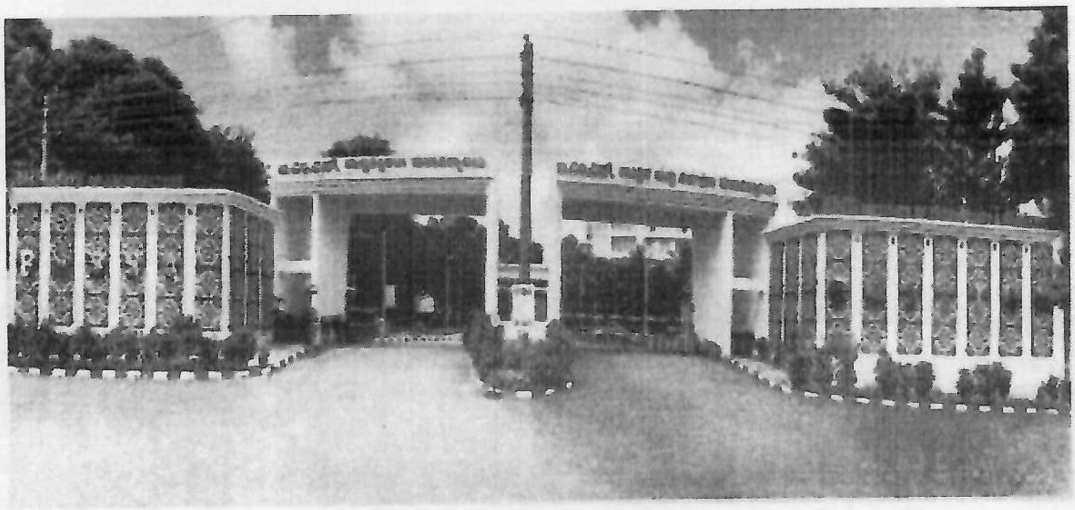
BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE New Delhi)

Yelahanka, Bengaluru 560119



Bachelor of Engineering

Department of Computer Science and Engineering

IV Semester Scheme and Syllabus 2022 Scheme

Effective from the AY 2025-26

Approved in the BoS Meeting Held on 31st - January -2026

Vision and Mission of the Department

Vision:

To be a centre of excellence in Computer Science and Engineering education and research, nurturing technically competent, ethically responsible, and socially conscious professionals to meet global challenges and drive sustainable innovation.

Mission:

M1. To impart quality education in Computer Science and Engineering by integrating fundamental knowledge with emerging technologies and industry practices.

M2. To foster innovation, problem-solving, and research aptitude through a curriculum enriched with project-based learning, professional activities, and collaborative initiatives.

M3. To develop graduates with strong ethical values, leadership qualities, and a commitment to lifelong learning through co-curricular and extra-curricular activities.

Program Educational Objectives (PEOs)

PEO'S	
PEO1	**Professional Excellence:** Pursue successful careers in industry, academia, and entrepreneurship by applying the foundational knowledge of Computer Science and Engineering with professional competence.
PEO2	**Higher Education and Lifelong Learning:** Engage in higher studies, research, or professional development programs, demonstrating a commitment to lifelong learning in a rapidly evolving technological landscape.
PEO3	**Ethics and Social Responsibility:** Exhibit ethical behaviour, effective communication, teamwork, and leadership qualities, with a strong sense of responsibility toward society and the environment.

Program Specific Outcomes (PSOs)

PSO'S	
PSO-1	Apply theoretical foundations, Algorithmic principles and software engineering practices to develop efficient and scalable IT solutions.
PSO-2	Design effective systems by leveraging principles of computing and communication technologies.

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BMS Institute of Technology and Management
(An Autonomous Institution, Affiliated to VTU Belagavi)
Avalahalli, Doddaballapur Main Road, Bengaluru, Karnataka – 560064

REVISED

Date: 18-12-2024

CONTINUOUS INTERNAL EVALUATION (CIE)
AND
SEMESTER END EXAMINATION (SEE) PATTERN

(Applicable to UG students admitted from the 2022 batch, effective from the Academic year 2024-25 onwards)

The UG students admitted from the 2022 batch onwards are hereby informed to note the following regarding Continuous Internal Evaluation and Semester End Examination pattern:

- The Weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Examination (SEE) is 50%.
- The Minimum passing mark for the CIE is 40% of the Maximum marks (i.e. 20 marks out of 50) and for the SEE minimum passing mark is 35% of the Maximum marks (i.e. 18 out of 50 marks).
- A student will be declared to have passed the course if they secure a minimum of 40% (i.e. 40 marks out of 100) in the combined total of the CIE and SEE.

The following tables summarize the CIE and SEE Patterns for the courses of various credits:

IPCC COURSES: 4 CREDITS OR 3 CREDITS						
Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Theory Component	CIE – IA Tests	CIE – Test 1 (1.5 hr)	40	20	-	The sum of the two internal assessment tests will be **80 Marks** and the same will be scaled down to **20 Marks**.
		CIE – Test 2 (1.5 hr)	40			

	CIE – CCA (Comprehensive Continuous Assessment)	CCA	10	05	-	Any one assessment method can be used from the list appended below.
	Total CIE Theory			**25**	**10**	
Practical Component	CIE - Practical		30	15	-	Each laboratory experiment is to be evaluated for **30 Marks** using appropriate rubrics.
	CIE Practical Test		20	10	-	One test after all experiments to be conducted for **20 Marks**
	Total CIE Practical			**25**	**10**	
Total CIE Theory + Practical				**50**	**20**	
SEE			100	50	18	SEE exam is a theory exam, conducted for **100 Marks**, scored marks are scaled down to **50 Marks.**
CIE + SEE				**100**	**40**	
The laboratory component of the IPCC shall be for CIE only.						

Professional Core Courses (PCC) / Engineering Science Courses (ESC): 03 and 02 Credit						
Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Theory Component	CIE – IA Tests	CIE – Test 1 (1.5 hr)	40	30	-	The sum of the two internal assessment tests will be **80 Marks** and the same will be scaled down to **30 Marks**.
		CIE – Test 2 (1.5 hr)	40			
	CIE - CCAs	CCA	20	20	-	Any Two assessment methods can be used from the list. If it is project-based, one CCA shall be given.
	Total CIE Theory			**50**	**20**	
SEE			100	50	18	SEE is a theory exam, conducted for **100 Marks**, scored marks are scaled down to **50 Marks.**
CIE + SEE				**100**	**40**	

NON-IPCC COURSES: 01 Credit Course - MCQ						
Evaluation Type		**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Continuous Internal Evaluation Component	CIE – IA Tests (MCQs)	CIE – Test 1 (1 hr)	40	40	-	The question paper pattern for this course shall be an **MCQ** of **1 or 2 Marks (s).** The questions with 2 Marks can be framed based on a higher Bloom's level. The sum of the two internal assessment tests will be **80 Marks**, and the same will be scaled down to **40 Marks**.
		CIE – Test 2 (1 hr)	40			
	CIE - CCAs	CCA	10	10	-	Any One Assessment method can be used from the list provided below.
	Total CIE			**50**	**20**	
SEE (MCQ Type)				50	18	The question paper pattern for this course shall be an **MCQ** of **1 or 2 Marks (s).** The questions with 2 Marks can be framed based on higher Bloom's level. MCQ-type question papers of 50 questions with each question of a **01 Mark**, examination duration is 01 hour.
CIE + SEE				**100**	**40**	

Professional Core Course Laboratory (PCCL) /Ability Enhancement Course Laboratory (AEC) - 01 Credit					
Evaluation Type	**Internal Assessments (IAs)**	**Test/ Exam Marks Conducted for**	**Marks to be scaled down to**	**Min. Marks to be Scored**	**Evaluation Details**
Continuous Internal Evaluation	CIE - Practical	30	30		Each laboratory experiment is to be evaluated for **30 Marks** using appropriate rubrics.
	CIE - Practical Test	50	20		One test after all experiments is to be conducted for **50 Marks** and to be scaled down to **20 Marks**.
	Total CIE	-	**50**	**20**	
Semester End Examination		100	50	18	SEE to be conducted for **100 Marks**.
CIE+SEE		**100**		**40**	

Learning Activities for CCAs:
A faculty member may choose the following CCAs based on the needs of the course:

1. Course project
2. Literature review
3. MOOC
4. Case studies
5. Tool exploration
6. GATE-based aptitude test
7. Open book tests
8. Industry integrated learning
9. Analysis of Industry / Technical / Business reports
10. Programming assignments with higher Bloom level
11. Group discussions
12. Industrial / Social / Rural projects

CoE 18/12/2024

Dean AA 18.12.24

Principal 18/12/24

Copy To:
1. The Vice-Principal, Deans, HoDs, and Associate HoDs
2. All faculty members and students of 2022, 2023, and 2024 batch
3. Examination Section

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institution Affiliated to VTU, Belagavi)

B. E. Computer Science and Engineering

Scheme of Teaching and Examinations – 2022 Scheme

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2025-26 onwards)

UG PROGRAM: Department of Computer Science and Engineering **IV SEMESTER**

Sl. No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours					Examination				Credits
					L	T	P	S	Total	CIE Marks	SEE Marks	Total Marks	SEE Duration (H)	
1	PCC/BSC	BCS401	Analysis & Design of Algorithms	TD: CS PSB : CS	40	0	0	52	90	50	50	100	3	3
2	IPCC	BCS402	Microcontrollers	TD: CS PSB : CS	40	0	28	52	120	50	50	100	3	4
3	IPCC	BCS403	Database Management Systems	TD: CS PSB : CS	40	0	28	52	120	50	50	100	3	4
4	PCCL	BCSL404	Analysis & Design of Algorithms Lab	TD: CS PSB : CS	0	0	28	2	30	50	50	100	3	1
5	ESC	BCS405x	ESC/ETC/PLC	TD: CS/Maths PSB : CS/Maths	40	28	0	22	90	50	50	100	3	3
6	AEC/ SEC	BCS456x	Ability Enhancement Course/Skill Enhancement Course- IV	TD: Concerned Department PSB:CS	If the course is Theory				30	50	50	100	1	1
					14	0	0	16						
					If the course is a lab				30				2	
					0	0	28	2						
7	BSC	BBOC407	Biology for Information Technology	TD / PSB: BT, CHE,	28	0	0	32	60	50	50	100	3	2
8	UHV	BUHK408	Universal human values course	Any Department	14	0	0	16	30	50	50	100	1	1
9	MC	BNSK459	National Service Scheme (NSS)	NSS coordinator	0	0	28	0	28	100	---	100		0
		BPEK459	Physical Education(PE)(Sports and Athletics)	Physical Education Director										
		BYOK459	Yoga	Yoga Teacher										
		BMUK459	Music	Music Teacher										
		BNCK459	National Credit Corps (NCC)	NCC Coordinator										
			Total							**500**	**400**	**900**		**19**
			Non-Credit Mandatory Course (NCMC)Prescribed to Lateral entry Diploma Students											
10	NCMC	BENGD1P2	English Communication Skill-II	HSS	0	0	28	0	28	**100**	---	**100**		**0**
			The Lateral entry diploma students admitted to III semester are required to complete the English Communication skill -I in the III Semester and English Communication Skill -II in the IV Semester shall be considered for Vertical Progression as well as for the calculation of SGPA & CGPA ,But Completion of Course shall be mandatory for the award of degree.											

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L**: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

Ability Enhancement Course / Skill Enhancement Course – IV			
BCS456A	Green IT and Sustainability	BCS456E	Advanced Programming Skills using C++
BCS456B	Capacity Planning for IT	BCS456F	Introduction to Java
BCS456C	UI/UX (Lab)	BCS456G	Unix System Programming
BCS456D	Technical writing using LATEX (Lab)		
Engineering Science Course (ESC/ETC/PLC)			
BCS405A	Discrete Mathematical Structures	BCS405C	Optimization Technique
BCS405B	Graph Theory	BCS405D	Linear Algebra

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P : S) can be considered as (40 : 0 : 28 : 52) or (3 : 0 : 1: 0). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B. Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

IV SEMESTER SYLLABUS

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

ANALYSIS & DESIGN OF ALGORITHMS (40:0:0:52) 3

(Effective from the academic year 2025 -26)

Course Code	**BCS401**	CIE Marks	50
Teaching Hours(L:T:P:S)	40:0:0:52	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory	Exam Hours	3 Hours
Examination Nature	Theory		

Course Objectives:

This course will enable students to:

1. Explain the methods of analyzing the algorithms and to analyze performance of Algorithms.
2. State algorithm's efficiencies using asymptotic notations.
3. Solve problems using algorithm design methods such as the brute force method, greedy method, divide and conquer, decrease and conquer, transform and conquer, Dynamic programming, backtracking and branch and bound.
4. Choose the appropriate data structure and algorithm design method for a specified Application.
5. Introduce P and NP classes.

Preamble:

The advancement in science and technology enhance the performance of processor, which proportionally affect the characteristics of computer system, such as security, scalability and reusability. Important problems such as sorting, searching, string processing, graph problems, Combinational problems, numerical problems are basic motivations for designing algorithm and analyzing it. Since algorithm design techniques are growing at a fast pace, it has become important for IT professionals to upgrade their knowledge in order to meet growing industry demand.

Module-1

Introduction: What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework- Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency.

Performance Analysis: Estimating Space complexity and Time complexity of algorithms.

Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (**θ**) with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples problems. **Brute force design technique:** Selection sort, sequential search, string matching algorithm with complexity Analysis.

Textbook 1: Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2) Textbook 2: Chapter 1(section 1.1,1.2,1.3) (10 Hours)

Module-2

Divide and Conquer: General method, Recurrence equation for divide and conquer, solving it using Master's theorem, Divide and Conquer algorithms and complexity Analysis, Finding the maximum &minimum, Binary search, Merge sort, Quick sort.

Decrease and Conquer Approach: Introduction, Insertion sort, Topological Sorting. It's efficiency analysis.

Textbook 2: Chapter 3(Sections 3.1,3.2,3.3,3.4,3.5)

Textbook 1: Chapter 4 (Sections 4.1,4.2), Chapter 5(Section 5.1,5.2) (8 Hours)

Module-3

Greedy Method: General method, Coin Change Problem, Knapsack Problem, solving Job sequencing with deadlines Problems.

Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm with performance

analysis.
Single source shortest paths: Dijkstra's Algorithm. **Optimal Tree problem:** Huffman Trees and Codes.
Transform and Conquer Approach: Introduction, Heaps and Heap Sort.
Textbook 2: Chapter 4(Sections 4.1,4.2,4.4)
Textbook 1: Chapter 9 **(8 Hours)**

Module – 4

Dynamic Programming: General method with Examples, Multistage Graphs, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem, Optimal Binary tree method.
Textbook 2: Chapter 5 (Sections 5.1, 5.2, 5.4, 5.7, 5.9)
Textbook 1: Chapter 8(Section 8.3) **(7 Hours)**

Module – 5

Backtracking: General method, solution using back tracking to N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles Problems.
Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem.
NP-Complete and NP-Hard problems: Basic concepts, non- deterministic algorithms, P, NP, NP-Complete, and NP- Hard classes.
Textbook 2: Chapter 7 (Sections 7.1,7.2,7.3,7.4,7.5) Chapter 11 (Section 11.1)
Textbook 1: Chapter 12 (Sections 12.1,12.2) Chapter 11(11.3) **(7 Hours)**

Course Outcomes:
At the end of the course the student will be able to:
CO1: Make use of asymptotic notations and mathematically represent the complexity of the algorithm and explore the various classes (P, NP, NP Complete and NP Hard) problems.
CO2: Apply divide & conquer and decrease & conquer approaches to solve the computational problems
CO3: Analyze backtracking, branch & bound, Greedy Method, transform & conquer and dynamic programming techniques to solve real world problems.
CO4: Devise solutions for problems using suitable algorithm design techniques.

Text Books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, 2022. Pearson.
2. Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Reference Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford 2nd Edition , 2023

Continuous Comprehensive Assessments (CCA):

Students should submit a comprehensive report on Problems solved using various algorithmic design techniques using Leet code. Each student is required to solve six problems using LeetCode platform, consisting of two Easy, two Medium, and two Hard level problems. An Assessment test will be conducted for 10 marks and Report carries 10 Marks. The total weightage for this assessment is 20 marks.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

MICROCONTROLLERS (40:0:28:52) 4

(Effective from the academic year 2025 -26)

Course Code	**BCS402**	CIE Marks	50
Teaching Hours (L:T:P:S)	**40:0:28:52**	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory + 28 Hours Practical	Exam Hours	3 Hours
Examination Nature	Theory		

Course Objectives:

This course will enable students to:

1: Understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC.

2: Familiarize with ARM programming modules along with registers, CPSR and Flags.

3: Develop ALP using various instructions to program the ARM controller.

4: Understand the Exceptions and Interrupt handling mechanism in Microcontrollers.

5: Discuss the ARM Firmware packages and Cache memory policies.

Module – 1

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

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

Textbook 1: Chapter 1 - 1.1 to 1.4, Chapter 2 - 2.1 to 2.5

RBT: L1, L2, L3 **(8 Hours)**

Module – 2

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

Textbook 1: Chapter 3 - 3.1 to 3.6

RBT: L1, L2, L3 **(8 Hours)**

Module – 3

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

Textbook 1: Chapter 5.1 to 5.5 and 5.13

RBT: L1, L2, L3 **(8 Hours)**

Module – 4

Exception and Interrupt Handling: Exception handling, ARM processor exceptions and modes, vector table, exception priorities, link register offsets, interrupts, assigning interrupts, interrupt latency, IRQ and FIQ exceptions, basic interrupt stack design and implementation.

Textbook 1: Chapter 9.1 and 9.2

RBT: L1, L2, L3 **(8 Hours)**

Module – 5

Caches: The Memory Hierarchy and Cache Memory, Caches and Memory Management Units:

CACHE Architecture: Basic Architecture of a Cache Memory, Basic Operation of a Cache Controller, The Relationship between Cache and Main Memory, Set Associativity, Write Buffers, Measuring Cache Efficiency, CACHE POLICY: Write Policy—Writeback or Writethrough, Cache Line Replacement Policies, Allocation Policy on a Cache Miss. **Textbook 1: Chapter 12.1 to 12.3** **RBT: L1, L2, L3** **(8 Hours)**	
Course outcomes (Course Skill Set): At the end of the course, the student will be able to: CO1: Illustrate the design philosophy adapted by ARM processors in embedded systems CO2: Use embedded system principles to handle exceptions, manage interrupts and memory, and interface peripherals effectively. CO3: Develop the assembly language programs using ARM and THUMB instructions set and simulate the same. CO4: Identify efficient techniques and rules for writing C code which improves performance of ARM processors to interface the hardware.	
Practical Component of IPCC:	
PART A	
Software:	
1	Develop and simulate ARM ALP for Data Transfer, Arithmetic and Logical operations (Demonstrate with the help of a suitable program).
2	Develop an ALP to multiply two 16-bit binary numbers.
3	Develop an ALP to find the sum of first 10 integer numbers.
4	Develop an ALP to find the largest/smallest number in an array of 32 numbers
5	Develop an ALP to count the number of ones and zeros in two consecutive memory locations.
6	Simulate a program in C for ARM microcontroller using KEIL to sort the numbers in ascending/descending order using bubble sort.
7	Simulate a program in C for ARM microcontroller to find factorial of a number.
Hardware: Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.	
1	Control a light or appliance using a phone or browser via Wi-Fi.
2	Automatically control a DC motor fan using the onboard NTC temperature sensor
3	Use an onboard accelerometer to sense tilt and rotate the stepper motor in clockwise and anti-clockwise direction.
4	Recognize a clap sound using MIC input and basic edge-AI pattern recognition.
5	Emulate a vehicle wiper using a servo motor controlled by PWM.
6	Generate sine, triangle, and square waves using onboard DAC and analyse on oscilloscope.

PART B
Open ended experiment : 1. Analyze the interrupt latency of **FIQ vs IRQ** in LPC2148 using software simulation. 2. Simulate a program in C for ARM microcontroller using KEIL to search/sort the elements. 3. Simulate a program in C for ARM microcontroller using KEIL to perform basic arithmetic operations using functions. 4. Develop an ALP to sort/search the element
Text Books: 1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008. **Reference Books:** 1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication, 2019. 2. Insider's Guide to the ARM7 based microcontrollers, Hitex Ltd.,1st edition, 2005.
Continuous Comprehensive Assessments (CCA): ·Students should **implement a project using sensors** and conduct experiments to demonstrate functionality (10 marks) ·A **comprehensive report** on the implemented project must be submitted.(10 marks)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

DATABASE MANAGEMENT SYSTEM (40:0:28:52) 4

(Effective from the academic year 2023 -24)

Course Code	**BCS403**	CIE Marks	50
Teaching Hours (L:T:P:S)	**40:0:28:52**	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory + 28 Hours Practical	Exam Hours	100
Examination Nature	Theory		

Course objectives:

This course will enable students to :

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

MODULE-1

Preamble: Database Management Systems course is intended to deliver students the elementary concepts of a database management system and equips them to design and implement a database application built over those concepts. It also introduces advanced level areas like transaction processing, concurrency control and recovery management.

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.

Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.

Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams, Specialization and Generalization.

Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10 **(8 Hours)**

MODULE-2

Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.

Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.

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

Textbook 1: Ch 5.1 to 5.3, Ch 8.1 to 8.5; Ch 9.1 to 9.2
Textbook 2: 3.5

(8 Hours)

MODULE-3

Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and

Fifth Normal Form. **Textbook 1: Ch 14.1 to 14.7, Ch 6.1 to 6.5**	**(8 Hours)**
MODULE-4	
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 **SQL: Advanced Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL. **Textbook 1: Ch 6.1 to 6.5,Ch 7.1 to 7.3**	**(8 Hours)**
MODULE-5	
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, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking. **Textbook 1: Ch 20.1 to 20.6,Ch 21.1 to 21.5**	**(8 Hours)**
Continuous Comprehensive Assessments (CCA): Students are required to solve a curated set of **six problems** on the Leet Code platform that simulate Database related logic. You must document your approach, time/space complexity analysis, and successful submission proofs in a comprehensive report. An Assessment test will be conducted for 10 marks and the Report carries 10 Marks. The total weightage for this assessment is 20 marks.	

PRACTICAL COMPONENT OF IPCC

PART A	
Sl.NO	**Experiments**
1	Create a table called Employee & execute the following. **Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)** 1. Create a user and grant all permissions to the user. 2. Insert the any three records in the employee table contains attributes EMPNO, ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. 4. Insert null values to the employee table and verify the result.
2	Create a table called Employee that contain attributes EMPNO, ENAME, JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employee table. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. 5. Delete the employee whose Empno is 105.

3	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. **Employee(E_id, E_name, Age, Salary)** 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employee table 3. Find the Maximum age from employee table. 4. Find the Minimum age from employee table. 5. Find salaries of employee in Ascending Order. 6. Find grouped salaries of employees.
4	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. **CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)**
5	Create cursor for Employee table & extract the values from the table. Declare the variables,Open the cursor & extract the values from the cursor. Close the cursor. **Employee(E_id, E_name, Age, Salary)**

PART B

DBMS Mini-Project (Practical Application): Design and Implementation of a Relational Database Solution for a Real-World Scenario.

Identify a real-world business process or organizational system (e.g., Bank Management, Pharmacy Management, University Enrollment, Gym Membership, or Food Delivery Service) and perform a complete database lifecycle implementation by addressing the following:

i). **Requirement Analysis & Modeling:** * Define the problem statement and scope.

- Construct a comprehensive **Entity-Relationship (ER) Diagram** including entities, attributes, and relationship cardinalities.
- **Schema Design & Normalization: * Convert the ER model into relational tables.**
- Demonstrate the normalization process (from **1NF to 3NF**) to eliminate data redundancy and update anomalies.

ii). **Physical Implementation (SQL):** * Write **DDL (Data Definition Language)** commands to create the database structure with appropriate Primary Key, Foreign Key, and Check constraints.

- Populate the tables with sample data using **DML (Data Manipulation Language)**.

iii). **Data Retrieval & Logic:** * Develop at least five complex SQL queries involving **Joins, Sub queries, and Aggregate Functions** to extract meaningful insights (e.g., "Find the top 3 selling products in the last quarter").

Implement one advanced database object, such as a **Trigger, Stored Procedure, or View**, to automate a specific business rule.

Course outcomes (Course Skill Set):

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

CO1. Describe the basic elements of a relational database management system

CO2. Design entity relationship for the given scenario.

CO3. Apply various Structured Query Language (SQL) statements for database manipulation.

CO4. Analyze various normalization forms for the given application.

CO5. Apply transaction processing and concurrency control concepts to solve given problem.

Suggested Learning Resources:

Text Books:

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

2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Reference Books:

1. **Coronel, C., Morris, S., and Rob, P.**, Database Principles: Fundamentals of Design, Implementation, and Management, 10th Edition (International Edition), 2012, Cengage Learning.
2. **Silberschatz, A., Korth, H. F., and Sudarshan, S.**, *Database System Concepts*, 7th Edition, 2021, McGraw Hill.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

ANALYSIS & DESIGN OF ALGORITHMS LABORATORY (0:0:28:02) 1

(Effective from the academic year 2025 -26)

Course Code	**BCSL404**	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:02	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

Course Objectives:

This course will enable students:

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

Note:

1. The laboratory syllabus consists of PART-A and PART-B. While PART-A has 10 conventional experiments, PART-B has typical open-ended experiments. The maximum marks for the laboratory course are 100.
2. Both PART-A and PART-B are considered for CIE and SEE.
3. Students have to answer 1(one) question from PART-A and 1(one) question from PART-B.
4. The questions set for SEE shall be from among the experiments under PART-A. It is evaluated for 70 marks out of the maximum 100 marks.
5. The open-ended question set for SEE shall be any other open-ended question and not selected from the experiments under PART-A. It shall be evaluated for 30 marks.

Sl.No.	PART – A
1.	**A.** Design and implement C program using the Brute Force String Matching algorithm to find all occurrences of a given pattern in a text. Display the starting position(s) where the pattern occurs and analyze the time complexity of the algorithm. **B.** Design and implement C program to determine whether all elements in a given array are unique (i.e., no duplicate elements are present) also analyze the time complexity of the algorithm. Run the program for varied values of n> 5000
2.	Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C how the divide-and- conquer method works along with its time complexity analysis: worst case, average case and best case.
3	Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C how the divide-and- conquer method works along with its time complexity analysis: worst case, average case and best case.
4.	Design and implement C Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.

5	Design and implement C Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
6.	Design and implement C Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
7	Design and implement C Program to obtain the Topological ordering of vertices
8	Design and implement C Program to solve 0/1 Knapsack problem using Dynamic Programming method.
9	Design and implement C Program to find a subset of a given set S = {sl , s2, ... ,sn} of n positive integers whose sum is equal to a given positive integer d.
10	Design and implement C Program for N Queen's problem using Backtracking.

Part B

OPEN-ENDED EXPERIMENTS

Open-ended experiments are a type of laboratory activity where the outcome is not predetermined and students are given the freedom to explore, design, and conduct the experiment based on the problem statements as per the concepts defined by the course coordinator. It encourages creativity, critical thinking, and inquiry-based learning.

Topics for Open ended Experiments:

- Brute force
- Divide Conquer
- Decrease and Conquer Approach
- Greedy Method
- Transform and Conquer Approach
- Dynamic Programming
- Backtracking
- Branch and Bound

Course Outcomes:

The students will be able to:

CO1: Build programs to implement algorithms for solving computing problems..

CO2: Analyse algorithms to deduce their time complexities.

Suggested Learning Resources: (Textbook/ Reference Book/ Manuals):

Text books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 3rd Edition, 2022. Pearson.
2. Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Reference Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI. 4th Edition , 2022
2. Design and Analysis of Algorithms, S. Sridhar, Oxford 2nd Edition , 2023.

SYLLABUS FOR ENGINEERING SCIENCE COURSE (ESC/ETC/PLC)

DEPARTMENT OF MATHEMATICS
Choice Based Credit System (CBCS)
SEMESTER – IV

DISCRETE MATHEMATICAL STRUCTURES (40:28:0:22) 3
(Effective from the academic year 2025-2026)

Course Code	**BCS405A**	CIE Marks	50
Teaching Hours(L: T:P:S)	40:28:0:22	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory + 28 Hours Tutorial	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Understand an intense foundational introduction to fundamental concepts in discrete mathematics.
2. Interpret and solve the language associated with logical reasoning, relations, and functions.

Preamble: Discrete Mathematics course introduces students to the mathematics of discrete structures which build the mathematical foundation of Information Technology. Discrete mathematics has wide variety of application in problem analysis, decision making and provides adequate basics for the IT students who will be taking advanced courses like Security, Machine Learning and the Theory of Computing. The concepts of counting, mathematical induction, functions, relations, and graph theory provides an applied introduction to model mathematical concepts to the real word applications.

Module – 1 : Fundamentals of Logic

Fundamentals of Logic: Basic connectives and Truth tables, Tautologies, Logical Equivalence: The laws of logic, Logical implications, Rules of inference.

Applications: Quantifiers and proofs of Theorems.

(08 Hours)

Module – 2 : Relations

Relations: Properties of relations, Equivalence relations, Partitions, Partial orders and Extremal elements in posets.

Applications: Hasse diagrams **(08 Hours)**

Module –3 : Functions

Functions: Types of function, Properties of functions, Composition of functions, Inverse functions and Invertible Functions

Applications: The pigeonhole principle **(08 Hours)**

Module – 4 : Mathematical Induction, Recursive Definitions and Recurrence Relations

Mathematical Induction, Recursive Definitions and Recurrence Relations:
Method of mathematical induction, Recursive definition, First order linear recurrence relation-Formulation problems and examples. Second order linear homogeneous recurrence relations with constant coefficients.

Applications: Statement problems on recurrence relations (applicable to real life)

(08 Hours)

Module – 5 : Fundamental Principles of Counting

Fundamental Principles of Counting: Overview, The rule of sum and product, Permutations, Combinations and Combinations with repetition.

Applications: **The Principles of Inclusion and Exclusion:** Generalization of the principle, Derangements- Nothing is in its right place.

(08 Hours)

Course Outcomes:

The Students should be able to

CO1: Apply mathematical logic to validate propositions.

CO2: Use properties of relations and functions in theoretical algorithms.

CO3: Apply mathematical induction for recursive and non-recursive concepts.

CO4: Make use of the concepts related to combinatorics in different fields of computer science.

Text books:

1. R.P. Grimaldi: "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Ed., Pearson, 2003.
2. K.H. Rosen: "Discrete Mathematics and Its Applications", 8th Ed., McGraw-Hill, 2019.
3. J.P. Tremblay & R. Manohar: "Discrete Mathematical Structures with Applications to Computer Science", McGraw-Hill, 1975.

Reference Books:

1. **S.S. Epp:** "Discrete Mathematics with Applications", 5th Ed., Cengage, 2019.
2. **Levin. O:** "Discrete Mathematics: An Open Introduction", 3rd Ed., Oscar Levin, 2019.
3. **Knuth. D.E:** "Concrete Mathematics", 2nd Ed., Addison-Wesley, 1994.
4. **Cameron. P.J:** "Combinatorics: Topics, Techniques, Algorithms", CUP, 1994.
5. **West. D.B:** "Introduction to Graph Theory", 2nd Ed., Pearson, 2000.

Web links and Video Lectures (e-Resources):

- **Discrete Mathematical Structures by IIT Madras (Prof. Kamala Krithivasan): https://youtu.be/xlUFkMKSB3Y**
- **NOC: Discrete Mathematics by IIIT Bangalore (Prof. Ashish Choudhury): https://youtu.be/sPQ3ptUMltA**
- **Discrete Mathematics by IIT Ropar (Prof. Sudarshan Iyengar): https://youtu.be/F6VxAXg4eMQ**

Continuous Comprehensive Assessments (CCA):

- Programming Assignments
- GATE based test

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DEPARTMENT OF MATHEMATICS
Choice Based Credit System (CBCS)
SEMESTER - IV

GRAPH THEORY (40:28:0:22) 3

(Common to CSE/ISE/AI&ML)
(Effective from the academic year 2025-26)

Course Code	**BCS405B**	CIE Marks	50
Teaching Hours (L:T:P:S)	40:28:0:22	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory + 28 Hours Tutorial	Exam Hours	3 Hours
Examination Nature	Theory		

Course Objectives:

This course aims to prepare the students to:

1. Understand the basics of graph theory and their various properties
2. Model problems using graphs and to solve these problems algorithmically.
3. Apply graph theory concepts to solve real world applications like routing, TSP/traffic control, etc.

Teaching-Learning Process

Pedagogy (General Instructions):

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

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

Module-1: Introduction to Graph Theory

Definitions and Examples, Standard graphs - complete graph, regular graph, Peterson graph, bipartite graph, complete bipartite graph. Subgraphs, Regular graphs, wheels, Induced subgraphs, Subgraphs - proper subgraph, spanning subgraph, induced subgraph. Isomorphism of graphs. **Applications:** Konigsberg bridge problem.

(8 Hours)

(RBT Levels: L1, L2 and L3)

Module-2: Planar Graphs

Introduction, Planar and non-planar graphs, Combinatorial representation, Hamilton Paths and Cycles, Kuratowski's graph, Kuratowski's theorem, Outer planar graphs, Maximal planar graphs, Euler's formula, crossing number, Dual of a planar graphs, Euler's polyhedral formula. **Applications:** Detection of planarity using elementary reduction method

(8 Hours)

(RBT Levels: L1, L2 and L3)

Module-3: Trees

Introduction, Trees and their basic properties, examples. Types of trees - rooted trees, spanning trees, binary trees, Sorting, Prefix Codes and Weighted trees. **Applications:** DFS and BFS Algorithms.

(8 Hours)

(RBT Levels: L1, L2 and L3)

Module-4: Graph coloring

Introduction, Vertex coloring, Chromatic number of a graph, Results for general graphs, The chromatic polynomial of a graph, Basic properties of chromatic polynomial, Decomposition theorem, Multiplication theorem. Map coloring. **Applications:** Five color theorem

(8 Hours)

(RBT Levels: L1, L2 and L3)

Module-5: Graph Algorithms

Introduction, Minimal spanning trees - Kruskal and Prim's algorithm, Dijikstra's shortest path algorithm. Transport Networks – Max-flow, Min-cut Theorem, Matching Theory. **Applications:** Travelling salesman problem - nearest neighbourhood method.

(8 Hours)

(RBT Levels: L1, L2 and L3)

Course outcomes:

The students will be able to:

CO1: Demonstrate understanding of graph structures, subgraphs, and isomorphism through standard examples and basic applications like the Königsberg Bridge Problem.

CO2: Interpret structural properties of planar and non-planar graphs through the use of Kuratowski's theorem, Euler's formula.

CO3: Solve traversal problems using DFS and BFS on basic tree structures.

CO4: Illustrate vertex coloring, chromatic polynomials, and map coloring techniques with applications like the Five Color Theorem.

CO5: Apply Kruskal's and Prim's algorithms to determine the Minimal Spanning Tree of a connected, weighted graph.

Text Books:

1. Narsingh Deo, Graph theory with applications to engineering and computer Science, PHI, 1979.
2. Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition – 2007. ISBN 978-81-7758-424-0.
3. Gary Chartrand and Ping Zang, Introduction to graph theory, Tata McGraw-Hill addition 2006.
4. F. Harary, Graph theory, Narosa publishing house, New Delhi, 2013.

Reference Books:

1. Douglas B. West, "Introduction to graph theory", 2nd Edition, PHI, 2001, ISBN-9780130144003, 0130144002.
2. Geir Agnarsson and Raymond Greenlaw, Graph theory-Modeling, application and Algorithm, Pearson publications, 1998
3. Cormen T.H., Leiserson C. E, Rivest R.L., Stein C., Introduction to Algorithms, 3rd Edition, PHI 2010, ISBN:9780262033848

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc22_ma10/preview

https://onlinecourses.nptel.ac.in/noc25_cs03/preview

Continuous Comprehensive Assessments (CCA):

- Programming Assignment
- GATE based test

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DEPARTMENT OF MATHEMATICS
Choice Based Credit System (CBCS)
SEMESTER - IV

OPTIMIZATION TECHNIQUE (40:28:0:22) 3
(Common to CSE/ISE/AI&ML/CSBS Branches)
(Effective from the academic year 2025-26)

Course Code	**BCS405C**	CIE Marks	50
Teaching Hours (L:T:P:S)	40:28:0:22	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory + 28 Hours Tutorial	Exam Hours	03
Examination Nature	Theory		

Course Objectives: The goal of the course is to:

- Understand the methodology of OR problem solving and formulate linear programming problem.
- Develop formulation skills in transportation models and assignment problems hence find solutions.
- Understand the basics in the field of game theory.

General Instructions:

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

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

Module – 1 : Introduction to LPP and Solution to LPP

Introduction to LPP and Solution to LPP: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).

RBT: L1, L2, L3 **(8 Hours)**

Module – 2 : Simplex method and Big-M method

Simplex method and Big-M method: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method, Degeneracy in LPP.

RBT: L1, L2, L3 **(8 Hours)**

Module – 3 : Transportation Problem

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Unbalanced T.P, Finding optimal solution by MODI method, Maximization T.P. Degeneracy in transportation problems.

RBT: L1, L2, L3 **(8 Hours)**

Module – 4 : Assignment Problem

Assignment Problem: Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP).

RBT: L1, L2, L3 **(8 Hours)**

Module – 5 : Game Theory

Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn and mX2 games by graphical method. Formulation of games.

RBT: L1, L2, L3 **(8 Hours)**

Course outcomes (COs)

CO1	Develop operational research models from the verbal description of the real system.
CO2	Solve linear programming problems using appropriate techniques.
CO3	Interpret minimum cost of transporting item from Source and Destination.
CO4	Apply the Hungarian method and related concepts to assignment problems
CO5	Interpret the basics of strategic gaming and extensive games.

Suggested Learning Resources:

Text Books:

1. **S.D.Sharma**, "Operations Research", Kedarnath Ramnath & Co, 2008.
2. **J.K Sharma**, "Operations Research - Theory and Applications", Macmillan Publications India Ltd, 2013.
3. **Kanti swaroop, P.K.Guptha and Man Mohan,** "Operation Research", Sultan Chand

Reference Books:

1. **H.A.Taha**, "Operations Research", Pearson, 7th Edition, June 2002.
2. **Hiller and Liberman**, "Introduction to Operations Research", MGH, 7th Edition, 2002.
3. **S.K Sinha**, "Reliability and life testing", Wiley Eastern.

Web links and Video Lectures (e-Resources):

- http://www2.informs.org/Resources/
- http://www.mit.edu/~orc/
- http://www.ieor.columbia.edu/

Continuous Comprehensive Assessments (CCA):

- Programming Assignment
- GATE based test

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DEPARTMENT OF MATHEMATICS
Choice Based Credit System (CBCS)
SEMESTER – IV

LINEAR ALGEBRA (40:28:0:22) 3
(Effective from the academic year 2025-26)

Course Code	**BCS405D**	CIE Marks	50
Teaching Hours (L:T:P:S)	40:28:0:22	SEE Marks	50
Total Number of Contact Hours	40 Hours Theory + 28 Hours Tutorial	Exam Hours	03
Examination Nature	Theory		

Course Objectives: The goal of the course is to:

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

General Instructions:

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

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

Module – 1 : Eigenvalues and Eigenvectors

Introduction, Polynomials of matrices, minimal polynomials, characteristic polynomials of block matrices, generalized eigenvectors and eigenspaces, Jordan canonical form.

RBT: L1, L2, L3 **(8 Hours)**

Module – 2: Inner Product Spaces

Introduction, Inner products, inner product spaces, length and orthogonality, orthogonal sets and bases, projections, Gram-Schmidt process, QR-factorization.

RBT: L1, L2, L3 **(8 Hours)**

Module – 3: Linear Algebra Tools for Optimization and Data Analysis

Introduction, Hessian Matrix, method of steepest descent, singular value decomposition. dimensionality reduction – principal component analysis.

RBT: L1, L2, L3 **(8 Hours)**

Module – 4: Linear Least Squares

Introduction, Linear least squares, existence, and uniqueness, geometrical interpretation, data fitting with least squares, pseudoinverse, ill-conditioning, and numerical stability.

RBT: L1, L2, L3 **(8 Hours)**

Module – 5: Applications of Least Squares and Regularization

Introduction, Regression models - linear and polynomial, data smoothing techniques, constrained least squares, introduction to regularization and overfitting, handling data issues - rank deficiency and robustness.

RBT: L1, L2, L3 **(8 Hours)**

Course outcomes (COs):

At the end of the semester the students are able to

CO1	Calculate eigenvalues and eigenvectors to solve matrix polynomial and canonical form problems.
CO2	Demonstrate inner product and orthogonality concepts to perform projections and QR-factorization.
CO3	Implement singular value decomposition and steepest descent methods for data analysis and optimization.
CO4	Solve least squares problems and verify solution stability and uniqueness conditions.
CO5	Employ regression and regularization techniques to address rank deficiency and improve model robustness.

Suggested Learning Resources:

Text Books:

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

Reference Reference Books:

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

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm
- https://www.coursera.org/learn/linear-algebra-machine-learning
- Linear Algebra by Dr. K.C. Sivakumar, IIT Madras: https://nptel.ac.in/courses/106108482
- Linear Algebra (Prof. A.K. Lal, IIT Kanpur): http://www.digimat.in/nptel/courses/video/111104137/L01.html

Continuous Comprehensive Assessments (CCA):

- Programming Assignment
- GATE based test

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SYLLABUS FOR ABILITY ENHANCEMENT COURSE / SKILL ENHANCEMENT COURSE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

GREEN IT AND SUSTAINABILITY (14:0:0:16) 1
(Effective from the academic year 2025-26)

Course Code	**BCS456A**	CIE Marks	50
Teaching Hours(L:T:P:S)	14:0:0:16	SEE Marks	50
Total Number of Contact Hours	14 Hours Theory	Exam Hours	1 Hour
Examination Nature	MCQ		

Course Objectives:
This course will enable students to:
1: Understand challenges for Green ICT and the environmental impact.
2: Learn different aspects of ICT metrics and Sustainable Cloud Computing.
3: Explore effects of software design on sustainability.

Module – 1

Green ICT -History, Agenda, and Challenges Ahead: Introduction, Industrial Revolution, The Emergence of Information and Communication Technologies, The Agenda and Challenges Ahead. **(3 Hours)**

Module – 2

Emerging Technologies and Their Environmental Impact: Introduction, Number of Connected Devices, Increased, Functionality, Increased Number of Separate Functions , Increased Demand for Speed and Reliability , Obsolescence—The Problem of Backward Compatibility, The Other Side of the Balance Sheet, Video conference as an Alternative to Business Travel, Dematerialization of Product Chain, Travel Advice/Road Traffic Control, Intelligent Energy Metering , Building Management Systems, Saving IT. **(3 Hours)**

Module – 3

Measurements and Sustainability: Introduction, ICT Technical Measures, Ecological Measures and Ethical Consideration, Systems Engineering for Designing Sustainable ICT–Based Architectures. **(3 Hours)**

Module – 4

Sustainable Cloud Computing: Introduction, Challenges in the Use of Cloud Computing As Green Technology, Cloud Computing and Sustainability, Sustainable Applications of Cloud Computing, Technologies Associated With Sustainable Cloud Computing, Future Prospects of Sustainable Cloud Computing, Reflections on Sustainable Cloud Computing Applications. **(3 Hours)**

Module – 5

Sustainable Software Design: Overview and Scope, Evaluating Sustainability Effects , Sustainability and the Product Life Cycle , Direct Effects: Sustainability During Use, Runtime Energy Consumption Basics , Analyzing the Energy Consumption of an Application , Energy Consumption Reduction Using Physical Properties of Semiconductors, Optimizing the Energy Consumption of an Application: Compiler Techniques, Optimizing the Energy Consumption of an Application: Runtime Approaches. **(2 Hours)**

Course outcomes:

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

CO1: Classify the challenges for Green ICT

CO2: Relate the environmental impact due to emerging technologies.

CO3: Demonstrate different aspects of ICT metrics.

CO4: Compare the various parameters related to Sustainable Cloud Computing.

CO5: Interpret the effects of software design on the sustainability.

Text Books:

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

Continuous Comprehensive Assessments (CCA):

1. Poster Presentation

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16/2/26

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

CAPACITY PLANNING FOR IT (14:0:0:16) 1
(Effective from the academic year 2025 -26)

Course Code	**BCS456B**	CIE Marks	50
Teaching Hours(L:T:P:S)	14:0:0:16	SEE Marks	50
Total Number of Contact Hours	14 Hours Theory	Exam Hours	1 Hour
Examination Nature	MCQ		

Course Objectives:
This course will enable students to:
- Understand requirement and measurements for capacity planning, measurement and monitoring.
- Measurement of data for prediction towards planning process.
- Understand concepts related to deployment, installation, configuration, and management.
- Role of virtualization and cloud services in capacity planning.

Module – 1

Goals, Issues, and Processes: capacity planning, Quick and Dirty Math, Predicting When Your Systems Will Fail, Make Your System Stats Tell Stories, Buying Stuff: Procurement Is a Process, Performance and Capacity: Two Different Animals, The Effects of Social Websites and Open APIs.
Setting Goals for Capacity: Different Kinds of Requirements and Measurements, Architecture Decisions. **(4 Hours)**

Module – 2

Measurement: Units of Capacity: Aspects of Capacity Tracking Tools, Applications of Monitoring. **(3 Hours)**

Module – 3

Measurement: API Usage and Its Effect on Capacity, Examples and Reality.
Predicting Trends: Riding Your Waves. **(3 Hours)**

Module – 4

Predicting Trends: Procurement, The Effects of Increasing Capacity, Long-Term Trends, Iteration and Calibration.
Deployment: Automated Deployment Philosophies, Automated Installation Tools, Automated Configuration. **(3 Hours)**

Module – 5

Virtualization and Cloud Computing: Virtualization, Cloud Computing, Computing Resource Evolutions, Mixed Definitions, Cloud Capacity, Use it or lose it (your wallet), Measuring the clouds, Cloud Case Studies, Cloud Use Case: Anonymous Desktop Software Company. **(4 Hours)**

Course outcome (Course Skill Set)
At the end of the course the student will be able to:
- Identify the requirement and measurements for capacity planning by considering the goal, issues, and processes.
- Explain capacity measurement and monitoring.
- Make use of measurement data for prediction towards overall planning process.
- Explain the concepts related to deployment, installation, configuration, and management.
- Demonstrate how the virtualization and cloud services fit into a capacity plan.

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

Continuous Comprehensive Assessments (CCA):
- Poster Presentation

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

UI/UX LABORATORY (0:0:28:2) 1
(Effective from the academic year 2025-26)

Course Code	**BCS456C**	CIE Marks	50
Teaching Hours(L:T:P: S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3
Examination Nature	Practical		

Course objectives:

- Understand the importance of the User Interface Design process.
- To make the learners familiar with the importance of requirement, user analysis and different levels of design for a particular project and the techniques to be used.
- To introduce them to Figma tool- a tool for prototyping

Sl. No	Part A Experiments
1	Design a Logo for an E-Commerce app
2	Design an email that showcases a promotional offer of the e-commerce app.
3	Design brochure that showcases different features of the e-commerce app
4	Create sketches and low-fidelity wire frames and experiment the user testing
5	Create High-Fidelity Mockups & Prototypes from the wireframes.
6	Figma basics: Creating basic responsive elements like buttons, input elements, etc. to understand frames, groups, layout, constraints, texts, vector, color palette,etc.
7	Basic Clickable Prototyping using figma
8	Create a Design System for an e-commerce app using Grid and Spacing, Typography, Color System, and UI elements like icons, images, buttons, Inputs, Cards, Search Bar, Lists, etc.
9	Reusing the above Design System, compose the Home page, Product Page, and Checkout Page of the e-commerce app
	Part B **Open ended Experiment**
1	Create a generic prototype of any application both in Web vs. App
2	Test your sitemap using Treejack

Course outcomes:
At the end of the laboratory course the students will be able to:
CO1: Experiment with various visual design aspects.
CO2: Theme the visual look and feel of the user experiences using figma
CO3: Create effective and compelling screen based experiences.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

TECHNICAL WRITING USING LaTeX (0:0:28:2) 1
(Effective from the academic year 2025 -26)

Course Code	**BCS456D**	CIE Marks	50
Teaching Hours(L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	03
Examination Nature	Practical		

Course objectives:

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

Sl.No.	**PART A: Experiments**
1	Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.
2	Develop a LaTeX script to create a document that displays the sample Abstract/Summary
3	Develop a LaTeX script to create a simple title page of the VTU project Report [Use suitable Logos and text formatting]
4	Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry]
5	Develop a LaTeX script to create a document that contains the following table with proper labels.

Table: 5.1 Student Marks sheet

S.No	USN	Student Name	Marks		
			Subject1	Subject2	Subject3
1	1BY23IS001	Name 1	89	60	90
2	1BY23IS002	Name 2	78	45	98
3	1BY23IS002	Name 3	67	55	59

6	Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document

	by using the subgraph concept
7	Develop a LaTeX script to create a document that consists of the following two mathematical equations $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ $= \frac{-2 \pm \sqrt{2^2-4*(1)*(-8)}}{2*1}$ $= \frac{-2 \pm \sqrt{4+32}}{2}$ $T(n) = 2^2 \left[2T\left(\frac{n}{2^2}\right) + \frac{n}{2^2}\right] + 2n$ $T(n) = 2^3 T\left(\frac{n}{2^3}\right) + n + 2n$ $T(n) = 2^3 T\left(\frac{n}{2^3}\right) + 3n..$ $T(n) = 2^i T\left(\frac{n}{2^i}\right) + in.$
8	Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document
9	Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section
10	Develop a LaTeX script to design a simple presentation structure using Beamer packages
	PART B
1	Develop a LaTeX script to present an algorithm in the document using algorithm/algorithmic/algorithm2e library
2	Develop a LaTeX script to create a simple report and article by using suitable commands and formats of user choice.

Course outcomes:

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

CO1: Apply basic LaTeX command to develop simple document
CO2: Develop LaTeX script to design technical presentation (ppt)
CO3: Illustrate LaTeX script to present theorems and mathematical equations in the document
CO4: Develop programs to generate the complete report with citations and a bibliography
CO5: Illustrate the use of Tikz and algorithm libraries to design graphics and algorithms in the document

Suggested Learning Resources:

Text Books:

1. Lamport - LaTex - A Document Preparation System 2e,
2. A Short Introduction to LaTeX BY FIRUZA KARMALI (AIBARA), A book for beginners, 2019

Reference Book:

3. Formatting Information: A Beginner's Introduction to Typesetting with LaTeX, BY PETER FLYNN, Comprehensive TeX Archive Network (2005)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

ADVANCED PROGRAMMING SKILLS USING C++ (0:0:28:2) 1
(Effective from the academic year 2025 -26)

Course Code	**BCS456E**	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3 Hours
Examination Nature	Practical		

Course Objectives:
This course will enable students :

1. To provide strong foundations in C++ programming, covering fundamental and advanced concepts for developing efficient, structured, and maintainable software solutions.
2. To enable students to design and implement object-oriented systems, applying principles such as abstraction, encapsulation, inheritance, and polymorphism to solve real-world problems.
3. To develop competency in building robust and reliable C++ applications, incorporating exception handling, file handling, and appropriate software development practices.
4. To strengthen analytical and problem-solving skills through data structures, algorithms, and Standard Template Library (STL) for designing efficient computational solutions to practical applications.

Sl.No.	Experiments PART A
1.	**C++ Fundamentals Refresher: Functions and recursion, Arrays and strings, Pointers in C++** A University Library maintains a list of book titles for student reference. To automate the process, the library plans to develop a menu-driven C++ program. Write a C++ program to perform the following operations: a) Store the titles of five books using an array of strings. (Hint: Use a two-dimensional character array to store book titles.) b) Display all the book titles using a user-defined function. (Hint: Use cin.getline() to read book titles containing spaces.) c) Search for a given book title using a recursive function. (Hint: The recursive search function should include base condition and a recursive call.) d) Update the title of a selected book using pointers. (Hint: Pass the address of the selected book title to the update function using a pointer) e) Provide a suitable menu-driven interface for the above operations. Note: Write a single complete C++ program. Use appropriate header files. Follow proper indentation and meaningful variable names.

2.	**Object-Oriented Programming (OOP) : Inheritance, Polymorphism, Encapsulation & Abstraction** A bank wants to develop a simplified Online Banking System to manage different types of customer accounts. Each account has common operations such as depositing and withdrawing money, but the rules differ based on the account type. Write a C++ program to implement an Online Banking System using the principles of Object-Oriented Programming. The system should support the following: a) Create an abstract base class BankAccount that contains: Protected data members for account number and balance A pure virtual function calculateInterest() Public member functions to deposit and withdraw money b) Derive the following classes from BankAccount: SavingsAccount CurrentAccount c) Implement inheritance to reuse common functionality and override the calculateInterest() function in each derived class. d) Demonstrate polymorphism by accessing derived class objects using a base class pointer and calling the overridden functions. e) Apply encapsulation by restricting direct access to data members and providing controlled access through member functions.
3.	**Programs using Exception Handling & File I/O** Develop a Student Result Management System using C++ to demonstrate File I/O and Exception Handling. The system stores student details such as roll number, name, and marks in a file to ensure permanent data storage. File handling is used to write and read student records from a text file. Exception handling is incorporated to manage runtime errors such as invalid marks entry (outside 0–100) and file opening failures. A menu-driven interface allows the user to add student results, display records, or exit the program. The use of try and catch blocks prevents program crashes and displays meaningful error messages, thereby improving the reliability of the system.
4.	**Data Structures Implementation in C++ : Linked Lists, Stacks & Queues** The College Canteen Order Management System is designed to manage food orders efficiently using different data structures. When a customer places an order, the placeOrder() function is used to add the order to a queue, ensuring that orders are processed in the order they are received (FIFO). At the same time, the order is recorded in a linked list using the addOrderList() function to maintain a complete list of all orders. When an order is ready, the prepareOrder() function moves the order from the queue to a stack, following the LIFO principle. Finally, the serveOrder() function serves the prepared order from the stack. The displayAllOrders() function is used to display all the orders stored in the linked list. This scenario demonstrates the practical use of queues, stacks, and linked lists in a real-world application.

5.	**Data Structures Implementation in C++: Trees and Graphs** A ride-sharing application maintains a large number of active ride requests. Each request is assigned a unique Ride ID, and the system must quickly insert new ride requests, cancel existing ones, and search for a specific ride in real time. Since the number of requests changes dynamically and performance is critical, the application uses a Red-Black Tree to store Ride IDs to ensure balanced and efficient operations. a) Design a C++ program to implement a Red-Black Tree that supports the following operations: b) Insert a new Ride ID into the Red-Black Tree. c) Search for a given Ride ID. d) Display all Ride IDs in sorted order using inorder traversal. e) Explain how the Red-Black Tree maintains balance after insertions. Implement the same scenario using 2-3 trees also.
6.	**Algorithms & Problem Solving: Sorting algorithms, Searching techniques** An online shopping platform maintains a large database of products, where each product is identified by a price value. Customers frequently search for products within a given price range (for example, products priced between ₹5,000 and ₹10,000). To efficiently handle such queries, the system uses a range search technique on an ordered data structure. Design a C++ program to implement Range Search that performs the following tasks: 1. Store product prices in an appropriate data structure. 2. Accept a lower bound and upper bound for the price range. 3. Display all product prices that fall within the specified range. 4. Explain how range search improves query efficiency compared to linear searching.
7	**Algorithms & Problem Solving: Greedy algorithms, Recursion & backtracking** In a college campus, an event coordinator must select activities to be conducted in a single auditorium. Each activity has a start time and end time, and only one activity can be held at a time. To utilize the auditorium efficiently, the coordinator wants to select the maximum number of non-overlapping activities. Design a C++ program using the Greedy approach to solve this problem. Your program should: Accept the number of activities along with their start and end times. Sort the activities based on their finishing times. Select and display the maximum number of activities that can be conducted without time conflicts. Hint: Greedy choice: Always select the activity that finishes earliest. Sort activities based on end time. After selecting one activity, choose the next activity whose start time is greater than or equal to the previous activity's end time.

8	**Programs using Containers & Iterators** In a library management system, book IDs need to be stored and displayed efficiently. Write a C++ program using an STL container to store the book IDs dynamically. Use the vector container to insert book IDs using the push_back() function and display all the stored book IDs using an iterator
9	**Programs using Templates** Create a function template findMax() to compare two values and return the greater one. The same function should work for both integer marks and floating-point CGPA, eliminating the need to write separate functions for different data types.
10	**Programs using Templatized Data Structures** Create a templated Stack class to store different types of student results. The class should be able to hold either integer marks or floating-point CGPA, removing the need to write separate stack classes for each data type. Include methods such as push(), pop(), and display() to manage the stack elements efficiently.
	PART-B **Open Ended Experiment**

1. Write a program to demonstrate File-based Inventory System
2. Write a program to demonstrate Text Search Engine (STL + files)
3. Design a **generic task scheduling system** in C++ that manages tasks arriving over time.
4. Create a **text editor simulation** that supports undo and redo operations.
5. Design a system to find and optimize paths in a **maze or map**

Course Outcomes:

The students will be able to:

CO1: Apply fundamental and advanced C++ programming concepts to develop efficient and maintainable programs for computing problems.

CO2: Design and implement object-oriented solutions for real-world problems using concepts of classes, inheritance, polymorphism, encapsulation, and abstraction.

CO3: Develop robust C++ applications by incorporating exception handling mechanisms and performing file input/output operations for data persistence.

CO4: Implement and analyze core data structures and algorithms, including linked lists, stacks, queues, trees, graphs, sorting, searching, greedy techniques, and backtracking, to solve computational problems efficiently.

CO5: Utilize the Standard Template Library (STL) and algorithmic problem-solving techniques to design and implement practical, real-world applications in C++.

Text books:

1	Deitel, Paul, and Harvey Deitel. C++ How to Program. 10th ed., Pearson, 2016.
2	Balagurusamy, E. Object-Oriented Programming with C++. 8th ed., McGraw Hill Education, 2020

Reference Book:

1	Bjarne Stroustrup. Programming -- Principles and Practice Using C++. 3rd edition., Addison-Wesley, 2024.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – IV

INTRODUCTION TO JAVA (0:0:28:2) 1

(Effective from the academic year 2025 -26)

Course Code	**BCS456F**	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3 Hours
Examination Nature	Practical		

Course Objectives:

This course will enable students to:

1. To familiarize students with the Java compiler and the Eclipse development environment.
2. To enable students to learn and apply object-oriented problem-solving techniques using Java.
3. To train students in connecting the database , designing and developing Graphical User Interfaces.

Sl.No.	Experiments
	PART-A
1.	A company wants to calculate salaries for its employees. The salary calculation varies depending on the employee type: • For a regular employee, the salary is just the basic salary. • For employees who receive a bonus, the salary is basic salary + bonus. • For employees who receive bonus and allowance, the salary is basic salary + bonus + allowance. Create a class **Salary Calculator** with a method **calculateSalary()** overloaded to handle all three cases. Write a main method to demonstrate the calculation of salary for: • A regular employee • An employee with bonus • An employee with bonus and allowance. Use **method overloading** to implement calculateSalary(). Display the calculated salary for each type of employee.
2.	A university needs to manage information about various individuals associated with it. Create a class hierarchy in which a base class Person contains common attributes such as name, age, and address. Derive two subclasses, Student and Faculty, where Student includes additional attributes rollNumber and course, and Faculty includes employeeId and department. Design the above class hierarchy using inheritance and write a Java program to demonstrate single inheritance and method overriding, where both Student and Faculty override a common method displayDetails() to display their respective information.

3	An online learning platform offers courses that include both video-based instruction and assignment-based evaluation. Define an interface VideoContent with a method playVideo() and another interface Assessment with a method submitAssignment(). Create a class OnlineCourse that implements both interfaces. Design the system and write a Java program to demonstrate multiple inheritance using interfaces, showing how the class OnlineCourse implements the interfaces and how the methods are invoked using an object of the OnlineCourse class.
4.	Consider a scenario where a system continuously monitors randomly generated numbers and processes them based on their nature. The application is designed using multithreading and consists of three threads. The first thread acts as a number generator, producing a random integer every one second. Once a number is generated, it is evaluated for parity. If the number is even, the second thread is triggered to compute and display its square. If the number is odd, the third thread takes over and computes and displays its cube. This coordinated multithreaded approach ensures simultaneous number generation and conditional processing.
5	Analyze the given scenario A university system manages student grades and file storage: Reads student names and marks from user input. • Throws InvalidGradeException if marks are not in 0–100. • Handles NumberFormatException for invalid numeric input. • Handles ArithmeticException while calculating average marks (division by zero). • Handles ArrayIndexOutOfBoundsException when accessing a student in the array. • Handles NullPointerException if a student object is null. • Writes the grades to a file and handles IOException. Write a Java Program to implement the above Exceptions.
6.	Write a java program to create an abstract class named shape that contains an empty method named number of sides (). Provide three classes named trapezoid, triangle and Hexagon such that each one of the classes extends the class shape. Each one of the class contains only the method number of sides () that shows the number of sides in the given geometrical figures.
7	Write a GUI program using Swing and event handlers in Java where: • The user enters a **temperature** in Celsius or Fahrenheit. • The user can click a button to **convert** it to the other scale. • The result is displayed in the GUI. • Includes **input validation** (non-numeric input handled with exception).
8	Imagine a digital library management system where a librarian interacts with a central record book. In this scenario, a Java program acts as the librarian, using JDBC as the communication channel to connect to the database, which represents the record book. Through this connection, the program can perform essential operations such as adding new records, removing outdated entries, updating existing information, and retrieving stored data whenever required. This analogy highlights how JDBC enables smooth and organized interaction between a Java application and a database for complete data management.

	PART-B Open Ended Experiment
Design and implement a Java application using Swing and connect DBMS using JDBC. The application should feature an attractive and user-friendly interface with effective look-and-feel enhancements. You may use any suitable Java technologies, frameworks, and databases to develop a robust and well-structured solution	
Course Outcomes: The students will be able to: CO1: Apply object-oriented principles and core Java concepts effectively in program development. CO2: Design and implement GUI applications using Swing and event handling. CO3: Develop Java applications with JDBC for real-time problems.	
Text books:	
1	Herbert Schildt, Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15)
2	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
Reference Books:	
1	Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016.
2	Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER IV

UNIX SYSTEM PROGRAMMING (0:0:28:2) 1

(Effective from the academic year 2025 -26)

Course Code	**BCS456G**	CIE Marks	50
Teaching Hours (L:T:P:S)	0:0:28:2	SEE Marks	50
Total Number of Contact Hours	28 Hours Practical	Exam Hours	3 Hours
Examination Nature	Practical		

Course Objectives:

This course will enable students to:

1. Implement C programs using UNIX system calls and simulating operating system concepts
2. Hands-on experience with UNIX/Linux operating systems, including command usage and file management.
3. Demonstrate scripting languages in Unix environment

Sl.No	Part A Experiments
1.	Inside the main() function of a C program a. write C code to print all the command line parameters and environment variables. b. Write C code to find the PATH environment variable, which is of the form PATH=/usr/local/bin:/usr/bin:/bin:/usr/local/games:/usr/games:./ then write C code to tokenize the PATH variable string into individual directories
2.	Write a C program to implement various exec() system calls
3.	Write a C program to implement counting semaphores using pthreads
4.	Write a program that has a counter as a global variable. Spawn 10 threads in the program, and let each thread increment the counter 1000 times in a loop. Print the final value of the counter after all the threads finish—the expected value of the counter is 10000. Run this program first without using locking across threads, and observe the incorrect updation of the counter due to race conditions (the final value will be slightly less than 10000). Next, use locks when accessing the shared counter and verify that the counter is now updated correctly.
5.	Write a C program to simulate UNIX commands like ls -l, grep
6.	Write a C program to display information of a given file which determines type of file and Inode information, where the file name is given as command line argument
7.	Write a C program to catch, ignore and accept the signals, SIGINT.
8.	Write a linux device driver that prints simple hello messages to the kernel during module insertion and removal.

9.	Write a driver that will allow us to read and write a character to a pseudo-device
10.	Write a user space program in C that opens your memory driver as a file, writes the string "Hello user", reads a character back, and prints that character to the terminal. The user program should display: PID PPID STATE PRIORITY CPU_TIME 1 0 R 20 1200 2 1 S 30 850 ... Total Processes: 135

PART B

Open Ended Experiment

Design and Implementation of a Custom Linux Kernel System Call for Process Monitoring. You are required to **modify the Linux kernel by adding a new system call** named:
get_procinfo()

Course Outcomes:

The students will be able to:

CO 1: Apply Unix system calls for various OS operations.
CO 2: Apply various IPC techniques for OS management.
CO 3: Demonstrate device driver programming and modify Linux Kernel.

Textbooks

1. Jonathan Corbet , Alessandro Rubini, Greg Kroah-Hartman "Linux Device Drivers" O'Reilly Publications, February 2005
2. Robert Love, Linux Kernel Development, 2010

References

1. https://www.eecs.umich.edu/courses/eecs473/Labs/Lab4.pdf

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – IV

BIOLOGY FOR INFORMATION TECHNOLOGY (28:0:0:32) 2
COMMON TO ALL INFORMATION TECHNOLOGY BRANCHES (CSE/ISE/AIML)
(Effective from the academic year 2025 -26)

Course Code	**BBOC407**	CIE Marks	50
Teaching Hours/ (L:T:P:S)	**28:0:0:32**	SEE Marks	50
Total Number of Contact Hours	28 Hours Theory	Exam Hours	3 Hours
Examination Nature	Theory		

Course Objectives:

- To familiarize the students with the basic biological concepts and their engineering applications.
- To enable the students with an understanding of bio-design principles to create novel devices and structures.
- To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- To motivate the students to develop interdisciplinary vision of biological engineering.

Teaching-Learning Process (General Instructions)

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

1. Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
2. Instructions with interactions in classroom lectures (physical/hybrid).
3. Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
4. Flipped classroom sessions (~10% of the classes).
5. Industrial' visits, Guests talks and competitions for learning beyond the syllabus.
6. Students participation through audio-video based content creation for the syllabus (as assignments).
7. Use of gamification' tools (in both physical/hybrid classes) for creative learning outcomes.
8. Students seminars (in solo or group) /oral presentations.

Module – 1

Preamble Exploring " BIOLOGY FOR INFORMATION TECHNOLOGY " isn't just a scientific pursuit; it's a strategic investment in nation- building and economic growth. By bridging biology with engineering, we unlock pathways to sustainable development, innovative industries, and improved healthcare solutions. This interdisciplinary approach not only enriches our understanding of living systems but also propels us towards a future where technological advancements drive societal progress and economic prosperity. Let's harness the power of biology to engineer a brighter tomorrow for our nation and the world.

CELL BASIC UNIT OF LIFE

Introduction. Structure and functions of a cell. Stem cells and their application.
Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids.
Importance of special biomolecules: Properties and functions of enzymes, vitamins and hormones.

(5 Hours)

Module – 2

APPLICATION OF BIOMOLECULES

Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics production, Nucleic acids in vaccines and diagnosis, Proteins in food production, lipids in biodiesel and detergents production, Enzymes in biosensors fabrication, food processing, detergent formulation and textile processing.

(5 Hours)

Module – 3

ADAPTATION 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.

(5 Hours)

Module – 4

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS:

Echolocation, Photosynthesis. Bird flying, Lotus leaf effect, Plant burrs, Shark skin, Kingfisher beak. Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

(5 Hours)

Module – 5

TRENDS IN BIOENGINEERING:

Muscular and Skeletal Systems as scaffolds, scaffolds and tissue engineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete. Bioremediation. Biomining.

(5 Hours)

Course outcomes (Course Skill Set)

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

1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
3. Corroborate the concepts of biomimetics for specific requirements.
4. Think critically towards exploring innovative biobased solutions for socially relevant problems.

Text Books

1. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
2. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
3. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
6. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

Reference Books:

1. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

2. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
3. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N GeethaA C Udayashankar Lambert Academic Publishing, 2019.
4. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
5. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016.

Continuous Comprehensive Assessments (CCA):

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system

Department of Humanities and Social Sciences

Choice Based Credit System (CBCS)

SEMESTER – IV

UNIVERSAL HUMAN VALUES (UHV) (14:0:0:16)1

(Common to all branches)

(Effective from the academic year 2025 -26)

Course Code	**BUHK408**	CIE Marks	50
Teaching Hours/Week (L: T:P:S)	14:0:0:16	SEE Marks	50
Total Number of Contact Hours	14 Hours Theory	Exam Hours	01
Examination Nature	MCQ		

Course Objectives:

This course is intended to:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds

Teaching-Learning Process (General Instructions)

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

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.
3. State the need for UHV activities and its present relevance in the society and provide real-life examples.
4. Support and guide the students for self-study activities.
5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self- evolution.
7. Encourage the students for group work to improve their creative and analytical skills.

Module – 1

Introduction to Value Education:
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity –
Current Scenario, Method to Fulfil the Basic Human Aspirations

(03 Hours)

Module – 2

Harmony in the Human Being:
Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

(03 Hours)

Module – 3

Harmony in the Family and Society:
Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

(03 hours)

Module – 4

Harmony in the Nature/Existence:
Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

(03 hours)

Module – 5

Implications of the Holistic Understanding – a Look at Professional Ethics:
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession

(03 hours)

Course outcome (Course Skill Set)
At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature);
1. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. □ They would have better critical ability.
2. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
3. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Expected to positively impact common graduate attributes like:
1. Ethical human conduct
2. Socially responsible behaviour
3. Holistic vision of life

4. Environmentally responsible work
5. Having Competence and Capabilities for Maintaining Health and Hygiene.
6. Appreciation and aspiration for excellence (merit) and gratitude for all.

Textbooks and Teachers Manual	
1.	The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 97893-87034- 47-1
2.	The Teacher"s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G
Reference Books:	
1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3.	The Story of Stuff (Book).
4.	SThe Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5	Small is Beautiful - E. F Schumacher
6	Slow is Beautiful - Cecile Andrews
7	Economy of Permanence - J C Kumarappa.
8	Bharat Mein Angreji Raj – Pandit Sunderlal
9	Rediscovering India - by Dharampal
10	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11	India Wins Freedom - Maulana Abdul Kalam Azad
12	Vivekananda - Romain Rolland (English)
13	Gandhi - Romain Rolland (English)
14	Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15	Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16	A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17	P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers
18	A N Tripathy, 2003, Human Values, New Age International Publishers.
19	Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20	E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
21	M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22	B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
23	B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Department of Humanities and Social Sciences

Choice Based Credit System (CBCS)

SEMESTER – III to VI

NATIONAL SERVICE SCHEME **(0:0:28: 0)0**

(Common to all branches)

(Effective from the academic year 2025 -26)

Course Code	**BNSK359/459/559/659**	CIE Marks	100
Teaching Hours (L:T:P:S)	0:0:28 : 0	SEE Marks	-
Total Number of Contact Hours	28 Hours Practical	Exam Hours	-

Mandatory Course (Non-Credit)

(Completion of the course shall be mandatory for the award of degree)

Course Objectives: National Service Scheme (NSS) will enable the students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Module – 1

Introduction to NSS

History and growth of NSS, Philosophy of NSS, Objectives of NSS, Meaning of NSS Logo, NSS Programs and activities, administrative structure of NSS, Planning of programs / activities, implementation of NSS programs / activities, National & State Awards for NSS College Program Officer / Volunteers. **(04 Hours)**

Module – 2

Overview of NSS Programs

Objectives, special camping – Environment enrichment and conservation, Health, Family, Welfare and Nutrition program. Awareness for improvement of the status of women, Social Service program, production-oriented programs, Relief & Rehabilitation work during natural calamities, education and recreations, Selection of the problem to be addressed. **(04 Hours)**

Module – 3

NSS Activities - Group Contributions to Society / community (Activity based Learning) Organic Farming, Indian agriculture (Past, Present, Future) Connectivity for marketing, Waste management– Public, Private and Govt. organization, 5 R's. Water conservation techniques – role of different stakeholders – implementation, preparing an actionable business proposal for

enhancing the village income and approach for implementation. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. **(06 Hours)**

Module – 4

NSS National Level Activities for Society / Community at large (Activity based Learning) Developing Sustainable Water management system for rural areas and implementation approaches. Contribution to any national level initiative of Government of India. Foreg. Digital
India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.

(06 Hours)

Module – 5

NSS Individual Activities for Local Voice (Activity based learning)
Govt. school Rejuvenation and helping them to achieve good infrastructure, Plantation and adoption of plants. Know your plants. Spreading public awareness under rural outreach programs, National integration and social harmony events.

(06 Hours)

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
CO1: Understand the importance of his / her responsibilities towards society.
CO2: Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3: Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4: Implement government or self-driven projects effectively in the field.
CO5: Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Teaching Practice:

- Classroom teaching (Chalk and Talk)
- ICT – Power Point Presentation
- Audio & Video Visualization Tools

Assessment Details

Weightage	**CIE – 100%**
Presentation -1 Selection of topic, PHASE-1	20 Marks
Commencement of activity and its progress – PHASE – 2	20 Marks
Case Study based Assessment – Individual performance	20 Marks
Sector wise study and its consolidation	20 Marks
Video based seminar for 10 minutes by each student at the end of the course with Report	20 Marks

Suggested Learning Resources:
Text 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.

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SEMESTER – III to VI

PHYSICAL EDUCATION(SPORTS & ATHLETICS)(0:0:28:0) 0
(Common to all Branches)
(Effective from the academic year 2025 -26)

Course Code	BPEK359/459/559/659	CIE Marks	100
Teaching Hours(L: T:P:S)	0:0:28:0	SEE Marks	--
Total Number of Contact Hours	28 Hours Practical	Exam Hours	--

Mandatory Course (Non-Credit)
(Completion of the course shall be mandatory for the award of degree)

Course Objectives: The course will enable students to

1. Develop a healthy life style.
2. Acquire Knowledge about various stages of sports and games.
3. Focus on modern technology in sports.

Module – 1

Introduction of the game: Aim of sports and games, Brief history of the game, Nature of the game, Terminology & Modern trends of the game, Fitness & Skill tests along with Game Performance.

(06 Hours)

Module – 2

Offensive and Defensive Techno Tactical Abilities: Fitness, Fundamentals & Techniques of the game with the implementation of Biomechanics, Tactics- Drills for the Techno Tactical abilities, Individual and Group, Miner games- to implement the Techniques, Tactics and Motor abilities.

(05 Hours)

Module – 3

Team tactics and Rules of the Game: Rules and Regulations of the Game: Game rules as well as sequence of officiating, Team tactics: Offensive and Defensive team strategies and scrimmages, Practice Matches: among the group, Analysis of Techno Tactical abilities: Correction and implementation of skills and Sports Injuries and rehabilitation: First aid, PRICE treatment,

(05 Hours)

Module – 4

Sports Training: Introduction of Sports Training, Principles of Sports performance, how to increase and sustain the sports performance, Training Load & Recovery- How to increase the training load (volume/Intensity) and means and methods for Recovery, Periodization: Shorts, Medium and Long term,
Physiological changes: Changes in Lung capacity, heart beats etc...

(05 Hours)

Module – 5

Organization of Sports Event: Tournament system, Planning and preparation for the competition, Ground preparation and Equipment's, Organizing an event among the group.

(05 Hours)

The above 5 modules are common to all the sports events / games, we are offering the following games: **1. Baseball, 2. Kabaddi, 3. Table Tennis, and 4. Volleyball.**

Course outcomes:

The students will be able to:

1. Understand the importance of sports and games, inculcate healthy habits of daily exercise & fitness, Self-hygiene, good food habits, Create awareness of Self-assessment of fitness.
2. Develops individual and group techno tactical abilities of the game.
3. Increases the team combination and plan the strategies to play against opponents.
4. Outline the concept of sports training and how to adopt technology to attain high level performance.
5. Summarize the basic principles of organising sports events and concept of technology implemented to organise competitions in an unbiased manner.

Teaching Practice:

- Classroom teaching (Chalk and Talk)
- ICT – Power Point Presentation and video analysing.
- Practical classes in outdoor and indoor as per requirement.

CIE: 100 Marks

- CIE 1 for 40 marks – A theory paper which is MCQ / Descriptive conducted during the semester.
- CIE 2 for 60 marks – A practical test conducted at the end of the semester in which the student has to give fitness and skill tests and his performance in game will be assessed.

Text Books

1. Barbara Bushman, "ACSM's complete guide to Fitness & Health", 2011, Human Kinetics USA
2. **Pankaj Vinayak Pathak, *"Sports and Games - Rules and Regulation"*, 2019, Khel Sahitya Kendra.**
3. Hardayal Singh, *"Sports Training, General Theory & Methods"*, 1984 "Netaji Subhas, National Institute of Sports".
4. Keith A. Brown, "International Handbook of Physical Education and Sports Science", 2018, (5 Volumes) Hardcover.

References

1. Tudor O Bompa,*" Periodization Training for Sports"*, 1999, Human Kinetics, USA
2. Michael Boyle, "New Functional Training for Sports" 2016, Human Kinetics USA
3. Michael Kjaer, Michael Rogsgaard, Peter Magnusson, Lars Engebretsen & 3 more, "Text book of Sports Medicine: Basic Science and Clinical Aspects of Sports Injury and Physical Activity", 2002, Wiley Blackwell.
4. Scott L. Delp and Thomas K. Uchida, "Biomechanics of Movement: The Science of Sports, Robotics, and Rehabilitation", 2021, The MIT Press
5. MCARDLE W.D. "Exercise Physiology Nutrition Energy And Human Performance" 2015, LWW IE (50)

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YOGA (0:0:28:0) 0
(Common to all Branches)
(Effective from the academic year 2025 -26)

Course Code	**BYOK359/459/559/659**	CIE Marks	100
Teaching Hours(L:T:P:S)	0:0:28:0	SEE Marks	-
Total Number of Contact Hours	28 Hours Practical	Exam Hours	-

Course Objectives:

This course will enable students to:

1. Understand the importance of practicing yoga in day-to-day life.
2. Be aware of therapeutic and preventive value of Yoga.
3. Have a focused, joyful and peaceful life.
4. Maintain physical, mental and spiritual fitness.
5. Develop self-confidence to take up initiatives in their lives.

Module – 1

Introduction to Yoga: Introduction, classical and scientific aspects of yoga, Importance, Types,
Healthy Lifestyle, Food Habits, Brief Rules, Sithalikarana Practical classes. **(04 Hours)**

Module – 2

Physical Health: Introduction, Pre-requisites, Asana-Standing, Sitting, Supine and Prone,
Practical classes. **(06 Hours)**

Module – 3

Psychological Health: Introduction Thought Forms, Kriya (Kapalabhati), Preparation to Meditation, Practical classes. **(06 Hours)**

Module – 4

Therapeutic Yoga: Mudra Forms, Acupressure therapy, Relaxation techniques Practical classes. **(06 Hours)**

Module – 5

Spirituality & Universal Mantra: Introduction, Being Human, Universal Mantra, Universal
LOVE, Benefits of practice of Spirituality in day-to-day life, practical classes. **(04 Hours)**

Course Outcomes:

Students will be able to:

1. Understand the requirement of practicing yoga in their day-to-day life.
2. Apply the yogic postures in therapy of psychosomatic diseases
3. Train themselves to have a focussed, joyful and peaceful life.
4. Demonstrate the fitness of Physical, Mental and Spiritual practices.
5. Develops self-confidence to take up initiatives in their lives.

Teaching Practice:

- Classroom teaching (Chalk and Talk)
- ICT – Power Point Presentation
- Audio & Video Visualization Tools

CIE: 100 Marks
• CIE 1 for 40 marks – A theory paper which is MCQ / Descriptive conducted during the semester. • CIE 2 for 60 marks – A practical test conducted at the end of the semester in which the student have to perform asanas.
Text Books: *1.* George Feuerstein: The yoga Tradition (Its history, literature, philosophy and practice.) *2.* Sri Ananda: The complete Book of yoga Harmony of Body and Mind. (Orient paper Backs: vision Books Pvt.Ltd., 1982. *3.* B.K.S Iyenkar: Light on the Yoga sutras of patanjali (Haper Collins Publications India Pvt.,Ltd., New Delhi.) *4.* Science of Divinity and Realization of Self – Vethathiri Publication, (6-11) WCSC, Erode **Reference Books:** 1. Principles and Practice of Yoga in Health Care, Publisher: Handspring Publishing Limited, ISBN: 9781909141209, 9781909141209 2. Basavaraddi I V: Yoga in School Health, MDNIY New Delhi, 2009 3. Dr. HR. Nagendra: Yoga Research and applications (Vivekanda Kendra Yoga Prakashana Bangalore) 4. Dr. Shirley Telles: Glimpses of Human Body (Vivekanda Kendra Yoga Prakashana Bangalore)

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MUSIC (0:0:28:0) 0
(Common to all Branches)
(Effective from the academic year 2025 -26)

Course Code	BMUK359/459/559/659	CIE Marks	100
Teaching Hours(L: T:P:S)	0:0:28:0	SEE Marks	-
Total Number of Contact Hours	28 Hours Practical	Exam Hours	-

Mandatory Course (Non-Credit)
(Completion of the course shall be mandatory for the award of the Degree)

Course Objectives:

The course will enable the students to:

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyze the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of settings.

Module – 1

Preamble: Contents of the curriculum intend to promote music as a language to develop an analytical, creative, and intuitive understanding. For this the student must experience music through study and direct participation in improvisation and composition.

Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Laya, Raga, Tala, Mela. **(03 Hours)**

Module – 2

Compositions: Introduction to the types of compositions in Carnatic Music - Geethe, Jathi Swara, Swarajathi, Varna, Krithi, and Thillana, Notation system. **(03 Hours)**

Module – 3

Composers: Biography and contributions of Purandaradasa, Thyagaraja, Mysore Vasudevacharya. **(03 Hours)**

Module – 4

Music Instruments: Classification and construction of string instruments, wind instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments **(03 Hours)**

Module – 5

Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Notation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethein Malahari, and one Jathi Swara, One Nottu Swara OR One krithi in a Mela raga, a patriotic song **(14 Hours)**

Course Outcomes (COs):

The students will be able to:

CO1: Discuss the Indian system of music and relate it to other genres (Cognitive Domain)

CO2: Experience the emotions of the composer and develop empathy (Affective Domain)

CO3: Respond to queries on various patterns in a composition (Psycho-Motor Domain)

Teaching Practice:

- Classroom teaching
- ICT – PowerPoint Presentation
- Audio & Video Visualization Tools

CIE: 100 Marks

- **CIE 1** for 40 marks – A theory paper which is MCQ / Descriptive conducted during the semester
- **CIE 2** for 60 marks – A practical test conducted at the end of the semester in which the student has to recite one Sarale Varase mentioned by the examiner in three speeds. Sing / Play the Geethe in Malahari. Singing / Playing Jathi Swara / Krithi.

Text Books:

1. Vidushi Vasantha Madhavi, "Theory of Music", Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana - Vol. 1 (English), Shreenivaasa Prakaashana, 2018.

Reference Books:

1. Lakshminarayana Subramaniam, Viji Subramaniam, "Classical Music of India: A Practical Guide", Tranquebar 2018.
2. R. Rangaramanuja Ayyangar, "History of South Indian (Carnatic) Music", Vipanci Charitable Trust; Third edition, 2019.
3. Ethel Rosenthal, "The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past", Pilgrims Publishing, 2007.
4. Carnatic Music, National Institute of Open Schooling, 2019.

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SEMESTER – III to VI

NATIONAL CADET CORPS (0:0:28:2)0
(Common to all Branches)
(Effective from the academic year 2025 -26)

Course Code	BNCK359/459/559/659	CIE Marks	100
Teaching Hours(L: T:P:S)	0:0:28:2	SEE Marks	-
Total Number of Contact Hours	28 Hours Practical	Exam Hours	-

Mandatory Course (Non-Credit)
(Completion of the course shall be mandatory for the award of degree)

Course Objectives:
This course will enable students to:
- Understand the vision of NCC and its functioning.
- Understand the security set up and management of Border/Coastal areas.
- Acquire knowledge about the Armed forces and general awareness.

Module– 1

Introduction to National Cadet Corp: What is NCC, who can join NCC, benefits, Establishment, history, 3 wings, motto, core values, Aims, flag, song, pledge, cardinals, Organization, Director General NCC, Directorates, Uniform and Cadet ranks, Camps, Certificate exams, Basic aspects of drill.

National Integration: Importance of national integration, Factors affecting national integration, Unity in diversity, Role of NCC in nation building.

Disaster Management: What is a Disaster, Natural and Man-made disasters, Earthquake, Floods.

(04 Hours)

Module– 2

Indian Army: Introduction to Indian Army, Command and control, Fighting & supporting arms, Rank structure, Major Regiments of the Army, Major Wars and Battles, Entry to the Indian Army, Renowned leaders and Gallantry Awardees.

(02 Hours)

Module– 3

Indian Air Force: Introduction to Indian Air Force, Command and control, Rank structure, Major Aircrafts, Entry to the Indian Air Force, Renowned leaders.

Indian Navy: Introduction to Indian Navy, Command and control, Rank structure, Major Ships and Submarines, Entry to the Indian Navy, Renowned leaders. **(02 Hours)**

Module– 4

Health and Hygiene: First Aid Protocols - CPR, Understanding Types of Bandages, Fire Fighting

Field & Battle Crafts: Field Signals using hands, Judging distance -Types of Judging Distance, Section formations-types of Section Formation **(10 Hours)**

Module– 5

Drill Practicals: Savdhan, Vishram, Salute, Turning, Marching.

(08 Hours)

Course outcomes:

The students will be able to:

CO1: Develop qualities like character, comradeship, discipline, leadership, secular outlook, spirit of adventure, ethics and ideals of selfless service.

CO2: Get motivated and trained to exhibit leadership qualities in all walks of life and be always available for the service of the nation.

CO3: Familiarize on the issues related to social & community development and disaster management and equip themselves to provide solutions.

CO4: Get an insight of the defense forces and further motivate them to join the defense forces.

Teaching Practice:

- Blackboard/Multimedia Assisted Teaching.
- Class Room Discussions, Brainstorming Sessions, Debates.
- Activity: Organizing/Participation in Social Service Programs.
- On Ground: Drill training.

CIE: 100 Marks

- CIE 1 for 40 marks – A theory paper which is MCQ / Descriptive conducted during the semester.
- CIE 2 for 60 marks – A practical test conducted at the end of the semester.

Text Books:

1. NCC Cadets Handbook –Common Directorate General of NCC, New Delhi.
2. NCC Cadets Handbook –Special(A), Directorate General of NCC, New Delhi.

Reference Books:

1. Chandra B. Khanduri, "Field Marshal KM Cariappa: a biographical sketch", Dev Publications,2000.
2. Gautam Sharma, "Valour and Sacrifice: Famous Regiments of the Indian Army", Allied Publishers,1990.

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SEMESTER – IV

ENGLISH COMMUNICATIONS SKILL II(0:0:28:0) NCMC

(Common to all Branches, for Lateral Entry Diploma students)

(Effective from the academic year 2025-2026)

Course Code	**BENGDIP2**	CIE Marks	100
Teaching Hours(L: T:P:S)	0:0:28:0 - NCMC	SEE Marks	-
Total Number of Lecture Hours	28 Hours Practical	Total marks	100

Course objectives:

This course will enable students to

1. Identify the Common Errors in Writing and Speaking of English.
2. Achieve better technical writing and Presentation skills for employment.
3. Acquire Employment and Workplace communication skills.
4. Enhance their conversation and public speaking skills.

Module – 1: Advanced Vocabulary

Introduction, learning through speeches, Descriptions, Word formation, Synonyms, Antonyms, learning words through situations, Homonyms and Homophones, Words often confused, One word substitution, Phrasal verbs, Idiomatic expressions, Developing technical vocabulary, Eponyms, Jumbled sentences: Introduction, Steps to approach jumbled sentences, Unscrambling a paragraph

(4 Hours)

Module – 2: Technical Reports and Proposals

Reports and Proposals: Introduction, Definition, Salient Features, Significance, Types, Use of Graphic Aids/Illustrations, Preparation and Planning, Data Collection, Analyzing and Organizing the Data, Writing and Revising, Preparing an Outline, Structure of Formal Reports Styles of Reports, Preparing a Checklist, Sample Reports, Technical Proposals - Purpose Importance, Types and
Structure.

(4 Hours)

Module – 3: Technical Writing Skills

Email and Other Writings: Introduction, Email Writing- Reasons for Popularity, Some Common Pitfalls, Guiding Principles for Composition, Maintaining Common Etiquette. Itinerary Writing, Inter-office Memorandum (Memos), Circulars, Notice, Agenda, and Minutes, Writing Instructions, Advertising.

Blogs and Reviews: Introduction, Movie Review, Book Review, Blog Writing **(6 Hours)**

Module – 4: Professional Speaking Practices

Conversations, Dialogues and Debates: Introduction, Purpose of General Conversations, Features of a Good Conversation, Tips for Improving Conversations, Short Conversations, Telephonic Skills, Debate, Situational Dialogues and Role Plays.

The Art of Negotiation: Introduction, Definition, Different Types of Negotiation Styles, Tips for
Win-Win Negotiation.

(6 Hours)

Module – 5: Communication in Workplace.

Public Speaking: Introduction, choosing an appropriate pattern, selecting an appropriate method, Art of Persuasion, making speeches interesting, Delivering different types of speeches. **Group Discussion:** Introduction, Definition, Difference between GD and debate, Number and duration, Personality traits to be evaluated, Dynamics of Group Behaviors/Group Etiquette and mannerisms, Type, opening of a GD, summarizing a discussion, Some tips for GD

Job Interviews: Introduction, Definition, Process, Stages of Interview, Types, Desirable Qualities, Preparation, Using Proper Verbal and Non-verbal Clues, Exhibiting Confidence, Tips for Success.

(6 Hours)

Course Outcomes: The students will be able to:

1. Understand and identify the Common Errors in Writing and Speaking.
2. Enhance Technical Writing and Presentation skills.
3. Exhibit Employment and Workplace communication skills.
4. Analyze and apply various Techniques of Information Transfer through presentation in different levels

Text Books:

1. "Professional Writing Skills in English" published by Fillip Learning – Education (ILS), Bangalore – 2022.
2. "Functional English" (As per AICTE 2018 Model Curriculum) (ISBN-978-93-5350-047-4) Cengage learning India Pvt Limited [Latest Edition 2019]

Reference Books:

1. Gajendra Singh Chauhan, Technical Communication, Cengage Learning India Pvt Limited, Latest Revised Edition, 2019
2. N.P. Sudharshana and C. Savitha, English for Engineers, Cambridge University Press ,2018. Meenakshi Raman and Sangeetha Sharma, Technical Communication – Principles and Practice, Oxford University Press, Third Edition 2017.