hellma android Programming – Pushing the Limits, Wiley India Pvt. Ltd., 1st Edition, 2014.
4. Pierre-Olivier Laurence, Amanda Hinchman-Dominguez, Mike Dunn, Programming Android with Kotlin, O'Reilly SPD Publishers, 1st Edition, 2021.

Reference Books:

1. Bill Phillips, Chris Stewart, Kristin Marsicano android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch Guides, 3rd Edition, 2017.
2. Ian F. Darwin android Cookbook: Problems and Solutions for Android Developers, O'Reilly Media, 2nd Edition, 2017.
3. Neil Smyth android Studio 4.2 Development Essentials – Java Edition, Payload Media, 1st Edition, 2021.

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System CBCS) SEMESTER – IV			
Course Title	ADVANCED JAVA		
Course Code	25BCSAE406C	**CIE MARKS**	50
(L : T : P)	(0:0:2)	**SEE MARKS**	50
Credits	1	**EXAM HOURS**	3

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand and demonstrate advanced Java programming concepts such as multi-threading, synchronization.
2. Apply Java collection framework and user-defined classes.
3. Design and develop web applications using Spring Boot.
4. Construct database interactions using Java Database Connectivity.

Program 1 - Thread Synchronization in Simulation Processing

Thread synchronization in simulation processing: Implement thread synchronization where one thread collects sensor data, another processes the data after collection is com-plete and the main thread waits for processing to finish before displaying the final simu-lation status.

Example: Synchronize data collection and processing threads using thread coordination mechanisms.

Program 2 - Custom Sorting Based on Tens Place Value

Custom sorting based on tens place value: Generate a set of random numbers and sort them according to the digit present at the tens place using a custom sorting mechanism.

Example: Sort randomly generated numbers based on their tens place values.

Program 3 - Student Record Management using Collections

Student record management using collections: Develop a student management system using a user-defined class containing USN, Name and Branch and store multiple student objects using the Java Collection Framework.

Example: Store and display multiple student records using an ArrayList.

Program 4 - Library Book Management using Collection Framework

Library book management using collection framework: Develop a library management system to store book details such as Book ID, Title, Author and Price using the Java Collection Framework.

Example Store and display book records using an ArrayList or LinkedList.

Program 5 - GUI Event Handling using Swing
GUI event handling using Swing: Develop a Swing application with two buttons, ”Alpha” and ”Beta”and display an appropriate message when either button is clicked using event handling. Example: Demonstrate Action Listener to respond to button click events.
Program 6 - Cookie Creation and Retrieval
Cookie creation and retrieval: Create a cookie named ”RNSIT” with the value ”RNSIT123” and retrieve the stored cookie information from the client browser. Example: Create and read browser cookies using Java web technologies.
Program 7 - Login Management using Cookies and Sessions in JSP
Login management using cookies and sessions in JSP: Develop a JSP application that stores the username in a cookie and maintains the login session using HTTP Session. Example: Display a personalized welcome message after successful login using cookies and sessions.
Program 8 - Form Handling using Spring Boot and Spring MVC
Form handling using Spring Boot and Spring MVC: Develop a Spring Boot application that accepts user input through an HTML form and displays a personalized greeting using a Spring MVC controller. Example: Accept a username from a form and display a greeting on the next page.
Program 9 - Automated Student Result Computation
Automated student result computation: Develop a web application that accepts student details, calculates the total marks automatically and displays the final result. Example: Enter student marks through a web form and generate the result instantly.
Program 10 - Fetching Student Records from MySQL Database
Fetching student records from MySQL database: Develop a Java application that connects to a MySQL database, retrieves all student records and displays them on the console. Example: Fetch and display all student details using JDBC.
Program 11 - Secure Database Operations using JDBC Prepared Statement
Secure database operations using JDBC Prepared Statement: Develop a Java application that securely inserts and deletes book records using JDBC Prepared Statement. **Example:** Insert a new book record and delete an unavailable book from the database using Prepared Statement.

Program 12 - Student Database Management using JDBC INSERT and DELETE
Student database management using JDBC INSERT and DELETE: Develop a Java ap-plication that performs INSERT and DELETE operations on a student database using JDBC. Example: Add new student records and remove outdated records from the database.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Apply advanced Java concepts such as multithreading and synchronization.
CO2	Implement Java programming concepts using collections and custom sorting techniques.
CO3	Construct applications using the Java Collection Framework to manage user defined objects.
CO4	Design GUI applications using Swing and event handling.
CO5	Develop database-driven and web applications using JDBC, JSP, Cookies, Sessions and Spring Boot.

ASSESSMENT AND EVALUATION REGULATIONS OF AEC

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
Alternate Assessment (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE (A+B)	50	20	Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.
SEE (C)	50	20	SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	100	40	Final marks shall be the sum of marks scored in Components A, B and C.

The minimum marks to be secured in CIE are 20 out of allotted 50 marks to appear for SEE, with minimum 40% scored in every component of CIE.

Textbooks:

1. Herbert Scheldt: JAVA the Complete Reference. 12th Edition, Tata McGraw-Hill. 2021.
2. Jim Keogh, The Complete Reference J2EE, 1st Edition Tata McGraw-Hill 2007.
3. Kathy Sierra, Bert Bates, Headfirst Java, O'Reilly, 2nd Edition.2005.

Reference Books:

1. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2007.
2. Stephanie Bod off et al: The J2EE Tutorial, 2nd Edition, Pearson Education,2004.
3. Uttam K Roy, Advanced JAVA programming, 1st Edition Oxford University press, 2015.

B.E. CSE (Data Science) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	JULIA		
Course Code:	25BCDAE406D	**CIE MARKS**	50
L :T : P:	0:0:2	**SEE MARKS**	50
Credits:	1	**EXAM HOURS**	03

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. To introduce the basics of Julia programming language.
2. To illustrate the data structures of Julia programming language.
3. To make use of built-in functions and packages.

Program 1

a. Develop a Julia program to simulate a calculator (for integer and real numbers).
b. Develop a Julia program to add, subtract, multiply and divide complex numbers. c. Develop a Julia program to evaluate expressions having mixed data types (integer, real, floating-point number and complex).

Program 2

a. Develop a Julia program for the following problem: A computer repair shop charges $100 per hour for labour plus the cost of any parts used in the repair. However, the minimum charge for any job is $150. Prompt for the number of hours worked and the cost of parts (which could be $0) and print the charge for the job.
b. Develop a Julia program to calculate a person's regular pay, overtime pay and gross pay based on the following: If hours worked is less than or equal to 40, regular pay is calculated by multiplying hours worked by rate of pay, and overtime pay is 0. If hours worked is greater than 40, regular pay is calculated by multiplying 40 by the rate of pay, and overtime pay is calculated by multiplying the hours in excess of 40 by the rate of pay by 1.5. Gross pay is calculated by adding regular pay and overtime pay.

Program 3

a. An amount of money P (for principal) is put into an account which earns interest at r% per annum. So, at the end of one year, the amount becomes P + P×r/100. This becomes the principal for the next year.
b. Develop a Julia program which reads numbers from a file (input.txt) and finds the largest number, smallest number, count, sum and average of numbers.

Program 4

a. Develop a Julia program and two separate functions to calculate GCD and LCM.
b. Develop a Julia program and a recursive function to calculate factorial of a number.
c. Develop a Julia program and a recursive function to generate Fibonacci series.

Program 5

a. Develop a Julia program which reads a string (word) and prints whether the word is palindrome.
b. Develop a Julia program which reads and prints the words present in a file (input.txt) having Random Data in which words are dispersed randomly (Assumption: a word is a contiguous sequence of letters. A word is delimited by any non-letter character or end-of-line).

Program 6

a. Develop a Julia program to determine and print the frequency with which each letter of the alphabet is used in a given line of text.
b. Develop a Julia program to generate a plot of mathematical equation: y = sin(x) + sin(2x).

Program 7
a. A survey of 10 pop artists is made. Each person votes for an artist by specifying the number of the artist (a value from 1 to 10). Develop a Julia program to read the names of the artists, followed by the votes, and find out which artist is the most popular. b. Develop a Julia program to generate a plot of (solid & dotted) a function: $y=x^2$ (use suitable data points for x).
Program 8
a. Given a line of text as input, develop a Julia program to determine the frequency with which each letter of the alphabet is used (make use of dictionary) b. Develop a Julia program to fetch words from a file with arbitrary punctuation and keep track of all the different words found (make use of set and ignore the case of the letters: e.g. to and To are treated as the same word)
Program 9
a. Develop a Julia program to evaluate expressions consisting of rational, irrational number and floating point numbers) b. Develop a Julia program to determine the following properties of a matrix: determinant, inverse, rank, upper & lower triangular matrix, diagonal elements, Euclidean norm and Square Root of a Matrix.
Program 10
a. Develop a Julia program to determine addition and subtraction of two matrices (element -wise). b. Develop a Julia program to perform multiplication operation on matrices: scalar multiplication, element wise multiplication, dot product, cross product.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the syntax, environment setup, and fundamental constructs of the Julia language.
CO2	Apply Julia's control structures and functions to develop basic programs.
CO3	Use and manipulate data structures such as arrays, tuples, sets, and dictionaries in Julia.
CO4	Utilize built-in functions and external packages for mathematical and scientific computation.
CO5	Demonstrate the ability to debug, test, and optimize Julia code for problem-solving tasks.

ASSESSMENT DETAILS (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded fora maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**

CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
The minimum marks to be secured in CIE is 20 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Textbooks

1. "Think Julia: How to Think Like a Computer Scientist", Authors: Ben Lauwens, Allen B. Downey, Publisher: O'Reilly Media, ISBN: 9781492045034.
2. Julia Programming Projects, Author: Adrian Salceanu, Publisher: PackPublishing, Description: Intermediate-level book focusing on solving real-world problems using Julia.
3. Mastering Julia, Author: Malcolm Sherrington, Publisher: Packt Publishing.

Reference Links:

1. The Julia Programming Language- https://julialang.org
2. Julia Documentation - https://docs.julialang.org

B.E. (CSE and Allied Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	BIOLOGY FOR ENGINEERS		
Course Code	25BFETH407	**CIE MARKS**	**50**
(L : T : P) + SL	(2:0:0)+(30 Hours/Sem)	**SEE MARKS**	**50**
Credits	2	**EXAM HOURS**	**2**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Familiarize the students with the basic biological concepts and their engineering
2. applications.
3. Enable the students with an understanding of bio design principles to create novel devices and structures.
4. Provide the students an appreciation of how biological systems can be redesigned as substitute products for natural systems.
5. Motivate the students to develop interdisciplinary vision of biological engineering.

Module-1	**6 Hours**
Introduction to fundamentals of life. Structure and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins, Enzymes and Lipids.	
Module-2	**6 Hours**
Introduction to applications of biomolecules: Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics, Nucleic acids in vaccines and diagnosis, Proteins in food production, Enzymes in biosensors fabrication, Genome & protein data types.	
Module-3	**6 Hours**
Introduction to adaptations of anatomical principles for bioengineering design, Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.	
Module-4	**6 Hours**
Introduction to nature inspired biomaterials and mechanisms - Echolocation, Photosynthesis, Bird flying, Lotus leaf effect, Shark skin, Kingfisher beak. Artificial blood - haemoglobin-based oxygen carriers (HBOCs).	
Module-5	**6 Hours**
Introduction to trends in bioengineering, Tissue engineering, stem cells and their appli-cations, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete.	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Corroborate the concepts of biomimetics for specific requirements.
CO2	Understand the basic biological concepts for relevant industrial applications. adaptation.
CO3	Evaluate the principles of design and development, for exploring engineering knowledge in biological.
CO4	Explore innovative biobased solutions for socially relevant problems.

ASSESSMENT AND EVALUATION REGULATIONS OF BSC

1 and 2-Credit Theory Courses (MCQs for assessment)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE - IA Tests (A)	30		Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20		Any two Assessment methods as per 24RNBE4.2, scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks.**
SEE (C)	**50**	**18**	**Question papers having 50 MCQs with each question carrying 01 mark, and Exam duration shall before 2hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE. .			

Textbooks:

1. B. M. Chandra Shekara and B. C. Basavaraju, Basuchandra's Biology for Engineers, 1st Edition, Basuchandra Publishers, 2025.
2. C. Rajendra Singh and N. Rathnakar Rao, Biology for Engineers, 1st Edition, Rajendra Singh C and Rathnakar Rao N Publishing, 2023.

Reference Books:

1. Stuart Fox and Krista Rompolski, Human Physiology, 16th Edition, McGraw-Hill Education, 2022.
2. S. Thyagarajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, W. Thilagaraj, S. Barathiand M. K. Jaganthan, Biology for Engineers, 1st Edition, Tata McGraw-Hill, 2012.
3. Arthur T. Johnson, Biology for Engineers, 1st Edition, CRC Press, 2011.
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall, 2011.
5. Sohini Singh and Tanu Allen, Biology for Engineers, 1st Edition, Vayu Education of India, 2014.
6. Yoseph Bar-Cohen, Biomimetics: Nature-Based Innovation, 1st Edition, CRC Press, 2012.
7. Dario Floreano and Claudio Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methodsand Technologies, 1st Edition, MIT Press, 2008.
8. C. R. Sunilkumar, N. Geethaand A. C. Udayashankar, Bioremediation of Heavy Metals: Bacterial Participation, 1st Edition, Lambert Academic Publishing, 2019.

B.E. (Common to all Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	NATIONAL SERVICE SCHEME		
Course Code	25BNSSP409	**CIE MARKS**	**100**
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	–
Credits	–	**EXAM HOURS**	–

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Identify the needs and problems of the community and participate in problem-solving activities.
2. Develop a sense of social and civic responsibility and utilize knowledge to find practical solutions to individual and community problems.
3. Develop the competencies required for group living and sharing responsibilities, and gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Module-1
Environment Issues and Role of NSS
Module-2
Disaster Management and Role of NSS
Module-3
Activities-1 (Choose from Activity List)
Module-4
Activities-2 (Choose from Activity List)
Module-5
Activities-3 (Choose from Activity List)

ACTIVITY LIST	
Helping local schools achieve good results and enhance their enrolment in Higher/Technical/Vocational Education.	Preparing an actionable business proposal for enhancing the village income.
Reduction in energy consumption.	Preparing an actionable business proposal for enhancing the village's income.
Creating awareness about rainwater harvesting in urban and rural areas.	Developing a Sustainable Water Management System.

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS.
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation.
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Plan and implement government initiatives or self-driven projects effectively in real-life community settings.
CO5	Communicate effectively with the community and with the officials.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each con-ducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Reference Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Web Links:

1. https://nss.gov.in/
2. https://pledge.mygov.in/

B.E. (Common to all Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	PHYSICAL EDUCATION		
Course Code	25BPEDU409	**CIE MARKS**	**100**
(L:T:P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	—
Credits	—	**EXAM HOURS**	—

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

1. Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness.
2. Familiarization of health-related Exercises, Sports for overall growth and development.
3. Participate in the competition at regional/state / national / international levels.
4. Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Module-1: Title: Athletics - Track Events - Relays	**3 Hours**

Relays

1. Relay Race: Starting, Baton Holding/Carrying, Baton Exchange in between zoneand Finishing.

Module-2: Title: Athletics - Triple Jumps	**3 Hours**

Triple Jump

A) Approach Run
B) Take-off
C) Step
D) Flight in the Hop
E) Jump and Landing

Module-3: Title: Athletics - Throws	**3 Hours**

Javelin Throw

A) Grip
B) Carry and Recovery (3/5 Impulse stride)
C) Release

Module-4: Title: CRICKET	**3 Hours**

A. Fundamental skills

1. Batting - Forward Defense Stroke, Backward Defense Stroke, Off Drive, On Drive, Straight Drive, Cover Drive, Square Cut.
2. Bowling - Out-swing, In-swing, Off Break, Leg Break and Googly.
3. Fielding: Catching - The High Catch, The Skim Catch, The Close Catch and throwing at the stumps from different angles. Long Barrier and Throw, Short Throw, Long Throw, Throwing on the Turn.
4. Wicket Keeping.

B. Rules and their interpretation and duties of the officials

Module-5: Title: BASEBALL	**3 Hours**

A. Fundamental skills

1. Player Stances – walking, extending walking, L stance, cat stance.
2. Grip – standard grip, choke grip.
3. Batting – swing and bunt. Pitching.
4. Baseball: slider, fast pitch, curve ball, drop ball, rise ball, change up, knuckle ball, screw ball.

B. Rules and their interpretation and duties of the officials

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Demonstrate the techniques of relay races, including starting, baton holding, exchange within the zoneand finishing, along with basic skills of javelin throw.
CO2	Apply the fundamental techniques of triple jump, including approach run, take-off, hop, step, jump, flightand landing.
CO3	Develop and perform javelin throw techniques, including grip, carry, impulse stride, releaseand recovery with proper coordination.
CO4	Exhibit fundamental skills of cricket, including batting, bowling, fielding, wicket keepingand understand rules and duties of officials.
CO5	Demonstrate basic skills and techniques in baseball, including player stances, grip, batting, pitchingand understand rules and officiating.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE IA Tests (A)	60	—	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	———
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. Health and Physical Education by V.K. Sharma.
2. Introduction to Physical Education, Fitnessand Sport by Daryl Siedentop.
3. Physical Education Activities, Sports and Games: The Origin and Background, Rules of Play, Teaching Hints and Fundamentals by Louis E. Means.

Reference Books:

1. Saraswati Health and Physical Education Textbook.
2. Foundations of Physical Education, Exercise Science and Sport by Deborah A. Wuest.

B.E. (Common to all Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	**YOGA**		
Course Code	**25BYOGA409**	**CIE MARKS**	**100**
(L:T:P) + SL	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**—**
Credits	**—**	**EXAM HOURS**	**—**

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Physical, Mental and Spiritual objectives of Yoga.
2. Explain the meaning of Yoga.
3. Discuss the importance of Yoga and its scope.
4. Describe the aims and objectives of Yoga.
5. Clarify the misconceptions on Yoga.

Module-1: Title: Suryanamaskara **3 Hours**

Suryanamaskara - Revision of practice 12 count 8 rounds

a) Suryanamaskar prayer.

b) Meaning, need & Importance

c) Benefits of Suryanamaskara

Module-2: Title: Asanas **3 Hours**

Need & importance of different Asana, Asana its meaning by name, technique, precautionary measures and benefits of each asana.

Sitting:

1. Bakasana
2. Hanumanasana
3. Yogamudra in Vajrasana

Standing:

1. Vatayanasana
2. Garudasana

Module-3: Title: Asanas	3 Hours
Need, importance of Asana. Different types, Asana by name, technique, precautionary measures and benefits of each asana **Prone line** 1. Bhujangasana 2. Shalabh asana **Supine line** 1. Utthita dvipadasana, 2. Ardha halasana **Balancing** 1. Sheershasana	
Module-4: Title: Pranayama	**3 Hours**
Kapalabhati - Revision of Kapalabhati practice 80 strokes/min 3 rounds	
Module-5: Title: Pranayama	**3 Hours**
Pranayam 1. Bhastrika 2. Bhramari Meaning, Need, importance of Pranayama. Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the meaning, objectives, scopeand importance of Yoga, including its physical, mentaland spiritual benefits and misconceptions.
CO2	Demonstrate Suryanamaskara (12 counts, 8 rounds) with correct technique, prayerand understanding of its need and benefits.
CO3	Perform sitting and standing Asanas (Bakasana, Hanumanasana, Yogamudra in Vajrasana, Vatayanasana, Garudasana) with proper technique, precaution-sand benefits.
CO4	Execute prone, supineand balancing Asanas (Bhujangasana, Shalabhasana, Utthita Dvipadasana, Ardha Halasana, Sheershasana) with correct body align-ment and safety measures.
CO5	Practice Pranayama techniques (Kapalabhati, Bhastrika, Bhramari) with proper method, breathing controland understanding of their importance and health benefits.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	—	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	——
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. The Yoga Sutras of Patanjali by Sri Swami Satchidananda.
2. Light on Yoga by B.K.S. Iyengar.

Reference Books:

1. The Heart of Yoga by T.K.V. Desikachar.
2. Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati.

B.E. (Common to all Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	MUSIC		
Course Code	25BMUSK409	**CIE MARKS**	**100**
(L : T : P) + SL	(0:0:0)+(30 Hours/Sem)	**SEE MARKS**	—
Credits	—	**EXAM HOURS**	—

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Understand the significance of music in daily life and gain an overview of Indian folk, contemporary, and Western music traditions.
2. Acquire basic knowledge of introductory Carnatic music exercises and compositions.
3. Compare the fundamental features of Carnatic and Hindustani music.
4. Recognize the classification of wind instruments and appreciate the contributions of eminent composers to Indian classical music.

Module-1	**3 Hours**
Importance of music in daily life ,Indian folk, and contemporary music.Introduction to Western music.	
Module-2	**3 Hours**
Compositions: Introduction to the few types of composition in Carnatic Music- Nottu Swara, Sarale and janti varase, Alakara.	
Module-3	**3 Hours**
Comparative Study of Carnatic and Hindustani Music based on Geographical origin and development , Musical structure and style ,Raga and Tala systems.	
Module-4	**3 Hours**
Music Instruments: Classification and construction of wind instrurnents in both Car-natic and Hindustani Music.	
Module-5	**3 Hours**
Composers: Biography and contributions of of the following eminent personalities Mut-tuswami Dikshitaru , Shyama Shastri, Mysore Vasudevacharya, Pt. Bheemasen Joshi	

COURSE OUTCOMES

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution and fundamental concepts of Indian classical music.
CO2	Compare and distinguish the characteristics of selected Carnatic and Hindustani music compositions.
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music.
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Project (B)	40	—	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass.			

Textbooks:

1. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana-Vol. 1 (English), Shreenivaas Prakaashana, 2018.
2. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Government of India, New Delhi.

Reference Books:

1. Lakshminarayana Subramaniam, Viji Subramanaim, Classical Music of India: A Practical Guige, Tranqueber 2018.
2. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai.

B.E. (Common to all Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title	ADDITIONAL MATHEMATICS-II		
Course Code	25BMADP410	**CIE MARKS**	100
(L : T : P) + SL	(1:0:0)+(14 Hours/Sem)	**SEE MARKS**	–
Credits	–	**EXAM HOURS**	–

COURSE LEARNING OBJECTIVES

The purpose of the course is to facilitate the learner to:

1. Apply the fundamental concepts of linear algebra to solve systems of linear equations and analyze mathematical models.
2. Solve second-order and higher-order ordinary differential equations using appropriate analytical methods in engineering applications.
3. Develop the knowledge and problem-solving skills required to evaluate multiple integrals and apply the change of order of integration.
4. Apply numerical methods to obtain approximate solutions to mathematical problems arising in science and engineering.

Module-1

Linear Algebra: Introduction, rank of a matrix by elementary row operations, echelon form, consistency of systems of linear equations, Gauss elimination method, eigenvalues and eigenvectors of a square matrix and problems.

Module-2

Numerical Methods: Finite differences, interpolation/extrapolation using Newton's forward and backward difference formulae (statements only), solution of polynomial and transcendental equations using Newton–Raphson and Regula–Falsi methods (formulae only) with illustrative examples, numerical integration using Simpson's one-third rule (without proof)and problems.

Module-3

Higher Order Ordinary Differential Equations: Linear differential equations of second and higher order with constant coefficients, homogeneous and non-homogeneous equations, inverse differential operatorsand particular integral restricted to $R(x) = e^{ax}$, sin $ax$and cos ax for $f(D)y = R(x)$.

Module-4

Double Integrals: Definition, evaluation over rectangular and general regionsand change of order of integration.

Module-5

Triple Integrals: Definition, evaluation over simple regionsand applications of triple integrals to the evaluation of volumes.

COURSE OUTCOMES

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

CO1	Solve systems of linear equations using matrix algebra.
CO2	Apply the knowledge of numerical methods in modelling and solving engineering problems.
CO3	Apply analytical methods to solve higher-order differential equations.
CO4	Solve double integrals, including change of order of integration.
CO5	Solve triple integrals and evaluate volumes of geometrical regions.

ASSESSMENT AND EVALUATION REGULATIONS OF NCMC

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE - IA Tests (A)	60	-	Sum of Two Internal Assessment Tests (MCQs) each con-ducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods as per 24RNBE4.2, scaled to 40 marks.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks.
The minimum marks to be secured in CIE is 40 (40%) out of allotted 100 marks to Pass.			

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2015.
2. N. P. Bali and Manish Goyal, Engineering Mathematics, 7th Edition, Laxmi Publishers, 2007.
3. Rohit Khurana, Engineering Mathematics, Vol. I, 1st Edition, Cengage Learning, 2015.

Additional Mathematics I and II:

1. These courses are prescribed for III and IV semesters, respectively, for lateral entry Diploma holders admitted to the III semester of B.E./B.Tech. programmes. Students shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case a student fails to register for the course or fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such cases, the student shall fulfill the course requirements during subsequent semesters to earn the qualifying CIE marks. These courses are prescribed for CIE only and have no Semester End Examination (SEE).
2. Additional Mathematics I and II shall not be considered for vertical progression or for the calculation of SGPA and CGPA. However, successful completion of these courses is mandatory for the award of the degree.
3. Successful completion of Additional Mathematics I and II shall be indicated as Satisfactory in the grade card. Non-completion of these courses shall be indicated as Unsatisfactory.



VISION

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MISSION

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions.
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class professionals with social responsibility.
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students.
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