



SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 - 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV, AE) and NAAC with 'A+' grade, QS - I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – CSE

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

3rd Semester

Computer Science and Engineering												
Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BMATS301	Probability and Statistics	ASC	MAT	3	2	0	3	50	50	100	4
2	BCS302	Digital Design & Computer Organization	IPCC	CSE	3	0	2	3	50	50	100	4
3	BCS303	Operating System	IPCC	CSE	3	0	2	3	50	50	100	4
4	BCS304	Data Structures and Applications	PCC	CSE	3	0	0	3	50	50	100	3
5	BCSL305	Data Structures Lab	PCCL	CSE	0	0	2	3	50	50	100	1
6	BCS306x	ESC/ETC/PLC	ESC	CSE	If the course is a Theory			3	50	50	100	3
					3	0	0					
					If the course is a Laboratory							
					2	0	2					
7	BSC307	Social Connect and Responsibility	UHV	ANY	0	0	2	-	100	-	100	1

				DEPT								
8	BXX308x	Ability Enhancement Course/Skill Enhancement Course – III	AEC/ SEC	CSE	If the course is a Theory			1	50	50	100	1
					1	0	0					
					If the course is a Laboratory			2				
					0	0	2					
9	BES309	Environmental Studies	MC	Civil	1	0	0	1	50	50	100	1
10	BNS310	National Service Scheme (NSS)	NCMC	NSS Coordinat or	0	0	2	-	100	-	100	0
	BPE310	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO310	Yoga		Yoga Teacher								
	BMU310	Music		Music Teacher								
11	BCE311	Competency Enhancement Course-1	NCMC	CDCAC	2	0	0	-	100	-	100	0
									700	400	1100	22

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)

Course Code	Course Name	Course Code	Course Name
BCS306A	Numerical Techniques	BCS306C	Web Application Development with HTML and PHP
BCS306B	Object Oriented Programming with C++	BCS306D	Unix and Shell Programming

Ability Enhancement Course/Skill Enhancement Course – III			
Course Code	Course Name	Course Code	Course Name
BCS308A	MS Office and Latex	BCS308C	Project Management with Git
BAD308B	Data Analytics with R Programming	BCS308D	Data Visualization with Python
<p>Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). 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 (B.E.) 2024-25 may please be referred.</p> <p>National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th 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, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.</p>			

Semester: III					
Probability and Statistics					
Course Code	:	BMATS301	Credits	:	4
Hours/Week (L:T:P)	:	3:2:0	CIE	:	50 Marks
Total Hours	:	50Hrs	SEE	:	50 Marks
Course Type	:	ASC	SEE Duration	:	3 Hours

Prerequisites:

Courses	Basic Mathematics
Knowledge on Fundamental Concepts	Basic differentiation and Integration
Knowledge on Connected Tools (If any)	Basic computer knowledge

Course Learning Objectives: This course will enable the students to

CLO1	Find the association between attributes and the correlation between two variables.
CLO2	Introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
CLO3	Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
CLO4	Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.
CLO5	Find the association between attributes and the correlation between two variables.

MODULE- 1	10Hrs
Curve fitting and Statistical Analysis: Curve fitting by method of least squares: $y = ax+b$, $y = ax^2 + bx+c$ and $y = ab^x$, Correlation–Karl Pearson’s coefficient of correlation, Rank correlation and Regression analysis – lines of regression (without proof)- problems. Self-study: Curve fitting by method of least squares: $y = ae^{bx}$, ax^b . Applications: Multiple regression in performance tuning and optimization in software engineering. Textbook 1: Ch. 24: 24.5(a), 24.5(b), 24.6(1). Ch. 25: 25.12, 25.13, 25.16, 25.14 Text book 2: Ch. 11: 11.1 - 11.3, Ch. 12	
MODULE- 2	10Hrs
Probability Distributions-1: Random Variables (Discrete and Continuous). Probability mass and density functions. Mathematical expectation, Mean and variance. Discrete probability distributions: Binomial, Poisson, and Normal distributions (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Self-study: Exponential distribution. Applications: Analyse the performance of the algorithms. Text book 1: Ch. 4: 4.1-7.4.1 & Ch. 5: 5.1 - 5.4	
MODULE-3	10Hrs
Probability Distributions-2: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient. Stochastic process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.	

Self-study: Joint Probability distribution for two continuous random variables

Applications : Rank web pages based on their importance.

Text book 2: Ch. 3: 3.1-3.4, Ch. 5: 5.2-5.5

MODULE-4

10Hrs

Sampling Theory: Introduction, sampling distribution, standard error, Type-I and Type-II errors. Testing of hypothesis, levels of significance, confidence limits, test of significance for large samples for mean and proportions. test of significance for small samples - Students 't' distribution, Chi-square distribution as a test of goodness of fit.

Self-study: sampling of attributes, F-distribution.

Applications: Data analysis and Cryptography.

Text book 2: Ch. 1: 1.1-1.2, Ch. 6: 6.7, Ch. 8: 8.1-8.6, Ch. 10: 10.1-10.8

MODULE-5

10Hrs

Design of Experiments & ANOVA:

Principles of experimentation in design, The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design.

Self-study: Analysis of completely randomized design, randomized block design.

Applications: Comparison of algorithm performance.

Text book 3: Ch. 1- Ch. 5

Course Outcomes: After completing the course, the students will be able to

CO1	Analyze data using correlation and regression techniques and Apply the principles of least squares to perform curve fitting.
CO2	Utilize probability distributions and random variable concepts to model and simulate uncertainties in engineering systems such as atmospheric turbulence.
CO3	Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem.
CO4	Apply statistical inference techniques including hypothesis testing, error analysis.
CO5	Develop the knowledge of experimental design and perform statistical analysis using ANOVA techniques.

Text Books

1	"A First Course in Probability", Sheldon Ross ,10 th edition, 2019, ISBN-13: 978-0134753119
2	"Probability and Statistics for Engineers and Scientists", Ronald E. Walpole et al., 9 th edition, 2010, ISBN-13: 978-0321629111
3	"Design and Analysis of Experiments", Douglas C. Montgomery's, 9 th edition, 2012, ISBN-13: 978-1118146927

Reference Books

1	"Calculus", James Stewart: Cengage Publications, 7 th edition, 2019.
2	"Engineering Mathematics", Srimanta Pal & Subodh C.Bhunja: Oxford University Press, 3 rd edition., 2016.

3	"A Textbook of Engineering Mathematics", N.P Bali and Manish Goyal: Laxmi Publications, 10 th edition, 2022
4	"Advanced Engineering Mathematics", C. Ray Wylie, Louis C. Barrett: McGraw – Hill Book Co., New York, 6 th edition, 2017.
5	"Higher Engineering Mathematics", H.K. Dass and Er. Rajnish Verma: S.Chand, 3rd edition, Publication, 2014.

Web links and Video Lectures (e – Resources)	
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1	https://nptel.ac.in/courses.php?disciplineID=111
2	https://www.class-central.com/subject/math(MOOCs)

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2					2	2	
CO2	3	3	2	2					2	2	
CO3	3	3	3	3		1			2	2	
CO4	3	3	3	2		1			2	2	
CO5	3	3	3	2		1			2	2	

Semester: III					
Digital Design & Computer Organization					
Course Code	:	BCS302	Credits	:	4
Hours/Week(L:T:P)	:	3:0:2	CIE	:	50 Marks
Total Hours	:	40+12 Hrs	SEE	:	50 Marks
Course Type	:	IPCC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Basic knowledge of electronics
Knowledge on Fundamental Concepts	Understanding of number systems, Boolean algebra, logic gates, combinational and sequential circuits, data representation.
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Demonstrate the functionalities of binary logic system.
CLO2	Explain the working of combinational and sequential logic system.
CLO3	Realize the basic structure of computer system.
CLO4	Illustrate the working of I/O operations and processing unit.
CLO5	Implement efficient arithmetic operations.

Module – 1		08Hrs
Introduction to Digital Design: Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.		
Text book 1: Ch. 1:1.9, Ch. 2: 2.4, 2.5, 2.8, Ch. 3: 3.1, 3.2, 3.3, 3.5, 3.6, 3.9		
Module – 2		08Hrs
Combinational Logic: Introduction, Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. Sequential Logic: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.		
Text book 1: Ch. 4: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, Ch. 5: 5.1, 5.2, 5.3, 5.4.		
Module – 3		08Hrs
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.		
Text book 2: Ch. 1: 1.2 to 1.4, 1.6, Ch. 2: 2.2, 2.3 to 2.5		
Module – 4		08Hrs
Input/output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration,		

Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

Text book 2: Ch. 4: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, Ch. 5: 5.4, 5.5.1

Module – 5

08Hrs

Arithmetic: Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, signed – operand multiplication, fast multiplication.

Text book 2: Ch. 6: 6.1 to 6.5

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant
1.	Given a 4-variable logic expression, simplify it using appropriate technique and implement the same using basic gates.
2.	Implement Binary– Half and Full Adder, Half and Full Subtractor. using basic gates
3.	Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model.
4.	Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor.
5.	Design Verilog HDL to implement Decimal adder.
6.	Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1.
7.	Design Verilog program to implement types of De-Multiplexer.
8.	Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D.

Course Outcomes: After completing the course, the students will be able to

CO1	Recall and define the fundamental concepts of digital design, computer organization components.
CO2	Explain the working principles and basic theorems of digital design and the purpose of memory and I/O organization in digital systems.
CO3	Apply Boolean algebra and K-map techniques to simplify logic expressions, for the construction of combinational circuits.
CO4	Analyze the structure and performance of digital systems to determine their operational effectiveness.
CO5	Evaluate, compare and recommend optimized solutions in various applications of digital design and computer operations.

Text Books

1	“Digital Design With an Introduction to Verilog Design”, M. Morris Mano, Michael D. Ciletti, 5 th Edition, 2013, Pearson Education. ISBN-10: 8131794741.
2	“Computer Organization”, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 5 th Edition, 2019, Tata McGraw Hill. ISBN-13: 9781259005275.

Reference Books

1	“Digital Design and Computer Architecture”, David Money Harris and Sarah L. Harris, 1 st Edition, 2007, Elsevier, ISBN 9780080922812.
2	“Computer Organization and Architecture”, William Stallings, 11 th Edition, 2022, Pearson Education. ISBN-10: 9356061599.

Web links and Video Lectures (e - Resources)	
1	https://www.youtube.com/watch?v=g3oSkhK9ghg&list=PLDVWzw0WSIX6sIZo1WiVFo_oEFOV3d0LNx
2	https://www.youtube.com/watch?v=CDO28Esqmcg&list=PLhwVAYxlh5dvB1MkZrcRZy6x_a2yORNAu

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	3	2		2			2	1		1
CO2	3	3	1		2			2	1		1
CO3	3	2			2			2	1		1
CO4	3	2			2			2	1		1
CO5	3	2	1	1	2				1		1

Semester: III			
Operating System			
Course Code	: BCS303	Credits	: 4
Hours/Week(L:T:P)	: 3:0:2	CIE	: 50 Marks
Total Hours	: 40+14 Hrs	SEE	: 50 Marks
Course Type	: IPCC	SEE Duration	: 3 Hours

Prerequisites:	
Courses	Problem Solving through C.
Knowledge on Fundamental Concepts	Computer fundamentals, Arrays, Structures .
Knowledge on Connected Tools (If any)	Command-line tools, GNU debugger.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts and functionalities of operating systems, including process management, memory management, file systems, and input/output systems.
CLO2	Analyze the structure and components of modern operating systems and evaluate their role in resource management and system performance.
CLO3	Apply concepts of concurrency, synchronization, and deadlock handling to develop efficient system-level solutions.
CLO4	Examine memory allocation techniques, including paging and segmentation, and their impact on system performance.
CLO5	Explore file system design, disk scheduling algorithms, and I/O systems to understand data storage and retrieval mechanisms.

Module - 1	08Hrs
Introduction to operating systems, System structures: What operating systems do, Computer System organization, Computer System architecture, Operating System structure, Operating System operations, Process management, Memory management, Storage management, Protection and Security, Distributed system, Special-purpose systems, Computing environments. Operating System Services: User - Operating System interface, System calls, Types of system calls, System programs, Operating system design and implementation, Operating System structure, Virtual machines, Operating System debugging, Operating System generation, System boot.	
Text Book 1: Ch. 1: 1.1-1.12, Ch. 2: 2.2-2.11	
Module - 2	08Hrs
Process Management: Process concept; Process scheduling, Operations on processes, Inter process communication. Multi-threaded Programming: Overview, Multithreading models, Thread Libraries, Threading issues. Process Scheduling: Basic concepts, Scheduling Criteria, Scheduling Algorithms, Thread scheduling, Multiple-processor scheduling,	
Text Book 1: Ch. 3: 3.1-3.4, Ch. 4: 4.1-4.4, Ch. 5: 5.1 -5.5	

Module - 3		08Hrs
Process Synchronization: Synchronization: The critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classical problems of synchronization. Deadlocks: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock.		
Text Book 1: Ch. 6: 6.1-6.6 , Ch. 7: 7.1 -7.7		
Module - 4		08Hrs
Memory Management: Memory management strategies: Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.		
Text Book 1: Ch. 8: 8.1-8.6, Ch. 9: 9.1-9.6		
Module - 5		08Hrs
File System, Implementation of File System: File system: File concept, Access method, Directory and Disk structure, File system mounting, File sharing, Implementing File system, File system structure, File system implementation, Directory implementation, Allocation methods, Free space management. Secondary Storage Structure, Protection: Mass storage structures, Disk structure, Disk attachment, Disk scheduling, Disk management. Protection: Goals of protection, Principles of protection, Domain of protection, Access matrix and its Implementation.		
Text Book 1: Ch. 10: 10.1-10.5, Ch. 11: 11.1-11.5 , Ch. 12: 12.1-12.5 , Ch. 17: 17.1 - 17.5		

Course Outcomes: After completing the course, the students will be able to	
C01	Understand the architecture, services, and functionalities of modern operating systems.
C02	Apply knowledge of process management, including scheduling algorithms, inter-process communication, and synchronization techniques
C03	Analyze and compare memory management strategies such as paging, segmentation, and virtual memory.
C04	Examine the structure and management of file systems and apply disk scheduling techniques.
C05	Analyze the mechanisms of I/O management and evaluate the role of device drivers and interrupt handling in efficient system performance.

Practical Component:

Instructions: Implement the specified program in C by clearly defining input/output behavior, structuring it into functions using Vim, Gedit

Sl.N O	Experiments
1	Demonstrate by creating five Child Processes using system call fork () and display their ids

2	Simulate CPU scheduling: FCFS, SJF, Round Robin, Priority (compute turn around and wait times)
3	Implement Producer–Consumer problem using semaphores.
4	Implement IPC via FIFO (named pipe): implement reader–writer process interaction
5	Demonstrate FIFO, LRU, optimal Page replacement algorithm to determine number of page faults.
6	Demonstrate Banker's Algorithm for deadlock avoidance and safe state determination
7	Implement Memory allocation strategies: First Fit, Best Fit, Worst Fit.
8	Implement file system simulation using hierarchical directory structure (simulate mkdir, ls, cd).
9	Simulate disk scheduling algorithm like SCAN, LOOK, C-LOOK and SSTF.
10	Demonstration of installation of Kali Linux using Vmware and study of Unix/Linux general purpose utility command List: man, who, cat, cd, cp, ps, ls etc...

Text Books

1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015, 978-0-470-12872-5
2	Raphaël Hertzog, Jim O’Gorman, Mati Aharoni, Kali Linux Revealed: Mastering the Penetration Testing Distribution, Offsec Press, 2017, ISBN-13: 9780997615609.

Reference Books

1	Ann McHoes, Ida M. Flynn, Understanding Operating Systems 6th Ed., Cengage Learning, 2010, ISBN-13: 9781439079201.
2	D. M. Dhamdhare, Operating Systems: A Concept Based Approach 3rd Ed., McGraw Hill, 2013, ISBN-13: 9781259005589.
3	P. C. P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Ed., PHI Learning, 2014, ISBN-13: 9788120348363.
4	William Stallings, Operating Systems: Internals and Design Principles 6th Ed., Pearson, 2008, ISBN-13: 9780136006329.

Web links and Video Lectures (e - Resources)

1	https://youtu.be/mXw9ruZaxzQ
2	https://youtu.be/vBURTt97EkA
3	https://www.youtube.com/watch?v=783KABtuE4&list=PLIemF3uozcAKTgsCij82voMK3TMR0YE_f

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
C01	2	2	2		2	1			1		2
C02	3	3	3		2						2
C03	3	3	3		2						2
C04	3	2	3		2						2
C05	2	2	3		2						2

Semester: III					
Data Structures and Applications					
Course Code	:	BCS304	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50Marks
Total Hours	:	40 Hrs	SEE	:	50Marks
Course Type	:	PCC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving through programming.
Knowledge on Fundamental Concepts	Programming skills
Knowledge on Connected Tools (If any)	Text Editor

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the knowledge of the fundamentals of data structures and their applications.
CLO2	Illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO3	Use linear data structures to design and develop solutions to real world problems.
CLO4	Discuss applications of Nonlinear Data Structures in problem solving.
CLO5	Apply the hashing techniques in mapping key value pairs and Optimal Binary Search Trees.

Module - 1	08Hrs
Introduction: Data and Information, Data Structure, Classification of Data Structures, Operations on Data Structure, Pointers and Dynamic Memory Allocation. Arrays and Structures: Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Representation of Multidimensional Arrays, Strings. Text Book: Ch 1: 1.2, Ch 2: 2.1-2.7	
Module - 2	08Hrs
Stacks: Definition, Operations, array representations of stacks, Stacks using Dynamic Arrays, Different representation of expression. Stack applications -Infix to postfix conversion, Postfix expression evaluation, function call tracing, recursion. Queues: Definition, Array Representation, Queue Operations, using Dynamic arrays, De-queues, Priority Queues. Text Book: Ch 3: 3.1,3.2,3.4-3.6	
Module - 3	08Hrs
Linked Lists: Singly linked list implementation, insertion, deletion and searching operations on linear list, Circularly linked lists- insertion, deletion and searching Operations for Circularly linked lists, doubly linked list implementation, insertion, deletion and searching operations, applications of linked lists – Stack and queue implementation, Manipulation of polynomials (addition), representing sparse matrices. Text Book: Ch 4: 4.1-4.5,4.7,4.8	
Module - 4	08Hrs

Trees: Terminologies, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Binary Search Trees – Definition, Insertion, Deletion, Traversal, and Searching operation on Binary search tree. Application of Trees-Evaluation of Expression, Selection tree, Forests.

Text Book: Ch 5: 5.1-5.3, 5.7-5.9.

Module – 5		08Hrs
Introduction To Efficient Binary Search Trees: Optimal Binary Search Trees		
Graphs: Definitions, Terminologies, Representation of Graphs, Elementary Graph Operations- Breadth First Search, Depth First Search.		
Hashing: Hash Table organizations, Hashing Functions, Static and Dynamic Hashing, collision resolution techniques.		
Text Book: Ch 6: 6.1,6.2 Ch 8:8.1 -8.3, Ch 10: 10.1		

Course Outcomes: After completing the course, the students will be able to	
CO1	Infer the concept of linear and nonlinear data structures.
CO2	Apply array, stack and queue concepts to solve problems.
CO3	Apply linked list concepts to solve real world problems
CO4	Analyze Tree Data Structure to develop solutions for real-world problems.
CO5	Apply graph traversal techniques to search and hashing techniques to organize the data.

Text Book	
1	“Fundamentals of Data Structures in C”, Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, , 2nd Ed, Universities Press, 2023, ISBN:978 81 7371 605 8

Reference Books	
1	“Data Structures: A Pseudo-code approach with C”, Gilberg & Forouzan, 2 nd Edition, Cengage Learning, 2014, ISBN: 978-8131503140
2	“An Introduction to Data Structures with Applications”, Jean-Paul Tremblay & Paul G. Sorenson, , 2 nd Edition, McGraw Hill, 2013, ISBN: 978-0074624715
3	Data Structures using C, Reema Thareja, 3 rd Edition, 2012 Oxford press.

Web links and Video Lectures (e – Resources)	
1	https://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
2	https://nptel.ac.in/courses/106/105/106105171/
3	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
4	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
5	https://nptel.ac.in/courses/106/102/106102064/

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2	1		1						2
CO2	3	3	2	2	2						2
CO3	3	2	2	2	2						2
CO4	3	3	3	3	3	1					3
CO5	3	3	2	3	3	1					3

Semester: III					
Data Structures Lab					
Course Code	:	BCSL305	Credits	:	1
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50Marks
Total Hours	:	15 Hrs	SEE	:	50Marks
Course Type	:	PCCL	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming
Knowledge on Fundamental Concepts	C programming concepts
Knowledge on Connected Tools (If any)	Editor

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the knowledge of dynamic memory management concepts in C
CLO2	Illustrate various Linear data structures and their applications such as stacks, queues and lists
CLO3	Illustrate various Non-Linear data structures and their applications such as trees and graphs
CLO4	Develop problem-solving skills by applying appropriate data structures.
CLO5	Integrate file handling techniques with data structures.

Practical Component:

Sl.NO	Experiments
1	<p>Develop a Program in C for the following:</p> <p>a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String).</p> <p>b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen.</p>

2	<p>Develop a Program in C for the following operations on Strings. a. Read a main String (STR),</p> <p>a Pattern String (PAT) and a Replace String (REP)</p> <p>b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR.</p> <p>Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Don't use Built-in functions.</p>
3	<p>Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)</p> <p>a. Push an Element on to Stack</p> <p>b. Pop an Element from Stack</p> <p>c. Demonstrate how Stack can be used to check Palindrome</p> <p>d. Demonstrate Overflow and Underflow situations on Stack</p> <p>e. Display the status of Stack</p> <p>f. Exit</p> <p>Support the program with appropriate functions for each of the above operations</p>
4	<p>Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands.</p>
5	<p>Develop a Program in C for the following Stack Applications</p> <p>a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^</p> <p>b. Solving Tower of Hanoi problem with n disks</p>
6	<p>A food delivery app handles customer orders as they arrive. The orders must be processed in the order they were received, making queue data structure ideal. Design and implement a C program to simulate this system using a Circular queue. Program should have options to add and remove the food orders in appropriate order for their service. (Array Implementation of Queue with maximum size MAX). Include C functions to perform the following operations.</p> <p>a. Add a new food order.</p> <p>b. Delete an older order.</p> <p>c. Display all current orders in queue.</p> <p>d. Demonstrate Overflow and Underflow conditions.</p>
7	<p>A student To-Do Task Manager app allows the students to manage academic Task with member's id, title, dueDate, Category, priority. The facilities to be provided for the users are as follows</p> <p>a. Create a Tasks.</p>

	b. Add Task to start/end. c. Delete Task from start/end. d. View first/last task. e. Handle empty list conditions Design and Implement a menu driven Program in C for the above operations using Singly Linked List.
8	Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue. f. Exit
9	Develop a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z - 4yz^5 + 3x^3yz + 2xy^5z - 2xyz^3$ b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10	Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers . a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Exit
11	Develop a Program in C for the following operations on Graph(G) of Cities a. Create a Graph of N cities using Adjacency Matrix. b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method
12	Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function $H: K \rightarrow L$ as $H(K) = K \bmod m$ (remainder method), and implement hashing

	technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.
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Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze various linear and non-linear data structures
CO2	Demonstrate the working of different types of data structures
CO3	Apply appropriate searching and sorting algorithms for the given scenario.
CO4	Apply the appropriate data structure for solving real world problems
CO5	Design and formulate various methods of organizing data
Web links and Video Lectures (e - Resources)	
1	http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
2	https://nptel.ac.in/courses/106/105/106105171/
3	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
4	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
5	https://nptel.ac.in/courses/106/102/106102064/

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2						2
CO2	3	2	3	2	2						2
CO3	3	3	3		3	1		1	2		3
CO4	3	3	3	2	2	2		2	2		3
CO5	3	2	3	2	3	1		2	2		3

Semester: III					
Numerical Techniques					
Course Code	:	BCS306A	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Calculus, Linear Algebra, Differential Equations
Knowledge on Fundamental Concepts	Numerical methods for solving equations, interpolation, numerical integration, and error analysis
Knowledge on Connected Tools (If any)	MATLAB, GNU Octave

Course Learning Objectives: This course will enable the students to	
CLO1	Describe the concepts and methods of numerical differentiation and integration including adaptive and Gaussian techniques.
CLO2	Implement various numerical methods for solving ordinary differential equations including Runge-Kutta and predictor-corrector techniques.
CLO3	Apply finite difference and iterative techniques for solving partial differential equations numerically.
CLO4	Solve systems of linear algebraic equations using direct and iterative numerical methods.
CLO5	Construct solutions for engineering problems using the finite element method, Rayleigh-Ritz, and Galerkin approaches.

Module – 1	08Hrs
Numerical Differentiation and Integration Introduction, Numerical Differentiation, Numerical Integration, Euler-Maclaurin Formula, Adaptive Quadrature Methods, Gaussian Integration, Singular Integrals, Fourier Integrals, Numerical Double Integration. Applications: Link of Robotic Arm using MATLAB Self-study: Multiple Integrals Text Book 1: Ch. 11, Ch. 12: 12.2, 12.3, 12.4, 12.5, 12.8 Text Book 2: Ch. 5: 5.2, 5.4, 5.5, 5.6, 5.7, 5.9, 5.10	
Module – 2	08Hrs
Numerical Solution of Ordinary Differential Equations Introduction, Solution by Taylor's Picard's Method, Euler's Method, Runge-Kutta Methods, Predictor-Corrector Methods, the Cubic Spline Method, Simultaneous and Higher Order Equations, Boundary Value Problems: The Shooting Method, Finite-Difference Method. Applications: Phase-Locked Loop using MATLAB Self-study: Error estimation for the Euler method Text Book 1: Ch. 13: 13.2, 13.3, 13.6, 13.11, Ch. 14: 14.2, 14.3 Text Book 2: Ch. 7: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.10	

Module – 3	08Hrs
Numerical Solution of Partial Differential Equations Introduction, Finite-Difference Approximations, Laplace's Equation: Jacobi's Method, Gauss-Seidel Method, SOR Method, ADI Method, Parabolic Equations, Iterative Methods, Hyperbolic Equations. Applications: Plate Deflection using MATLAB Self-study: Laplace equation Text Book 1: Ch. 15: 15.2, 15.3, 15.4, 15.5 Text Book 2: Ch. 8: 8.1, 8.2, 8.3, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.4, 8.5, 8.6	
Module – 4	08Hrs
System of Linear Algebraic Equations Introduction, Solution of Centro-symmetric Equations, Direct Methods, LU- Decomposition Methods, Iterative Methods, ILL-conditioned Linear Systems. Applications: Singular value decomposition Self-study: Consistency of linear system of equations Text Book 2: Ch. 6: 6.1, 6.3, 6.3.6, 6.3.10, 6.3.11	
Module – 5	08Hrs
The Finite Element Method: Functionals- Base Function Methods of Approximation- The Rayleigh - Ritz Method -The Galerkin Method, Application to two dimensional problems Finite element Method for one and two dimensional problems. Applications: Application to two dimensional problems Self-study: Finite element method for two dimensional. Text Book 2: Ch. 10: 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3, 10.4.1, 10.4.2	

Course Outcomes: After completing the course, the students will be able to

CO1	Explain the principles of numerical integration, including singular and Fourier integrals and their practical applications.
CO2	Demonstrate the use of ODE solvers such as Euler's, Taylor's, and spline methods to compute approximate solutions.
CO3	Utilize numerical methods like Jacobi, Gauss-Seidel, SOR, and ADI to solve PDEs in different forms.
CO4	Analyze and compare the accuracy and stability of LU-decomposition and iterative methods in solving linear systems.
CO5	Develop approximate solutions for 1D and 2D boundary value problems using Finite Element Methods.

Text Books

1	"Numerical Methods", Balagurusamy, Standard Edition, July 2017, Tata McGraw –Hill, 978-0074633113
2	"Introductory Methods of Numerical Analysis", S.S. Sastry., 4 th edition, February 2005, Prentice Hall of India Private Limited, 81-203-2761-6

Reference Books

1	"Numerical Analysis and Algorithms", Niyogi, Pradip, Tata McGraw –Hill, 9780070494930 2003
2	"Applied Numerical Methods for Engineers using MATLAB and C", Robert j, Schilling and Sandra L. Harris., Thomson Asia Pte Ltd., 981-240-602-6, 2002
3	"Numerical Analysis", Ranganatham, Prasad, Ramesh Babu, S. Chand & Company PVT.LTD., 4 th ed, 2016, 978-525-3345-9

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2	1	1		1				1	1
CO2	3	3	2	2		1				1	1
CO3	3	3	2	2		1					1
CO4	3	3	2	3		1					1
CO5	3	3	3	3		1					2

Semester: III					
Object Oriented Programming with C++					
Course Code	:	BCS306B	Credits	:	3
Hours/Week(L:T:P)	:	2:0:2	CIE	:	50 Marks
Total Hours	:	30+10 Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming
Knowledge on Fundamental Concepts	Basic understanding of programming logic, data types, control structures, operators, and functions.
Knowledge on Connected Tools (If any)	Visual Studio Code , Code::Blocks

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the basics of object-oriented programming in C++ for organizing and storing related data using objects
CLO2	Implement constructors in C++ which are special type of functions.
CLO3	Demonstrate how a class can depend on another class to achieve modular and reusable code
CLO4	Analyze the use of virtual functions and explain their role in enabling runtime polymorphism
CLO5	Apply exception handling techniques and use file I/O operations to process data.

Module – 1	06Hrs
An overview of C++: What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program. Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment.	
Text Book 1: Ch.11, Ch.12	
Module – 2	06Hrs
Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, The this Pointer, Pointers to derived types, Pointers to class members Functions Overloading, Copy Constructors: Functions Overloading, Overloading	

Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.

Text Book 1: Ch.13, Ch.14

Module – 3

06Hrs

Operator Overloading: Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete

Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes.

Text Book 1: Ch.15, Ch.16

Module – 4

06Hrs

Virtual Functions and Polymorphism: Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding.

Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates

Text Book 1: Ch.17, Ch.18

Module – 5

06Hrs

Exception Handling: Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling.

The C++ I/O System Basics: C++ Streams, The C++ Classes, Formatted I/O File I/O: <fstream> and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF.

Text Book 1: Ch.19, Ch.20, Ch.21

Course Outcomes: After completing the course, the students will be able to

C01	Describe the fundamental principles of Object-Oriented Programming and demonstrate the use of C++ classes, objects.
C02	Demonstrate the use of constructor overloading to provide multiple ways of initializing objects.
C03	Develop efficient, reusable, and well-structured object-oriented solutions by applying inheritance principles
C04	Implement compile-time and run-time polymorphism to solve the given problem.
C05	Analyze the interaction between exception handling and file I/O in building reliable C++ programs.

Text Book

1	"The Complete Reference C++", Herbert Schildt, 4 th Edition, McGraw-Hill Education, 2005, ISBN: 0072226803
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Reference Books

1	"Object Oriented Programming with C++", A K Sharma , Pearson Education, 2014 ISBN-13: 9789332535804
2	" Object Oriented Programming With C++", M.P. Bhawe , Pearson Education , 2004 ISBN-13: 9788177583077

Web links and Video Lectures (e - Resources)	
1	Basics of C++ - https://www.youtube.com/watch?v=BCIS40yzssA
2	https://www.w3schools.com/cpp/cpp_intro.asp 2.
3	https://www.edx.org/course/introduction-to-c-3
4	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384364250678886443375_s_hared/overview
5	https://onlinecourses.nptel.ac.in/noc20_cs07/preview

Practical Component

Note: Design, develop, and implement the following problem statements using C++

Sl.NO	Experiments:
1.	To find the largest of three numbers
2.	To sort the elements in ascending and descending order.
3.	Using classes to display student name, roll number, marks obtained in two subjects and total score of student
4.	For a bank employee to print name of the employee, account_no. & balance. Print invalid balance if amount<500, Display the same, also display the balance after withdraw and deposit.
5.	To demonstrate function overloading for the following prototypes. add(int a, int b) add(double a, double b)
6.	Using Operator Overloading for overloading Unary minus operator.
7.	Using Multiple inheritance for performing arithmetic operation of two numbers
8.	Using Constructor in Derived classes to initialize alpha, beta and gamma and display corresponding values.
9.	Virtual functions to implement polymorphism
10.	a) To perform simple calculator operation using class template b) To implement stack and its operations using template class
11.	A function which throws a division by zero exception and catch it in catch block.
12.	To handle array out of bound exception.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2		3			1			2
CO2	3	2	2		3			1			2
CO3	3	2	2		3			1			2
CO4	3	2	2		3			1			2
CO5	3	2	2		3			1			2

Semester: III					
Web Application Development with HTML and PHP					
Course Code	:	BCS306C	Credits	:	03
Hours/Week(L:T:P)	:	2:0:2	CIE	:	50 Marks
Total Hours	:	30+10Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving using Programming
Knowledge on Fundamental Concepts	Computer Basics, Basic Logic Building, Text Editing Tools, Web and Internet Basics
Knowledge on Connected Tools (If any)	Notepad++

Course Learning Objectives: This course will enable the students to	
CLO1	Understand web programming fundamentals, HTTP, security, and HTML structure.
CLO2	Describe the syntax, structure, elements, and how HTML and XHTML are different.
CLO3	Use CSS to style, arrange, and structure web pages.
CLO4	Explore the role of JavaScript and the DOM in changing how a page looks and behaves.
CLO5	Build server-side programs using PHP along with web server tools.

Module – 1		06Hrs
Introduction to WEB Programming: Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security. Introduction to HTML, what is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements. Text Book 1: Ch. 1: 1.1 - 1.8		
Module – 2		06Hrs
HTML and XHTML: Origins of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text Markup, Images, Hypertext Links, Lists, and Tables. Forms, Syntactic differences between HTML and XHTML. Text Book 1: Ch. 2: 2.1 - 2.10		
Module – 3		06Hrs
CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The Box Model, Background images, tags. Text Book 1: Ch. 3: 3.1 - 3.12		
Module – 4		06Hrs
JavaScript: What is JavaScript and What can it do? JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events. Text Book 2: Ch. 6: 6.1 - 6.7		

Module – 5	06Hrs
Introduction to Server-Side Development with PHP: What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions, PHP Arrays and Superglobals: Arrays, \$_GET and \$_POST Super global Arrays, \$_SERVER Array, \$_FILES Array, Reading/Writing Files.	
Text Book 2: Ch. 8: 8.1 - 8.5, Ch. 9: 9.1 - 9.5	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamentals of web programming concepts to build structured web pages.
CO2	Design interactive web pages using HTML and XHTML.
CO3	Develop responsive web pages using CSS.
CO4	Apply JavaScript for dynamic and interactive content.
CO5	Analyze server-side processes to design and optimize PHP applications.

Text Books	
1	"Programming the World Wide Web", Robert W Sebesta, 6th Edition, Pearson Education, 2008, ISBN 978-0-13-213081-3.
2	"Fundamentals of Web Development", Randy Connolly, Ricardo Hoar, 1 st Edition, Pearson Education, 2016, ISBN: 978-9332575271.

Reference Books	
1	"Internet & World Wide Web How to program", M.Deitel, P.J.Deitel, A.B.Goldberg, 4 th Edition, 2008, Pearson Education / PHI, ISBN 0-13-175242-1.
2	"Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML5", Robin Nixon, 4 th Edition, 2015, O'Reilly Publications, ISBN: 978-9352130153.
3	"PHP and MySQL Web Development", Luke Welling, Laura Thomson, 5 th Edition, 2016, Pearson Education, ISBN: 978-9332582736.
4	"Professional JavaScript for Web Developers", Nicholas C Zakas, 3 rd Edition, 2012, Wrox/Wiley India, ISBN: 978-8126535088.

Web links and Video Lectures (e – Resources)	
1	Fundamentals of WEB Programming: https://www.youtube.com/watch?v=DR9dr6gxhDM
2	HTML and XHTML: https://www.youtube.com/watch?v=A1XIIDDxgwg
3	CSS: https://www.youtube.com/watch?v=J35jug1uHzE
4	Java Script and HTML Documents: https://www.youtube.com/watch?v=Gd0RBdFRvF0
5	Dynamic Documents with JavaScript: https://www.youtube.com/watch?v=HTFSIJALNKc

PRACTICAL COMPONENT:

Sl.NO	Experiments
1.	<p>Develop the HTML page named as “Myfirstwebpage.html”. Add the following tags with relevant content.</p> <ol style="list-style-type: none"> Set the title of the page as “My First Web Page” Within the body use the following tags: <ol style="list-style-type: none"> Moving text = “Basic HTML Tags” Different heading tags (h1 to h6) Paragraph Horizontal line Line Break Block Quote Pre tag Different Logical Style (,<u>,<sub>,<sup>etc).
2.	<p>Develop the HTML page named as “Table.html” to display your class time table.</p> <ol style="list-style-type: none"> Provide the title as Time Table with table header and table footer, row-span and col-span etc. Provide various colour options to the cells (Highlight the lab hours and elective hours with different colours.) Provide colour options for rows.
3.	<p>Develop an external style sheet named as “style.css” and provide different styles for h2, h3, hr, p, div, span, time, img&a tags. Apply different CSS selectors for tags and demonstrate the significance of each.</p>
4.	<p>Develop HTML page named as “registration.html” having variety of HTML input elements with background colors, table for alignment & provide font colors& size using CSS styles.</p>
5.	<p>Develop HTML page named as “newspaper.html” having variety of HTML semantic elements with background colors, text-colors& size for figure, table, aside, section, article, header, footer... etc.</p>
6.	<p>Apply HTML, CSS and JavaScript to design a simple calculator to perform the following operations: sum, product, difference, remainder, quotient, power, square-root and square.</p>
7.	<p>Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format.</p>
8.	<p>Write a PHP program to display a digital clock which displays the current time of the server</p>
9.	<p>Write a PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.</p>
10.	<p>Develop a PHP program (with HTML/CSS) to sort the student records which are stored in the database using selection sort.</p>

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2		1		2	2	1		2
CO2	2	2	3	2	3	1	2	2	1		2
CO3	2	3	2		3	1	2	1	1		2
CO4	1	1	2	2	2		1	1	1		2
CO5	1	2	2		3	1	2	1	1		2

Semester: III					
Unix and Shell Programming					
Course Code	:	BCS306D	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem solving through Programming
Knowledge on Fundamental Concepts	Basic OS Concepts, Computer Architecture Basics, programming logic and constructs
Knowledge on Connected Tools (If any)	Text editors Vi, Vim, nano, gedit

Course Learning Objectives: This course will enable the students to	
CLO1	Effective use of Unix concepts, commands and terminology
CLO2	Identify, access, and evaluate UNIX file system.
CLO3	Understand UNIX command syntax and semantics.
CLO4	Ability to read and understand specifications, scripts and programs
CLO5	Analyze Facility with UNIX Process.

Module - 1	08Hrs
Introduction of UNIX - Introduction, History, Architecture, Experience the Unix environment, Basic commands ls, cat, cal, date, calendar, who, printf, tty, sty, uname, passwd, echo, tput, and bc.	
Textbook 1: Ch. 1: 1.1 to 1.4 , Ch. 2 :2.1	
Module - 2	08Hrs
UNIX File System - The file, what's in a filename? The parent-child relationship, pwd, the Home directory, absolute pathnames, using absolute pathnames for a command, cd, mkdir, rmdir, Relative pathnames, The UNIX file system.	
Textbook 1: Ch. 4	
Module - 3	08Hrs
Basic File Attributes - ls -l, the -d option, File Permissions, chmod, Security and File Permission, users and groups, security level, changing permission, user masks, changing	

ownership and group, File Attributes, More file attributes: hard link, symbolic link, umask, find.

Textbook 1: Ch. 6

Module - 4

08Hrs

Introduction to the Shell Scripting - Introduction to Shell Scripting, Shell Scripts, read, Command Line Arguments, Exit Status of a Command, The Logical Operators && and ||, exit, if, and case conditions, expr, sleep and wait, while, until, for, \$, @, redirection. The here document, set, trap, Sample Validation and Data Entry Scripts.

Textbook 1: Ch. 11, Ch. 12, Ch. 14

Module - 5

08Hrs

Introduction to UNIX System process: Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file.. Signals.

Textbook 1: Ch. 9, Ch. 19

Course Outcomes: After completing the course, the students will be able to

CO1	Understand the basics of Unix concepts and commands.
CO2	Evaluate the UNIX file system.
CO3	Apply Changes in file system.
CO4	Develop shell scripts for automation
CO5	Analyze Facility with UNIX system process

Text Books

1	"Unix Concepts & Applications", Sumitabha Das, 4th Edition, Tata McGraw Hill, 2017 ISBN-13. 978-0070635463
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Reference Books

1	"Unix Shell Programming", Yashwant Kanetkar, 2003, ISBN · 9788170297536
2	"Introduction to UNIX", M G Venkatesh Murthy. ISBN: 978-8177587456
3	"Unix and Shell Programming", B.M. Harwani, Oxford University Press, 2013. ISBN-13 : 978-0198082163

Web links and Video Lectures (e - Resources)

1	https://www.geeksforgeeks.org/introduction-linux-shell-shell-scripting/
2	https://www.tutorialspoint.com/unix/
3	https://archive.nptel.ac.in/courses/117/106/117106113/

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										
CO2	2	2									
CO3	2	3	2								
CO4	2	2	3	1	2						1
CO5	2	3	3	2							

Semester: III					
Social Connect & Responsibility					
Course Code	:	BSC307	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	15 Hrs	SEE	:	-
Course Type	:	UHV	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CL01	Understand and appreciate the importance of environmental sustainability, cultural heritage and traditional practices
CL02	Apply experiential learning through field visits, case studies and community interaction
CL03	Develop skills in documentation, reporting and creative presentation through photo blogs or documentaries
CL04	Demonstrate awareness of organic farming, waste management, water conservation and their implementation in campus or community settings
CL05	Recognize the significance of indigenous crafts, culinary traditions and their socio-cultural value

Module 1		3Hrs
Plantation and adoption of a tree Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - - Objectives, Visit, case study, report, outcomes. Text Book 1		
Module 2		3Hrs
Heritage walk and crafts corner Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - - Objectives, Visit, case study, report, outcomes. Text Book 2		
Module 3		3Hrs
Organic farming and waste management Usefulness of organic farming, wet waste management in neighboring villages, and		

implementation in the campus – Objectives, Visit, case study, report, outcomes.

Text Book 3

Module 4	3Hrs
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Water conservation

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Text Book 4

Module 5	3Hrs
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Food walk

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

Text Book 5

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the significance of tree plantation, cultural heritage, organic farming, waste management, water conservation and traditional food practices
CO2	Demonstrate the ability to plan and execute community-focused environmental and cultural activities
CO3	Prepare and present photo blogs or documentaries to document and communicate findings.
CO4	Apply sustainable practices learned from field visits in campus or community projects
CO5	Appreciate and promote indigenous knowledge, crafts and culinary traditions as part of cultural preservation

Text Books	
1	Environmental Studies – Erach Bharucha, University Grants Commission, New Delhi.
2	Cultural Heritage of India – Haridas Bhattacharyya, Volumes 1–6, The Ramakrishna Mission Institute of Culture.
3	Organic Farming: Principles and Practices – P. Bhattacharyya & D. Chakraborty, Scientific Publishers.
4	Water Resource Engineering – Larry Mays, Wiley.
5	Indian Food: A Historical Companion – K. T. Achaya, Oxford University Press

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1				3	2		3		1
CO2	2					3	3	2	2		1
CO3					3	3	3	2	2		1
CO4	3					3	3	2			1
CO5	2					3	3	3	3		1

Semester: III					
MS Office and LaTeX					
Course Code	:	BCS308A	Credits	:	1
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	AEC	SEE Duration	:	2 Hours

Prerequisites:	
Courses	Basics of MS Office skills
Knowledge on Fundamental Concepts	Basic computer skills, familiarity with MS Office tools (Word, Excel, PowerPoint), understanding of text formatting, file handling, and foundational knowledge of LaTeX syntax and document structure.
Knowledge on Connected Tools (If any)	MS Office

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the interface, tools, and features of MS Word, Excel, PowerPoint, and LaTeX.
CLO2	Learn to apply formatting, perform mail merge, create charts, and use formulas for effective reporting and data analysis.
CLO3	Apply LaTeX for creating academic reports with tables, figures, and customized layouts.
CLO4	Design visually effective presentations using multimedia tools in PowerPoint.
CLO5	Integrate MS Office tools to automate document preparation and presentation tasks

Module – 1		03Hrs
Creating and formatting lab reports in MS Word: Headers, Footers, Page Breaks, Table of Contents, Mail Merge		
Textbook 1: Ch. 1 & Ch. 2.		
Module – 2		03Hrs
Using MS Excel: Data entry, formulas, conditional formatting, charting, filtering, pivot tables.		
Textbook 2: Ch. 2 & Ch. 2.		

Module – 3	03Hrs
Designing interactive presentations in PowerPoint : Slide master, transitions, multimedia, SmartArt.	
Textbook 3: Ch. 1.	
Module – 4	03Hrs
Introduction to LaTeX : Document class, sections, text formatting, abstract, title, table, figure.	
Textbook 4: Ch. 1.	
Module – 5	03Hrs
Advanced LaTeX : Page customization, bibliography, multi-column layout, including PDFs/images, code formatting.	
Textbook 4: Ch. 2.	

Sl.No	Experiment																														
MS Office																															
1.	Create a document in Microsoft Word containing at least two paragraphs and perform the following formatting and editing tasks: a) Set Margins, b) Insert Page Numbers, c) Format Heading, d) Text Emphasis, e) Spell Check, f) Reorder Paragraphs, g) Headers and Footers, h) Find and Replace, i) Watermark, and j) Protect Document.																														
2.	Create your class timetable in the Word document using the specified format, and then use the Mail Merge feature to send a birthday invitation referencing this timetable to 10 of your friends.																														
3.	<p>Given the table of Kabbadi player scores, perform the following:</p> <table><tr><th>Players</th><th>Team A</th><th>Team B</th></tr><tr><td>A</td><td>15</td><td>12</td></tr><tr><td>B</td><td>10</td><td>11</td></tr><tr><td>C</td><td>9</td><td>8</td></tr><tr><td>D</td><td>12</td><td>14</td></tr><tr><td>E</td><td>13</td><td>10</td></tr><tr><td>F</td><td>15</td><td>18</td></tr><tr><td>G</td><td>17</td><td>15</td></tr><tr><td>Average Score</td><td></td><td></td></tr><tr><td>Grade</td><td></td><td></td></tr></table> <p>1. Calculate average score for each team. Assign Grade 'A' to the team with the higher average. 2. Create a Bar Chart based on the scores. 3. Apply AutoFormat to the table. 4. Demonstrate both relative and absolute references in formulas.</p>	Players	Team A	Team B	A	15	12	B	10	11	C	9	8	D	12	14	E	13	10	F	15	18	G	17	15	Average Score			Grade		
Players	Team A	Team B																													
A	15	12																													
B	10	11																													
C	9	8																													
D	12	14																													
E	13	10																													
F	15	18																													
G	17	15																													
Average Score																															
Grade																															
4.	Create a worksheet with the following fields: Emp No, Ename, Basic Pay (BP), Travelling Allowance (TA), Dearness Allowance (DA), House Rent Allowance (HRA), Income Tax (IT), Provident Fund (PF), and Net Pay (NP). Apply appropriate formulas to compute the necessary values. Analyze the data using suitable charts and generate a report based on the findings.																														
5.	Create a 6-slide PowerPoint presentation about your organization including its name, vision, mission, an image, a brief description of organization and departments with																														

	document, and an organizational chart; add automatic 5-second slide transitions, custom animations, action buttons, and then present the slideshow.
6.	Create a PowerPoint presentation on any topic of your choice using a Master Slide that includes an appropriate slide design, layout, background color, slide number, and date. Using this Master Slide, demonstrate adding transition effects that automatically advance slides every 5 seconds, applying suitable fonts, images, and colors, inserting charts and hyperlinks, incorporating custom animations and action buttons, creating an organizational chart with relevant data, and finally, run the slideshow to present your work.
LaTeX (TeXworks)	
7.	Develop a LaTeX script to create a document that displays the sample Abstract/Summary
8.	Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with abstract and summary in the section. And also include header [title of document] and footer [institute name (SJCIT), page number] in the document.
9.	Develop a LaTeX script to create a simple title page of the VTU SJCIT project Report [Use suitable Logos and text formatting].
10.	Develop a LaTeX script to create the Certificate Page of the Report of SJCIT [Use suitable commands to leave the blank spaces for user entry].
11.	Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept.
12.	Develop a LaTeX script to create a simple report using suitable commands and formats of SJCIT.

Course Outcomes: After completing the course, the students will be able to

C01	Apply the fundamental features and functions of MS Office tools including mail merge tables.
C02	Analyze and present data effectively using MS Excel charts, formulas, and filters
C03	Create professional presentations using transitions, animations, and layout tools in PowerPoint
C04	Apply LaTeX syntax to compile and structure well-formatted academic and technical documents.
C05	Develop comprehensive project reports using advanced LaTeX commands and formatting techniques

Text Books

1	"Excel Formulas Functions for Dummies", Ken Bluttman, Wiley, 5 th Edition, 2018, ISBN: 978-1119518255.
2	"Microsoft Excel Step by Step, (Office 2021 and Microsoft 365)", Joan Lambert, Curtis Frye, -Curtis Frye, Pearson Education, Inc., 2021, ISBN-13: 978-0-13-756427-9.
3	"Analyzing Data with Power BI and Power Pivot for Excel (Business Skills)", Alberto Ferrari, Marco Russo, Microsoft Press, 1 st Edition, 2017, ISBN-13: 978-1509302765.
4	"A Short Introduction to Latex: A Book for Beginners", Firuza Karmali Aibara, Create space Independent Publishing Platform, 2019, ISBN-13: 978-1543162646.

Web links and Video Lectures (e - Resources)

1	https://www.excel-easy.com/
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2	https://www.youtube.com/watch?v=ormRboQsB-I
3	https://www.w3schools.com/excel/index.php
4	https://latex-tutorial.com/tutorials/
5	https://onlinecourses.swayam2.ac.in/aic20_sp17/preview

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2		3				2		3
CO2	3	3	2		3						3
CO3	2	2			3				3		3
CO4	3	2	2		3						2
CO5	3	3	2		3		1		2	2	2

Semester: III					
Data Analytics with R					
Course Code	:	BAD308B	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	AEC	SEE Duration	:	2 Hours

Prerequisites:	
Courses	Introduction to Programming
Knowledge on Fundamental Concepts	Basics of Data Structures, Mathematical Foundations
Knowledge on Connected Tools (If any)	Linux Editor

Course Learning Objectives: This course will enable the students to	
CLO1	Gain the knowledge of R Programming Concepts.
CLO2	Emphasis the graphical representation of data
CLO3	Explore the concept of Statistics in R
CLO4	Work with R charts and Graphs

Experiments	
Sl.NO	List of problems for which student should develop program and execute in the Laboratory
1.	<p>Demonstrate the steps for installation of R and R Studio. Perform the following:</p> <ol style="list-style-type: none"> Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type. Demonstrate Arithmetic and Logical Operations with simple examples. Demonstrate generation of sequences and creation of vectors. Demonstrate Creation of Matrices Demonstrate the Creation of Matrices from Vectors using Binding Function. Demonstrate element extraction from vectors, matrices and arrays
2.	<p>Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics:</p> <ol style="list-style-type: none"> Profit for each month.

	<p>b. Profit after tax for each month (Tax Rate is 30%).</p> <p>c. Profit margin for each month equals to profit after tax divided by revenue.</p> <p>d. Good Months – where the profit after tax was greater than the mean for the year.</p> <p>e. Bad Months – where the profit after tax was less than the mean for the year.</p> <p>f. The best month – where the profit after tax was max for the year.</p> <p>g. The worst month – where the profit after tax was min for the year.</p>																		
3.	Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication																		
4.	Develop a program to find the factorial of given number using recursive function calls.																		
5.	Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.																		
6.	<p>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:</p> <p>a) Find the Pearson and Spearman correlation coefficients. Are they similar?</p> <p>b) Plot the data using the plot command.</p> <p>c) Plot the logarithm (log) of each variable and see if that makes a difference.</p>																		
7.	<p>Develop R program to create a Data Frame with following details and do the following operations.</p> <table><tr><th>ItemCode</th><th>ItemCategory</th><th>ItemPrice</th></tr><tr><td>1001</td><td>Electronics</td><td>700</td></tr><tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr><tr><td>1003</td><td>Office Supplies</td><td>350</td></tr><tr><td>1004</td><td>USB</td><td>400</td></tr><tr><td>1005</td><td>CD Drive</td><td>800</td></tr></table> <p>a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.</p> <p>b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”</p> <p>Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames</p>	ItemCode	ItemCategory	ItemPrice	1001	Electronics	700	1002	Desktop Supplies	300	1003	Office Supplies	350	1004	USB	400	1005	CD Drive	800
ItemCode	ItemCategory	ItemPrice																	
1001	Electronics	700																	
1002	Desktop Supplies	300																	
1003	Office Supplies	350																	
1004	USB	400																	
1005	CD Drive	800																	
8.	<p>Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.</p> <p>a) Assigning names, using the air quality data set.</p> <p>b) Change colors of the Histogram</p> <p>c) Remove Axis and Add labels to Histogram</p> <p>d) Change Axis limits of a Histogram</p> <p>e) Add Density curve to the histogram</p>																		
9.	<p>Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.</p> <p>a) Find the total number rows & columns</p> <p>b) Find the maximum salary</p> <p>c) Retrieve the details of the employee with maximum salary</p> <p>d) Retrieve all the employees working in the IT Department.</p> <p>e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”</p>																		
10.	Using the built in dataset mtcars which is a popular dataset consisting of the design																		

	<p>and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors</p> <p>Develop R program, to solve the following:</p> <ol style="list-style-type: none"> What is the total number of observations and variables in the dataset? Find the car with the largest hp and the least hp using suitable functions Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness? What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations. Which pair of variables has the highest Pearson correlation?
11.	Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file.
12.	<p>Write R script</p> <ol style="list-style-type: none"> to read and write excel to read and write csv file. to work with Database file.
13.	<p>Write R script</p> <ol style="list-style-type: none"> Write R script to create bar chart(3 different styles preferable). Write R script to create Line graph (3 different styles preferable). Write R script to create pie chart(5 different styles preferable). Write R script to create Histogram.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the graphical packages of R for effective data visualization.
CO2	Apply various statistical analysis methods for performing data analytics.
CO3	Analyze the structures and components of R programming.
CO4	Evaluate the basics of data preparation using real-world examples.
CO5	Develop data-driven solutions by integrating file handling, data manipulation, and automation techniques in R programming.

Web links and Video Lectures (e - Resources)	
1	https://www.tutorialspoint.com/r/r_tutorial.pdf
2	https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/intro.html
3	https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html

4	https://www.w3schools.com/r/r_stat_data_set.asp
5	https://rpubs.com/BillB/217355

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			3				1		2
CO2	3	2	2	2	3						2
CO3	3	2	2	2	3				1		2
CO4	3	3	3	3	3				1		3
CO5	3	2	2	2	3						

Semester: III					
Project Management with Git					
Course Code	:	BCS308C	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	AEC	SEE Duration	:	2 Hours

Prerequisites:	
Courses	Problem solving through programming, Introduction to python programming.
Knowledge on Fundamental Concepts	File Handling, shell/terminal usage and Basic CLI Navigation.
Knowledge on Connected Tools (If any)	IDLEs

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts and workflow of version control systems like Git.
CLO2	Apply Git commands to manage code repositories, including staging, committing, branching, and merging.
CLO3	Collaborate effectively using remote repositories by performing cloning, pushing, pulling, and rebasing.
CLO4	Utilize Git tools Such as tagging, stashing, and cherry-picking for advanced version control operations.
CLO5	Analyze and modify Git history for auditing, debugging, or rolling back changes.
Instructions <ul style="list-style-type: none"> • Use a test repository to avoid impacting real projects, and perform all tasks in a Terminal or Git Bash environment suited to your operating system. • Use clear and descriptive commit messages, develop on feature branches, and always fetch or pull updates before pushing to prevent conflicts. 	

Sl. No	PART-A
1.	Setting Up and Basic Commands Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2.	Creating and Managing Branches Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3.	Creating and Managing Branches Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4.	Collaboration and Remote Repositories Clone a remote Git repository to your local machine by Changing the current working directory.
5.	Collaboration and Remote Repositories Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch by git fetch origin and replacing <branch-name> with the name of your local branch by git checkout <branch-name> Command.

6.	Collaboration and Remote Repositories Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7.	Git Tags and Releases Write the command to create a lightweight and annotated Git tag named "v1.0" for a commit in your local repository.
8.	Advanced Git Operations Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9.	Analysing and Changing Git History Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message.
10.	Analysing and Changing Git History Write the command to list all commits made by the author "JohnDoe" between "2025- 01-01" and "2025-12-31."
11.	Analysing and Changing Git History Write the command to display the last five commits in the repository's history.
12.	Analysing and Changing Git History Write the command to undo the changes introduced by the commit with the ID "abc123".

PART-B

Note:

- Ensure Git is installed by running git --version in your terminal. Be aware that newer Git versions use main instead of master as the default branch—adjust commands accordingly.
- Use commands like git revert and git reset with caution, as they modify commit history—especially in shared repositories.

Course Outcomes: After completing the course, the students will be able to

CO1	Identify the steps to initialize a Git repository and the purpose of basic version control commands such as add, commit, and status.
CO2	Illustrate the role of branching and merging strategies in Git during feature development
CO3	Perform Git stash and rebase operations to manage complex workflows and context switching
CO4	Describe how to clone remote repositories, synchronize changes, and collaborate with teams on shared codebases.
CO5	Analyze commit history and make informed decisions to revert, cherry-pick, or annotate changes.

Reference Books

1	"Pro Git", Scott Chacon & Ben Straub, 2nd edition, Apress®, 2009 ISBN:978-1-4842-0076-6
2	"Version Control with Git", Prem Kumar Ponuthurai & Jon Loeliger, O'Reilly Media, Inc., 3rd Edition, 2022, ISBN: 978-1-4920-9119-6
3	"Learn Git in a Month of Lunches", Rick Umali, 1st Edition, Manning Publications (distributed by Simon & Schuster) ISBN-10: 1617292419, 2015.

Web links and Video Lectures (e – Resources)	
1	https://research.computing.yale.edu/sites/default/files/files/Version%20Control%20with%20Git%281%29.pdf?utm_source=chatgpt.com
2	https://onlinecourses.swayam2.ac.in/aic20_sp10/preview
3	https://www.youtube.com/watch?v=SNryJ5UDI1w
4	https://www.cccwi.de/wp-content/uploads/2014/03/git-intro.pdf?utm_source=chatgpt.com

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	3				2	2	1
CO2	3	2	2	2	3				1	2	1
CO3	2	2	3	2	3				3	2	1
CO4	3	3	2	3	3				1	2	1
CO5	3	3	2	3	3				1	2	1

Semester: III			
Data Visualization with Python			
Course Code	: BCS308D	Credits	: 01
Hours/Week(L:T:P)	: 0:0:2	CIE	: 50Marks
Total Hours	: 15 Hrs	SEE	: 50Marks
Course Type	: AEC	SEE Duration	: 2 Hours

Prerequisites:	
Courses	Python
Knowledge on Fundamental Concepts	Programming Skills
Knowledge on Connected Tools (If any)	Jupyter notebook, Anaconda

Course Learning Objectives: This course will enable the students to	
CLO1	Demonstrate the use of IDLE or PyCharm IDE to create Python Applications.
CLO2	Apply a Python programming language to develop programs for solving real-world problems.
CLO3	Implement of Matplotlib for drawing different Plots.
CLO4	Demonstrate working with Seaborn , Bokeh.
CLO5	Working with Plotly for 3D, time series and maps.

Sl.No	Experiments
1	a) Design a python program to find the best of two test average marks out of three test's marks accepted from the user. b) Develop a Python program to check whether a given number is palindrome or not also count the number of occurrences of each digit in the input number.
2	Design a function F as $F_n = F_{n-1} + F_{n-2}$. Develop a Python program which accepts a value for N(where $N > 0$) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed.
3	a) Design a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters. b) Design a Python program to find the string similarity between two given strings.
4	Design a Python program which explains uses of customizing Seaborn plots with Aesthetic functions.
5	a) Design a python program to explain working with Bokeh line graph using Annotations and legends. b) Design a python program for plotting different types of plots using Bokeh.
6	Develop a python program to draw 3D Plots using Plotly Libraries.
7	a) Develop a python program to draw Time Series using Plotly Libraries. b) Design a python program for creating maps using Plotly Libraries.

8	<p>For the given dataset that contains immigration details to Canada from 1980 to 2013,</p> <ul style="list-style-type: none"> • Create an area plot for top 6 immigrant countries from 1990 to 2013. • Create and year-wise immigrant bar chart from India to Canada during the period of 1980 to 2013. • Create a boxplot for Indian, Phillipin and China immigrants. • Show the total no. of immigrants from India and France countries using Area Chart and Pie chart. • Create a scatter Histogram for the immigrants from Fiji and Singapore in the year 2013.
9	<p>For the given data set that contains the data of flights that were on time in January for the years 2019 and 2020. Using the two data sets visualize the data using matplotlib and plotly libraries to depict the following:</p> <ul style="list-style-type: none"> • Show the difference in statistics for distance for both the years using the appropriate plotting technique. • Visualize the no. of flights whose destination airport id is 11778 and 11267 using a bar plot or bar chart. • Create a Sunburst Plot for both the years depicting the difference among them.
10	<p>Visualize the given Placement Data Full Class dataset that contains details about Campus Recruitment using the below techniques for appropriate dimensions and differentiate between the two techniques:</p> <ul style="list-style-type: none"> • Histogram and Bar Chart [For histogram let no. of bins = 10]. • Facet Plot and Pair Plot. • Area Chart and Pie Chart [For yes or no data] .

Course Outcomes: After completing the course, the students will be able to

C01	Use of IDLE or PyCharm IDE to create Python Applications.
C02	Implement Matplotlib for drawing different types of plots.
C03	Build a effective 2D visualizations using Matplotlib.
C04	Design advanced visualizations using Seaborn and Bokeh .
C05	Develop interactive and advanced 3D/time-series visualizations using Plotly.

Web links and Video Lectures (e- Resources):

1.	Python https://www.youtube.com/watch?v= uQrJ0TkZlc
2.	https://www.geeksforgeeks.org/data-visualization-using-matplotlib/

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2	2	1	3						
CO2	3	2	2	2	3						
CO3	2	2	2	3	3						
CO4	2	2	3	3	3						
CO5	2	3	3	3	3						

Semester: III					
Environmental Studies					
Course Code	:	BES309	Credits	:	1
Hours/Week(L:T:P)	:	1:0:0	CIE	:	50Marks
Total Hours	:	15 Hrs	SEE	:	50Marks
Course Type	:	MC	SEE Duration	:	1Hour

Prerequisites:	
Courses	Basic Science
Knowledge on Fundamental Concepts	Environmental
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Create environmental and sustainability awareness among the students.
CLO2	Creating knowledge of relationship between the biotic and abiotic component
CLO3	Apply their ecological knowledge to illustrate and grasp the problem and describe the realities that managers face when dealing with complex issues.
CLO4	Develop skills, critical thinking and demonstrate socio-economic skills for Environmental protection
CLO5	Gain knowledge on different types of pollution in the environment, waste management and Environmental legislation

Module – 1	03Hrs
Ecosystem and Sustainability: Ecology and Ecosystem: Structure of Ecosystem, components, Types: Forest, Desert, Wetlands, River, Oceanic ecosystems. Sustainability: 17SDG targets and possible actions. Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation. Textbook 1 – Ch. 1, 2 & 3	
Module – 2	03Hrs
Natural Resource Management Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining - case studies and Carbon Trading Textbook 2 – Ch. 3 & 4	
Module – 3	03Hrs
Environmental Pollution & Waste Management Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. Waste Management: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge. Textbook 2 – Ch. 5 & 16	

Module – 4	03 Hrs
Global Environmental Issues Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology. Textbook 3 – Ch. 9 & 10	
Module – 5	03 Hrs
Environmental Legislation: Solid Waste Management Rules 2016, Biomedical Waste Management Rules, 2016. BBMP, BWSSB Norms Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): GIS & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Textbook 1 – Ch. 10, 11 & 12	

Course Outcomes: After completing the course, the students will be able to	
C01	Understand the principles of ecology and environmental issues that apply to air, land and water issues
C02	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components
C03	Conduct survey to describe the realities of waste management system.
C04	Identify the major challenges of environmental issues on a global scale
C05	Apply their environmental legislation to illustrate problems and describe the realities that managers face when dealing with complex issues.

Text Books	
1	Environmental Studies, Benny Joseph, 2005, Tata McGraw – Hill Publishing Company Limited.
2	Environmental Studies, S.M. Prakash, 2007, Elite Publishers Mangalore.
3	Environmental Studies – From Crisis to Cure, R Rajagopalan, 2005, Oxford University Press.

Reference Books	
1	Environmental Studies ,R.J.Ranjit Daniels and Jagadish Krishnaswamy, 2009 , Wiley India Private Ltd., New Delhi
2	Environmental Science – working with the Earth ,G.Tyler Miller Jr., 10 th Edition ,2004, Thomson Brooks /Cole,
3	Elements of Environmental Science and Engineering ,P. Meenakshi, 2006 , Prentice Hall of India Private Limited, New Delhi,

Web links and Video Lectures (e – Resources)	
1	https://sdgs.un.org/goals
2	https://archive.nptel.ac.in/courses/109/105/109105190/
3	https://kspcb.karnataka.gov.in/waste-management/biomedical-waste

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	1	1				1				
CO2	2	3		3		1	1				
CO3	2	2	3	2	1	1	1				
CO4		3	1			1	1				1
CO5	3	2	3	2	1	1	3				1

Semester: III					
National Service Scheme					
Course Code	:	BNS310	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem –solving.
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Activity- 1	08 Hrs
Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	
Activity - 2	08 Hrs
Waste management- Public, Private and Govt. organization, 5 R's	
Activity - 3	08 Hrs
Setting of the information imparting club for women leading to contribution in social and economic issues	

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl.	Topic	Group Size	Location	Activity Execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages / roadside / community area/ College campus etc.	Site selection /proper consultation/Continuous monitoring/Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2.	Waste management- Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers/ campus etc.	Site selection /proper consultation/Continuous monitoring/Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt. Teams / College campus etc.	Group selection/proper consultation/Continuous monitoring/Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 3rd Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.
➤ In the 3 rd semester, each student should do activities according to the scheme and syllabus. ➤ At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion. ➤ At the end of the 3 rd semester, consolidated report of all activities compiled report	

should be submitted as per the instructions.

Course Outcomes: After completing the course, the students will be able to

CO1	Exploit the importance of his / her responsibilities towards society.
CO2	Analyze 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 of societal problems.
CO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Assessment Details for CIE (100 Marks)

Weightage	CIE- 100 Marks
Selection of Topic, Commencement of activity and its progress	40 Marks
Case study based Assessment	20 Marks
Sector wise study and its consolidation	20 Marks
Video based seminar for 10 minutes by each student at the end of semester with Report	20 Marks
Total Marks for the course in the semester	100 Marks

Suggested Learning Resources:

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.

CO-PO Mapping

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1						3	2	2	2		3
CO2		3				3		2	2		3
CO3			3			3	2	2	2		3
CO4						3	2	2	2		3
CO5						2	3	3	2		3

Semester: III					
Physical Education (PE) (Sports & Athletics)					
Course Code	:	BPE310	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop awareness about personal health, wellness, and the importance of an active lifestyle through pre-fitness evaluation and orientation.
CLO2	Improve general physical fitness through structured training in strength, speed, and warm-up exercises
CLO3	Acquire sport-specific skills and techniques in traditional games such as Kabaddi or Kho-Kho through practical sessions.

Module – 1		4 Hrs
Orientation A. Lifestyle B. Health & Wellness C. Pre-Fitness test.		
Module – 2		4 Hrs
General Fitness & Components of Fitness A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash		
Module-3		16 Hours
Specific games (Any one to be selected by the student) A. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. B. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.		

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate core concepts of physical education, health, nutrition and fitness for personal well-being
CO2	Demonstrate exercises, sports and practices that enhance physical and mental Development
CO3	Apply foundational skills for careers in physical education, sports and fitness
CO4	Participate in sports competitions with discipline, teamwork and sportsmanship
CO5	Promote healthy lifestyles through wellness concepts and traditional/indigenous Activities

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
Total		100

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
C01	3	1					2	2	2		1
C02	2	2			2	2	2	2	2		1
C03	3					2	2				2
C04	2					2	3	2	2		3
C05	2				2	3	3	2	2		1

Semester: III					
Yoga					
Course Code	:	BY0310	Credits	:	-
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the history, various schools of yoga along with its aims, objectives and significance in holistic well-being.
CLO2	Demonstrate basic yoga practices and how to do them safely, clearing up common misunderstandings.
CLO3	Apply suryanamaskara with proper understanding of its structure, significance and health benefits.
CLO4	Describe the types, methods and benefits of various Asanas.
CLO5	Utilize the knowledge of specific asanas regularly to improve physical health and mental well-being.

Module - 1	05 Hrs
Introduction to Yoga: Origin, history, and development of Yoga, Meaning and definitions of Yoga, Different schools of Yoga, Aims and objectives of Yoga, Importance of prayer in Yoga practice. Text Book 1: Ch. 1 (Part 1)	
Module - 2	05 Hrs
Foundations of Yogic Practice: Yogic practices for a common man to promote positive health, Rules to be followed during yogic practices by the practitioner, Misconceptions about Yoga, Difference between yogic and non-yogic practices.	

Text Book 1: Ch. 1 (Part 1)	
Module - 3	05 Hrs
Suryanamaskara (Sun Salutation): Prayer and its meaning, Need, Importance and benefits of Suryanamaskara, 12-count structure and practice of 2 rounds. Text Book 1: Ch. 2 (Part 2)	
Module - 4	05 Hrs
Introduction to Asanas: Asana - Meaning, need, and importance, Classification of Asanas, General technique, precautionary measures, and benefits of each Asana. Text Book 1: Ch. 1 & 2 (Part 1 & 2)	
Module - 5	04 Hrs

Types of Asanas and Practice: Sitting Asanas - Padmasana, Vajrasana, Standing Asanas - Vrikshasana, Trikonasana, Prone Lying Asanas - Bhujangasana, Shalabhasana, Supine Lying Asanas - Utthitadvipadasana, Ardhalasana.

Text Book 1: Ch. 2 (Part 2)

Course Outcomes: After completing the course, the students will be able to

CO1	Summarize the history and major schools of yoga, highlighting their purpose in promoting holistic well-being.
CO2	Demonstrate basic yoga practices with correct techniques, ensuring safety and addressing common misconceptions.
CO3	Apply suryanamaskara sequences with proper understanding of its structure, significance, and health benefits.
CO4	Classify the types, methods, and benefits of various asanas with appropriate examples.
CO5	Adopt the practice of specific asanas into a regular routine to enhance physical health and mental well-being.

Text Book

1	"The Illustrates Light on Yoga" by BKS Iyengar, HarperCollins Publishers, 2004, ISBN-81:7223-606-9
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Reference Books

1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4 th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Yogapravesha in Kannada by Ajitkumar
4	Yoga for Children -step by step - by Yamini Muthanna

Web links and Video Lectures (e - Resources)

1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PL0zRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2			2		
CO2						2			2		
CO3						2	2	3	2		2
CO4						2			2		
CO5						2	2	3	2		2

Semester: III-VI					
Music					
Course Code	:	BMU310/410/509/610	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational concepts of Indian classical music, including the evolution and structure of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela systems.
CLO2	Recognize and describe various types of Carnatic compositions such as Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, along with the basics of the notation system.
CLO3	Appreciate the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
CLO4	Identify and explain the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
CLO5	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module - 1	03 Hrs
Preamble Contents of the curriculum intended to promote music as 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 Textbook1, V-1 Ch. 1-4	
Module - 2	03 Hrs
Compositions Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System. Textbook2 – Ch. 4-7	
Module - 3	03 Hrs
Composers Biography and contributions of Purandaradasa, Thyagaraja, Mysore Vasudevacharya, Kanakadasa Textbook3 – Ch. 2-5	
Module - 4	03 Hrs
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. Textbook1, V-4 – Ch. 2-6	
Module - 5	12 Hrs

Abhyasa Gana

Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase and sulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one jathi swara, oe krithi in a mela raga

Textbook1, V-1&2

Course Outcomes: After completing the course, the students will be able to

CO1	Outline the evolution of Indian music and key concepts like Shruthi, Swara, Raga and Tala.
CO2	Identify and interpret basic Carnatic compositions using standard notation.
CO3	Summarize the contributions of composers.
CO4	Classify Indian musical instruments and describe their construction and use.
CO5	Demonstrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books

1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, The Indian Music Publishing House, Chennai.
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, CBH Publications
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi.

Reference Books

1	Music of India, B. Chaitanya Deva, Munshiram Manoharlal Publishers
2	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, Asian Educational Services

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3		1		1		1	1	1		1
CO2	3		3	1	2	1	2	1	1		1
CO3	1				1	1	1		1		
CO4	2		2		3	1	1	1	1		1
CO5	3			1	2	1	1	1	1		1

Semester: III					
Competency Enhancement Course-1					
Course Code	:	BCE311	Credits	:	0
Hours/Week(L:T:P)	:	2:0:0	CIE	:	100 Marks
Total Hours	:	40 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Prerequisites:	
Courses	Fundamentals of Mathematics & English
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals, and elementary algebra. comprehension of basic English
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Gain a strong foundation in aptitude skills such as number systems, percentages, ratio & proportion and interest calculations to improve quantitative reasoning and problem-solving efficiency.
CLO2	Apply Vedic Mathematics techniques and shortcuts for rapid mental calculations, leading to increased accuracy and speed in aptitude-based assessments.
CLO3	Master logical reasoning topics like syllogisms, blood relations, puzzles and seating arrangements to develop structured thinking and effective decision-making skills.
CLO4	Understand and solve problems involving coding-decoding, visual sequences, clocks, calendars and analogies to enhance pattern recognition and reasoning speed.
CLO5	Utilize aptitude and reasoning skills to perform well in competitive exams, campus placements, and workplace situations, contributing to overall academic and professional success.

Module – 1	8 Hrs
Introduction to Aptitude and Vedic Mathematics Understanding Aptitude	

Overview of aptitude skills and their significance in problem-solving and decision-making. Types of aptitude skills commonly assessed in competitive exams and professional settings.

Vedic Mathematics Techniques

Introduction to Vedic Mathematics for faster and more efficient calculations. Key techniques and shortcuts to improve speed and accuracy in quantitative problems.

Importance of Aptitude Skills

The role of aptitude in career development and academic success. How strong aptitude skills enhance analytical thinking, logical reasoning, and performance in assessments.

Number System

Divisibility & Remainder, Multiples & Factors, Integers, LCM & HCF, Complete a number Series, Find the Missing Term and Wrong Term, Simplification, BODMAS Rule, Approximation, Decimals, Fractions, Surds & Indices

Textbook 1: Ch. 1-11

Module - 2		8 Hrs
Percentage Calculation-oriented basic percentage, Successive Selling type, Discount & MP, Dishonest Dealings Profit and Loss Cost Price (CP), Selling Price (SP), Marked Price (MP) / List Price, Discount, Profit (Gain), Loss, Profit Percentage, Loss Percentage, Discount Percentage, Relationship between CP, SP, and Profit/Loss Percentage, Successive Profits and Losses, False Weights and Dishonest Dealer Problems Blood Relation Basic Family Relationships (Parent, Sibling, Child, etc.), Direct Relationship Questions, Pointing or Introducing Type Questions, Family Tree/Hierarchical Relationship Questions, Coded Blood Relations, Puzzle-Based Blood Relations, Mixed/Complex Blood Relations, Single-Person Blood Relation Problems, Generational Relationships (Grandparent, Great-Grandparent, etc.), Relationships by Marriage (In-laws, Step-relations) Textbook 3: Ch. 2,3,4,6,7,10,12		
Module-3		8 Hrs
Simple and Compound Interest Definition of Simple Interest (SI), Calculation of Simple Interest, Principal, Rate, and Time, Amount in Simple Interest, Problems on SI (Direct, Inverse and Combined), Definition of Compound Interest (CI), Calculation of Compound Interest (Annual, Half-yearly, Quarterly, etc.), Difference between Simple and Compound Interest, Growth Factor and Compound Amount, Compound Interest for Fractional Years, Comparing SI and CI over Multiple Years, Depreciation and Appreciation Problems, Installment Payments (EMI-based Questions). Averages Definition and Formula of Average, Average of Numbers, Average of Consecutive Numbers, Average of Odd/Even Numbers, Weighted Average, Average in Groups (Merging and Replacement), Effect of Addition/Removal/Replacement on Average, Average Speed, Change in Average Due to Error (Wrong Entry), Shortcut Tricks and Applications Direction Sense Test Cardinal and intermediate directions, right and left directional movement, reference points and orientation, turns and angle-based movement, distance and displacement calculation, shadow and sun-based direction problems, shortest path and final position, direction sense using maps or diagrams, coded direction sense problems, complex/multiple person direction scenarios, error spotting in direction sense. Textbook 1: Ch. 2,5		
Module-4		8 Hrs

Ratio and Proportion and Variations

Definition of Ratio, Types of Ratio (Simple, Compound, Duplicate, Sub-duplicate, Triplicate), Properties of Ratio, Comparison of Ratios, Definition of Proportion, Types of Proportion (Direct, Inverse, Continued), Properties of Proportion, Mean Proportion, Fourth Proportion, Third Proportion, Relationship between Ratios and Proportions, Componendo and Dividendo Rules, Addendo and Subtrahendo, Applications of Ratio and Proportion in Problem, Direct Variation, Inverse Variation, Joint Variation, Combined Variation, Proportionality Constants, Word Problems on Variation, Application-based Variation Problems, Miscellaneous and Complex Variation Questions

Alligations and Mixtures

Definition of Alligation, Alligation Rule and Formula, Types of Mixtures (Simple and Compound), Problems on Mixing Two or More Quantities, Mean Price Calculation, Replacement of Quantities, Alligation on Solutions with Different Concentrations, Solving Alligation Questions Involving Profit and Loss, Application-Based Mixture Problems.

Series

Arithmetic Series, Geometric Series, Square Series, Cube Series, Fibonacci Series, Prime Number Series, Alternating Series, Factorial Series, Mixed Series, Exponential/Power Series

Textbook 1: Ch. 12,13&16

Module-5**8 Hrs****Articles and Prepositions**

Usage of articles (a, an, the), definite and indefinite articles, zero article usage, prepositions of time, place, direction, phrasal verbs, prepositional phrases, and error spotting.

Tenses and Subject-Verb Agreement

Present, past, and future tense forms, auxiliary verbs, rules of agreement with different subjects, and error spotting

Change of Voice and Speech

Active-passive transformations in all tenses, direct and indirect speech conversions, and related pronoun, tense, and time changes

Error Spotting and Sentence Correction

Identifying common grammatical errors such as incorrect word usage, faulty subject-verb agreement, tense errors, sentence fragments, and contextual sentence corrections

Synonyms, Antonyms, and Verbal Analogy

Finding words with similar or opposite meanings, commonly confused words, verbal analogies, and contextual vocabulary usage

Sentence Completion and One-Word Substitution

Choosing appropriate words or phrases to complete sentences, idiomatic expressions, logical sentence completion, and replacing phrases with single-word substitutes

Textbook 1: Ch. 14,15,17&29

Course Outcomes: After completing the course, the students will be able to

CO1	Solve numerical problems using Vedic Math and number systems to boost speed and accuracy.
CO2	Apply logical reasoning to puzzles, syllogisms, seating and classification problems.
CO3	Develop letter, number and symbol patterns and solve visual reasoning tasks.
CO4	Accurately solve problems on percentages, profit-loss, interest, ratios and partnerships.
CO5	Utilize aptitude and reasoning skills to excel in competitive exams and improve employability.

Text Books	
1	Quantitative Aptitude for Competitive Examinations , R.S. Aggarwal Chand Publishing. – 2023, ISBN-10: 9355012322
2	Vedic Mathematics , Bharati Krishna Tirthaji, Sixteenth Reprint, Published by Motilal Banarsidass Publishers, - 1985, ISBN- 978-8120801639
3	Logical and Analytical Reasoning , A.K. Gupta, 39 th Edition, Ramesh Publishing House – 2024, ISBN- 978-9350127766

Reference Books	
1	Puzzle Test & Seating Arrangements , K. Kundan (ISBN: 9789394666023),1 st Edition, BSC Publishing Company Pvt Ltd. - 2023
2	Logical Reasoning and Data Interpretation for the CAT , Nishit K. Sinha, 7 th Edition, Pearson Education -2020, (ISBN: 978-9353946616)

Web links and Video Lectures (e -Resources)	
1	https://www.youtube.com/watch?v=ZXcULvipQIM
2	https://www.youtube.com/watch?v=ZXcULvipQIM
3	https://www.youtube.com/watch?v=OHZ40sOT7mk
4	https://www.youtube.com/watch?v=9UtPPSX_vnk
5	https://www.youtube.com/watch?v=DlAjA3b21ow

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2									
CO2	3	3									
CO3	2	3									
CO4	3	2									
CO5	2	2			1						2



SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 - 2025

AICTE Approved, Accredited by NBA(CSE, ISE, ECE, ME, CV, AE) and NAAC with 'A+' grade, QS - I Gauge Gold Rated

SCHEME OF TEACHING AND EXAMINATION – B.E. – Computer Science and Engineering

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

4th Semester

Computer Science and Engineering												
Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BCS401	Design & Analysis of Algorithms	PCC	CSE	3	0	0	3	50	50	100	3
2	BCS402	Micro controller and Embedded Systems	IPCC	CSE	3	0	2	3	50	50	100	4
3	BCS403	Database Management Systems	IPCC	CSE	3	0	2	3	50	50	100	4
4	BBI404	Biology for Engineers	BSC	CHE	2	0	0	3	50	50	100	2
5	BCSL405	Design & Analysis of Algorithms Lab	PCCL	CSE	0	0	2	3	50	50	100	1
6	BCS406x	ESC/ETC/PLC	ESC	CSE	If the course is a Theory			3	50	50	100	3
					3	0	0					
					If the course is a Laboratory							
					2	0	2					
7	BUH407	Universal Human Values	UHV	ANY	1	0	0	1	50	50	100	1

				DEPT								
8	BXX408x	Ability Enhancement Course/Skill Enhancement Course - IV	AEC/ SEC	CSE	If the course is a Theory			1	50	50	100	1
					1	0	0					
					If the course is a Laboratory			2				
					0	0	2					
9	BMP409	Metaphysical Science	HSSMC	ANY DEPT	1	0	0	1	50	50	100	1
10	BNS410	National Service Scheme (NSS)	NCMC	NSS Coordinat or	0	0	2	-	100	-	100	0
	BPE410	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO410	Yoga		Yoga Teacher								
	BMU410	Music		Music Teacher								
11	BCE411	Competency Enhancement Course-2	NCMC	CDCAC	2	0	0	-	100	-	100	0
									650	450	1100	20

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)

Course Code	Course Name	Course Code	Course Name
BCS406A	Discrete Mathematical Structures and Graph Theory	BCS406C	Programming with Java
BCS406B	System Software	BCS406D	Linear Algebra
Ability Enhancement Course/Skill Enhancement Course – IV			
Course Code	Course Name	Course Code	Course Name
BCS408A	Green IT and Sustainability	BCS408C	Java Script and JQuery
BCS408B	Capacity Planning for IT	BCS408D	Mobile Application Development

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). 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 (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th 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, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Semester: IV					
Design & Analysis of Algorithms					
Course Code	:	BCS401	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40 Hrs	SEE	:	50 Marks
Course Type	:	PCC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Data structures and Applications, Problem Solving through Programming, Mathematics for CSE stream.
Knowledge on Fundamental Concepts	Structures, Recursion, Memory Allocation Techniques, File Concepts, Sorting and Searching Techniques.
Knowledge on Connected Tools (If any)	GCC, Turbo C.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand methods for analysing algorithms and assessing their performance.
CLO2	Illustrate algorithm efficiency using asymptotic notations and standard growth functions.
CLO3	Apply classical algorithm design techniques such as brute force, divide and conquer, decrease and conquer, and transform and conquer to solve computational problems.
CLO4	Illustrate the principles and typical examples of greedy, dynamic programming, backtracking, and branch and bound strategies.
CLO5	Interpret the concepts of computational complexity, including P, NP, NP-complete, and NP-hard problems.

Module – 1	08Hrs
Introduction: What is an Algorithm? Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems. Text Book 1: Ch. 1 : 1.1 - 1.3, Ch. 2: 2.1 - 2.4	
Module – 2	08Hrs
Brute Force and Exhaustive search: Selection Sort, Bubble sort, Brute-Force String Matching, Exhaustive Search. Divide and Conquer: Merge sort, Quick sort, Binary Tree Traversal, Multiplication of Large Integers and Strassen's Matrix Multiplication. Text Book 1: Ch. 3: 3.1-3.2, 3.4, Ch. 5: 5.1-5.4	
Module – 3	08Hrs
Decrease-and-Conquer: Insertion Sort, Topological Sorting. Transform-and-Conquer: Balanced Search Trees, Heaps and Heapsort. Space-Time Tradeoffs: Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm Text Book 1: Ch. 4: 4.1-4.2, Ch. 6: 6.3-6.4, Ch. 7: 7.1-7.2.	

Module – 4	08Hrs
Dynamic Programming: Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms. Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes.	
Text Book 1: Ch. 8: 8.1-8.2, 8.4, Ch. 9: 9.1-9.4	
Module – 5	08Hrs
Limitations of Algorithmic Power: Decision Trees, P, NP, and NP-Complete Problems. Coping With Limitations of Algorithmic Power: Backtracking: n-Queens problem, Subset-sum problem, Branch-and-Bound: Knapsack problem, Approximation algorithms for NP-Hard problems: Knapsack problem.	
Text Book 1: Ch. 11: 11.2-11.3, Ch. 12: 12.1-12.3	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze algorithm efficiency using asymptotic notations and classify algorithms into basic efficiency classes based on time and space complexity
CO2	Design and implement solutions to computational problems using Divide & Conquer and Decrease & Conquer strategies.
CO3	Develop solutions for real-world and complex computational problems by applying transform & conquer and dynamic programming techniques.
CO4	Construct graph and string processing algorithms using greedy approaches and input enhancement methods.
CO5	Differentiate between classes of computational problems (P, NP, NP-Complete) and apply advanced techniques such as backtracking, branch and bound, and approximation algorithms for efficient problem-solving.

Text Book	
1	"Introduction to the Design and Analysis of Algorithms", Anany Levitin, 3 rd Edition, Pearson, (2021), ISBN13: 9780137541133.

Reference Books	
1	"Computer Algorithms/C++", Ellis Horowitz, Satraj Sahni and Rajasekaran, 2 nd Edition, 2014, Universities Press, ISBN13: 9788173716119.
2	"Introduction to Algorithms", Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI 4 th Edition 2022, ISBN 978-0-262-03384-8.
3	"Design and Analysis of Algorithms", S. Sridhar, Oxford (Higher Education), 2 nd Edition, 2023, ISBN13: 9789354977886

Web links and Video Lectures (e - Resources)	
1	https://nptel.ac.in/courses/106/101/106101060/
2	https://nptel.ac.in/courses/106102064
3	https://nptel.ac.in/courses/106105164

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	2	1					2
CO2	3	3	3	2	2	1					2
CO3	3	3	3	2	2	1					2
CO4	3	3	3	2	3	2					2
CO5	3	3	3	2	2	2					2

Semester: IV					
Microcontroller and Embedded Systems					
Course Code	:	BCS402	Credits	:	4
Hours/Week(L:T:P)	:	3:0:2	CIE	:	50 Marks
Total Hours	:	40+12 Hrs	SEE	:	50 Marks
Course Type	:	IPCC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Digital Electronics, Basic Electronics, Embedded Systems
Knowledge on Fundamental Concepts	Understanding of microprocessor vs. microcontroller, I/O interfacing, memory architecture
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of ARM-based systems and basic architecture of CISC and RISC.
CLO2	Familiarize with ARM programming modules along with registers, CPSR and Flags.
CLO3	Develop ALP using various instructions to program the ARM controller.
CLO4	Understand the Exceptions and Interrupt handling mechanism in Microcontrollers.
CLO5	Discuss the ARM Firmware packages and Embedded System Components.

Module – 1	08Hrs
ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions Textbook 1: Ch. 1: 1.1 to 1.4, Ch. 2: 2.1 to 2.5	
Module – 2	08Hrs
Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants. Textbook 1: Ch.3: 3.1 to 3.6	
Module – 3	08Hrs
C Compilers and Optimization: Basic C Data Types, C Looping Structures, Register Allocation, Function, Calls, Pointer Aliasing, Portability Issues. Textbook 1: Ch.5: 5.1 to 5.7, 5.13	
Module – 4	08Hrs
Exception and Interrupt Handling: Exception handling, ARM processor exceptions and modes, vector table, exception priorities, link register offsets, interrupts, assigning interrupts, interrupt latency, IRQ and FIQ, exceptions, basic interrupt stack design and implementation. Firmware: Firmware and bootloader, ARM firmware suite, Red Hat redboot, Example:	

sandstone, sandstone directory layout, sandstone code structure.

Textbook 1: Ch. 9.1 and 9.2, Ch. 10

Module – 5

08Hrs

Embedded System Components: Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems. Core of an Embedded System including all types of processor/controller, Memory, Sensors and Actuators (LED, 7 segment LED display, stepper motor, Relay, Piezo Buzzer, Push button switch, Keyboard) Communication Interface (onboard and external types), Embedded firmware, Other system components.

Textbook 2: Ch. 1: 1.2 to 1.6, Ch. 2: 2.1 to 2.6

Sl.No.	Experiments
Module – 1	
1.	Using Keil software, observe the various Registers, Dump, CPSR, with a simple Assembly Language Programs (ALP).
Module – 2	
2.	Develop and simulate ARM ALP for Data Transfer, Arithmetic and Logical operations (Demonstrate with the help of a suitable program).
3.	Develop an ALP to multiply two 16-bit binary numbers.
4.	Develop an ALP to find the sum of first 10 integer numbers.
5.	Develop an ALP to find the largest/smallest number in an array of 32 numbers.
6.	Develop an ALP to count the number of ones and zeros in two consecutive memory locations.
Module – 3	
7.	Simulate a program in C for ARM microcontroller using KEIL to sort the numbers in ascending/descending order using bubble sort.
8.	Simulate a program in C for ARM microcontroller to find factorial of a number.
9.	Simulate a program in C for ARM microcontroller to demonstrate case conversion of characters from upper to lowercase and lower to uppercase.
Module – 4 and 5	
10.	To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds.
11.	To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to 'turn ON' LED when push button is pressed or at sensor detection.

Course Outcomes: After completing the course, the students will be able to

CO1	Recall foundational concepts of ARM and embedded systems.
CO2	Elucidate the operational principles of ARM processors and the role of firmware and system components in embedded applications.
CO3	Apply ARM instruction sets and basic C programming structures to develop and debug simple embedded system applications.
CO4	Analyse the design and implementation of various ARM-based application scenarios in embedded systems.
CO5	Evaluate enhancements to embedded applications using hardware/software integration.

Text Books	
1	“system developers”, Andrew N Sloss, Dominic Symes and Chris Wright, ARM guide, Elsevier, Morgan, Kaufman publishers, ISBN-10. 9781558608740, 2008.
2	“Introduction to Embedded Systems”, Shibu K V, Tata McGraw Hill Education, Private Limited, 2nd Edition. ISBN-13: 978-9339219680, 2017.

Reference Books	
1	“Microcontroller (ARM) and Embedded System”, Raghunandan.G.H, Cengage learning Publication, 2019, ISBN-13: 978-9353504106.
2	“Insider’s Guide to the ARM7 based microcontrollers”, Hitex Ltd.,1st edition, 2005, ISBN:9780954998813.

Web links and Video Lectures (e - Resources)	
1	https://www.youtube.com/watch?v=su6AJEK5bJU&t=1781s&pp=ygUVbWljcm9jb250cm9sbGVyIGFybSA3
2	https://www.youtube.com/watch?v=6vN586Jpojk&list=PLgwJf8NK-2e7nFEozQhZDZDSm09SwqbGP
3	https://www.arm.com/

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2				2			1	1		1
CO2	2				2			1	1		
CO3	3	2			2			1	1		
CO4	3	3			3			1	2		
CO5	3	3	2	1	3	1		1	2		1

Semester: IV					
Database Management System					
Course Code	:	BCS403	Credits	:	4
Hours/Week (L:T:P)	:	3:0:2	CIE	:	50 Marks
Total Hours	:	40 Hrs + 14 Hrs	SEE	:	50 Marks
Course Type	:	IPCC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving Through Programming, Data Structures, Discrete Mathematics, Operating Systems.
Knowledge on Fundamental Concepts	Unions, Intersections, Subsets, Propositional and predicate logic, Relations and Functions, Process Management & Concurrency.
Knowledge on Connected Tools (If any)	Oracle 11g, MySQL

Course Learning Objectives: This course will enable the students to	
CLO1	Illustrate the fundamental concepts of database systems, including the database approach, system architecture, data models, and various types of database users and environments.
CLO2	Design and model a relational database using Entity-Relationship (ER) concepts and map it to a relational schema while applying appropriate constraints and normalization techniques.
CLO3	Demonstrate the ability to write and execute SQL statements for defining schemas, manipulating data, enforcing constraints, and creating views in a relational database.
CLO4	Apply normalization techniques and functional dependency concepts to design well-structured relational schemas.
CLO5	Analyze transaction processing, concurrency control methods, and recovery techniques to ensure consistency and reliability in database systems.

Module – 1	08Hrs
<p>Databases and Database Users: Introduction; An example, characteristics of the database approach, actors on the scene; workers behind the scene, advantages of using the DBMS approach, A brief history of database Applications, when Not to use a DBMS.</p> <p>Database System – Concepts And Architecture: Data models, schemas, and instances, three schema architecture and data independence, database languages and interfaces, the database system environment, centralized and client/server/architectures for DBMSs. Classification of database management system.</p> <p>Text Book 1:Ch. 1: 1.1 – 1.8, Ch. 2: 2.1 to 2.6</p>	
Module – 2	08Hrs
<p>Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues.</p> <p>Relational Model: Relational Model Concepts, Relational Model Constraints and Relational</p>	

Database Schemas, Update Operations and Dealing with Constraint Violations, Relational Database Design using ER- to-Relational Mapping.	
Text Book 1: Ch. 3: 3.1 to 3.7, Ch. 5: 5.1 to 5.3, Ch. 9: 9.1	
Module – 3	08Hrs
SQL-The Relational Database Standard: SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Basic Queries in SQL, Insert, Delete and Update Statements in SQL, Additional Features of SQL, More Complex SQL Queries Specifying General Constraints as Assertion and Actions as Triggers, Views (Virtual Tables) in SQL, Schema Change Statements in SQL.	
Text Book 1: Ch. 6: 6.1 to 6.5, Ch. 5: 5.1 to 5.3 , Ch. 7: 7.1 to 7.4	
Module – 4	08Hrs
Database Design: Informal Design Guidelines for Relation Schemas, Functional Dependencies; Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover.	
Text Book 1: Ch. 14: 14.1 to 14.7 , Ch. 15: 15.1	
Module – 5	08Hrs
Transaction Processing Concept: Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, characterizing schedules based on recoverability and serializability, transaction support in SQL	
Concurrency Control & Database Recovery Techniques: Two phase locking techniques, Concurrency control based on Timestamp ordering, Recovery concepts, NO-UNDO/REDO Recovery Based on Deferred Update, Recovery based on deferred update and Immediate Update.	
Text Book 1: Ch. 20: : 20.1 to 20.6, Ch. 21: 21.1 – 21.2, Ch. 22: 22.1 to 22.3	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify and describe the fundamental concepts, architecture, and classifications of database systems.
CO2	Design relational database schemas using ER-modeling and map ER-diagrams to relational models.
CO3	Apply SQL to manage relational databases.
CO4	Apply normalization to design efficient relational schemas.
CO5	Develop reliable databases using transactions, concurrency control, and recovery.

Text Books	
1	Elmasri and Navathe,"Fundamentals of Database Systems", Pearson Education, 7 th Edition, 2016, ISBN-13: 978-0-13-397077-7.

Reference Books	
1	Silberschatz, Korth and Sudharshan ,“Database System Concepts”, McGraw-Hill 6 th Edition, 2016, ISBN 0-07-352332-1
2	Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems”, McGraw-Hill, 3 rd Edition, 2003, ISBN-10: 0072465638.

Web links and Video Lectures (e - Resources)	
1	https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLlwC9bZ0rmjSk1VRJROX4vP2YMI4Ebh
2	https://www.youtube.com/watch?v=sEaYXwmsLw0&list=PLyqSpQzTE6M-xymXggewlzcC3U4cdRoSu
3	https://www.w3schools.com/sql/default.asp
4	https://www.tutorialspoint.com/dbms/index.htm
5	https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/

Laboratory Programs

Instructions:	
<ul style="list-style-type: none"> Design, develop, and Implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under LINUX/Windows environment. 	
SL.NO	Experiments
1	<p>Create a table called Employee & execute the following. Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)</p> <ol style="list-style-type: none"> Create a user and grant all permissions to the user. Insert the any three records in the employee table contains attributes EMPNO, ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. Add primary key constraint and not null constraint to the employee table. Insert null values to the employee table and verify the result.
2	<p>Create a table called Employee that contain attributes EMPNO, ENAME, JOB, MGR, and SAL & execute the following.</p> <ol style="list-style-type: none"> Add a column commission with domain to the Employee table. Insert any five records into the table. Update the column details of job Rename the column of Employ table using alter command. Delete the employee whose Empno is 105.
3	<p>Queries using aggregate functions (COUNT, AVG, MIN, MAX, SUM), Group by, Orderby. Employee(E_id, E_name, Age, Salary)</p> <ol style="list-style-type: none"> Create Employee table containing all Records E_id, E_name, Age and Salary. Count number of employee names from employee table Find the Maximum age from employee table. Find the Minimum age from employee table. Find salaries of employee in Ascending Order. Find grouped salaries of employees.
4	<p>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)</p>
5	<p>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)</p>
6	<p>Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.</p>
7	<p>Install an Open Source NoSQL Data base MangoDB & perform basic CRUD (Create, Read, Update and Delete) operations. Execute MangoDB basic Queries using CRUD operations.</p>

CO – PO MAPPING MATRIX:

COs/POs	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2					1				2
CO2	3	2	3		2		1				2
CO3	2	3	2		3		1				2
CO4	3	3	2	1	2	1	1			1	2
CO5	3	3	2	2	3	2	1	1	1	1	2

Semester: IV					
Biology for Engineers					
Course Code	:	BBI404	Credits	:	2
Hours/Week(L:T:P)	:	2:0:0	CIE	:	50 Marks
Total Hours	:	30	SEE	:	50 Marks
Course Type	:	BSC	SEE Duration	:	3 Hrs

Prerequisites:	
Courses	Biology, Chemistry
Knowledge on Fundamental Concepts	-
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental biological structures and biomolecules
CLO2	Analyze the practical applications of biomolecules in biotechnology and daily life.
CLO3	Relate human organ systems to engineered designs and solutions
CLO4	Appreciate bioinspired materials and mechanisms derived from nature
CLO5	Explore emerging trends in bioengineering and biotechnology

Module – 1	6 Hrs
Introduction to Biology The cell: the basic unit of life, Structure and functions of a cell. The Plant Cell and animal cell, Prokaryotic and Eukaryotic cell, Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules; Enzymes (Classification (with one example each), Properties and functions), vitamins and hormones. Textbook 1. Ch.1, Ch.2, Ch.3, Ch.4, Textbook 2. Ch. 3, Ch.4, Textbook 3. Ch. 1, Ch. 2, Ch. 3, Textbook 4. Ch.2, Ch. 3, Ch. 4	
Module – 2	6 Hrs
Biomolecules and Their Applications (Qualitative) Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching). Textbook 1. Ch.5&6 Textbook 2. Ch. 4&20, Textbook 3. Ch. 5, Textbook 4. Ch.7& 8.	
Module-3	6 Hrs
Human Organ Systems and Bio Designs (Qualitative) Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems).	

Textbook 1. Ch.7-11, Textbook 2. Ch.7, 10, 13, 16 & 17 Textbook 3. Ch. 6, Textbook 4. Ch.9& 10.	
Module-4	6 Hrs
Nature-Bioinspired Materials and Mechanisms (Qualitative) Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and per fluoro carbons (PFCs). Textbook 1. Ch.12 &13, Textbook 2. Ch.2&3 Textbook 3. Ch. 7, Textbook 4. Ch.12 & 14.	
Module-5	6 Hrs
Trends in Bioengineering (Qualitative) Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Selfhealing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). Textbook 1. Ch.14 &15, Textbook 2. Ch.20 Textbook 3. Ch. 8, Textbook 4. Ch.15.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure and function of cells and major biomolecules essential for life processes.
CO2	Describe the applications of biomolecules in healthcare, environment, and biotechnology.
CO3	Elucidate the human organ systems using engineering analogies and identify associated bioengineering interventions.
CO4	Illustrate nature-inspired biological mechanisms and their technological applications in engineering and material science.
CO5	Discuss emerging trends and tools in bioengineering for diagnostics, therapeutics and environmental sustainability.

Text Books	
1	Biology for Engineers , Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao, N Publishing, Bengaluru, 2023, ISBN-10: 9353161355
2	Human Physiology , Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022, ISBN-10: 1264398786
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, ISBN-10: 1420077635
4	Biology for Engineers , Arthur T. Johnson, CRC Press, Taylor and Francis, 2011

Reference Books	
1	Biomedical Instrumentation , Leslie Cromwell, Prentice Hall 2011.
2	Biology for Engineers , Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
3	Biomimetics: Nature-Based Innovation , Yoseph Bar-Cohen, 1 st edition, 2012, CRC Press.

Web links and Video Lectures (e - Resources)	
1	https://nptel.ac.in/courses/121106008
2	https://freevidelectures.com/course/4877/nptel-biology-engineers-other-non-biologists
3	https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
4	https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
5	https://www.coursera.org/courses?query=biology
6	https://onlinecourses.nptel.ac.in/noc19_ge31/preview
7	https://www.classcentral.com/subject/biology
8	https://www.futurelearn.com/courses/biology-basic-concepts

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3					1					1
CO2	3	2			2	3					2
CO3	3				3	2	1				2
CO4	2	2			3	2					2
CO5	2	3				3					3

Semester: IV					
Design & Analysis of Algorithms Lab					
Course Code	:	BCSL405	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	14Hrs	SEE	:	50 Marks
Course Type	:	PCCL	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Data Structures and Applications, Problem Solving through Programming
Knowledge on Fundamental Concepts	C Programming Fundamentals and Data Structure Concepts.
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
CLO2	Apply diverse design strategies for effective problem-solving.
CLO3	Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.
CLO4	Understand limitations and computability of problems related to NP-Completeness and Approximation algorithm
CLO5	Compare algorithm design strategies (divide-and-conquer, greedy, dynamic programming, backtracking, graph algorithms) by developing equivalent programs and analyzing empirical results.

Experiments	
Sl. No.	List of problems for which student should develop program and execute in the Laboratory
1.	Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
2.	Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3.	Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
4.	Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph.
5.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.

6.	Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
7.	a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm. b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm.
8.	Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
9.	Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method.
10.	Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method.
11.	Design and implement C/C++ Program to find a subset of a given set $S = \{s_1, s_2, \dots, s_n\}$ of n positive integers whose sum is equal to a given positive integer d .
12.	Design and implement C/C++ Program for N Queen's problem using Backtracking.

Course Outcomes: After completing the course, the students will be able to

CO1	Develop programs to solve computational problems using suitable algorithm design strategy.
CO2	Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical).
CO3	Apply integrated development tools (IDEs) effectively to design, develop, and test programs.
CO4	Choose appropriate algorithm design techniques to develop solution to the computational and complex problems.
CO5	Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences

Web links and Video Lectures (e - Resources)

1	Virtual Labs : http://cse01-iiith.vlabs.ac.in/
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CO-PO Mapping

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	3	3	2	3						2
CO2	3	3	2	2	3						3
CO3	2	1	1	1	3						3
CO4	3	3	3	2	3						3
CO5	2	3	2	1	1				3	2	2

Semester: IV					
Discrete Mathematical Structures and Graph Theory					
Course Code	:	BCS406A	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hrs

Prerequisites:	
Courses	Engineering Mathematics, Set Theory
Knowledge on Fundamental Concepts	Understanding of logic, sets, relations, functions, counting principles, and basic proof techniques
Knowledge on Connected Tools (If any)	Mathematical software like Wolfram Alpha, MATLAB, or LaTeX

Course Learning Objectives: This course will enable the students to	
CLO1	Understand logical statements using truth tables, rules of inference, and quantifiers to construct valid logical arguments
CLO2	Explore Fundamental principles of counting, permutations, combinations, recurrence relations, and generating functions to solve combinatorial problems.
CLO3	Comprehend properties of relations and functions, including equivalence relations, partial orders, Stirling numbers, and function growth analysis.
CLO4	Apply the foundational concepts of group theory to solve problems in coding theory using the Hamming metric and matrix representations.
CLO5	Analyze various graph and tree structures, including their properties, representations, and applications in sorting and spanning tree algorithms

Module – 1		08Hrs
Fundamentals of Logic Basic Connectives and Truth Tables, Tautologies, Logical Equivalence: The laws of logic, Logical Implications, Rules of inference. Open Statement, Quantifiers, Definition and the use of Quantifiers, Definitions, and the proofs of theorems. Text Book 1: Ch. 2: 2.1-2.5		
Module – 2		08Hrs
Fundamental Principles of Counting and Combinatorics The Rule of Sum and Product, Permutations, Combinations, Principle of Inclusion and Exclusion, Derangements, The Binomial Theorem, Combinations with repetition. Recursive Definitions, Recurrence Relations Recursive definition, First order linear recurrence relation- Formulation problems and examples, Second order linear recurrence relations with constant coefficients- Homogeneous and Non homogeneous, Generating functions. Text Book 1: Ch. 1: 1.1 - 1.4, Ch. 10: 10.1 - 10.3, Ch. 8: 8.3		
Module – 3		08Hrs
Relations Properties of relations, Composition of Relations, Partial Orders, Hasse Diagrams, Equivalence Relations, and Partitions. Functions Functions-plain, One-to-one, onto functions, Stirling numbers of the second kind, Function composition and Inverse function, Growth of function.		

Text Book 1: Ch. 5: 5.1 - 5.3, Ch. 7: 7.1 - 7.4	
Module – 4	08Hrs
Groups theory: Definition, Examples and Elementary properties, Abelian groups, Homomorphism isomorphism, cyclic groups, cosets and Lagrange's theorem. Coding Theory: Elementary coding theory, the hamming metric, the parity-Check and Generator Matrices Text Book 1: Ch.15: 15.1 - 15.5, 15.7 - 15.9, 15.11	
Module – 5	08Hrs
Introduction to Graph Theory: Graphs and their basic properties - degree, path, cycle, complement, subgraphs, isomorphism, Computer representations of graphs. Eulerian and Hamiltonian graphs, Graph coloring, Planar graphs. Trees: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Spanning trees. Text Book 1: Ch.11: 11.1 - 11.6, Ch. 12: 12.1 - 12.3	

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the foundational concepts of logic, combinatorics, relations, and functions.
CO2	Apply counting techniques, recurrence relations, and function properties to solve computational problems.
CO3	Analyze complex problem scenarios and construct solutions using logical inference, graph theory, and algebraic structures.
CO4	Develop innovative approaches using discrete structures like graphs, groups, and recurrence relations.
CO5	Utilize the fundamental properties of graphs and trees to solve problems related to connectivity, traversal, and optimization.

Text Book	
1	"Discrete and Combinatorial Mathematics- An Applied Introduction", Ralph P. Grimaldi and B V Ramana, 5th Edition, Pearson Education, Asia,— 2017, ISBN 978-0321385024

Reference Books	
1	"Introduction to Graph Theory", Garry Chartand and Ping Zhang, Tata McGraw-Hill, 2006, 978-0070616080.
2	"Discrete Mathematical Structures Theory and Applications", D.S. Malik and M.K. Sen Latest Edition, Thomson, 2004, 978-0619212858.
3	"Discrete Mathematics and its Applications", Kenneth H. Rosen, Tata — McGraw Hill, 6 Edition, 7 th edition 2017, ISBN-(13): 978-0070681880
2	"Discrete and Combinatorial Mathematics", Ralph P. Grimaldi: 5th Edition, Pearson Education. 2004, 978-0-201-72634-3.
3	"Graph theory with the applications to engineering & Computer Science", Narsingh Deo, Dovers Publications, 2016, 978-0486807935.

Web Links	
1	https://www.youtube.com/playlist?list=PLHXZ9OQGMqxersk8fUxiUMSIx0DBqsKZS
2	https://www.youtube.com/playlist?list=PLl-gb0E4MII0sGLCJeqDB3y63HZ6lM5Ll
3	https://discrete.openmathbooks.org/dmoi4.html

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2	2	1						1	
CO2	3	3	2	2						1	
CO3	3	2	3	2					1	1	
CO4	3	2	3	3					1	1	
CO5									2	2	2

Semester: IV					
System Software					
Course Code	:	BCS406B	Credits	:	3
Hours/Week(L:T:P)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40 Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Operating System, Digital Design and Computer Organization, Micro Controller and Embedded Systems.
Knowledge on Fundamental Concepts	Instruction formats, addressing modes, CPU architecture, memory management.
Knowledge on Connected Tools (If any)	GCC

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the underlying principles of System Architecture and their machine interactions with the assemblers.
CLO2	Apply data structures and algorithms in the development of assemblers.
CLO3	Understand the basic loader and macro processor functions.
CLO4	Analyze the design and implementation techniques used in the development of system software components.
CLO5	Explore the functioning of system software tools and their role in program execution and optimization.

Module - 1	08Hrs
Machine Architecture: Introduction, System Software and Machine Architecture, Simplified Instructional Computer (SIC) - SIC Machine Architecture, SIC/XE Machine Architecture. Assemblers-1: Basic Assembler Function - A Simple SIC Assembler, Assembler Algorithm and Data Structures, Machine Dependent Assembler Features - Instruction Formats & Addressing Modes, Program Relocation. Test Book 1: Ch-1: 1.1-1.3.2, Ch-2: 2.1, 2.2	
Module - 2	08Hrs
Assemblers -2: Machine Independent Assembler Features - Literals, Symbol-Definition Statements, Expression, Program Blocks, Control Sections and Program Linking, Assembler Design Operations - One- Pass Assembler, Multi-Pass Assembler. Test Book 1: Ch-2: 2.3, 2.4	
Module - 3	08Hrs
Loaders and Linkers: Basic Loader Functions - Design of an Absolute Loader, A Simple Bootstrap Loader, Machine-Dependent Loader Features - Relocation, Program Linking, Algorithm and Data Structures for a Linking Loader. Macro Processor: Basic Macro Processor Functions - Macro Definitions and Expansion, Macro Processor Algorithm and Data Structures, Machine- Independent Macro Processor Features - Concatenation of Macro Parameters, Generation of Unique Labels, Conditional Macro Expansion, Keyword Macro Parameters. Test Book 1: Ch-3: 3.1, 3.2, Ch-4: 4.1, 4.2	

Module – 4	08Hrs
LEX and YACC – 1: Lex and Yacc - The Simplest Lex Program, Recognizing Words With LEX, Symbol Tables, Grammars, Parser-Lexer Communication, The Parts of Speech Lexer, A YACC Parser, The Rules Section, Running LEX and YACC, LEX and Hand- Written Lexers, Using LEX – Regular Expression, Examples of Regular Expressions, A Word Counting Program, Parsing a Command Line. Test Book 2: Ch-1, Ch-2.	
Module – 5	08Hrs
LEX and YACC - 2: Using YACC – Grammars, Recursive Rules, Shift/Reduce Parsing, What YACC Cannot Parse, A YACC Parser - The Definition Section, The Rules Section, Symbol Values and Actions, The LEXER, Compiling and Running a Simple Parser, Arithmetic Expressions and Ambiguity, Variables and Typed Tokens. Test Book 2: Ch-3.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure, functions, and purpose of different types of machine architecture.
CO2	Demonstrate the functionalities of an assembler.
CO3	Illustrate the working of loaders, linkers and macro processors with relevant examples.
CO4	Design and implement lexical analyzers to tokenize source code using tools and techniques such as regular expressions.
CO5	Develop parsers for simple programming languages using context-free grammars.

Text Books	
1	“System Software: An Introduction of System Programming”, Leland. L. Beck and D Manjula 3rd edition, 2012, ISBN 978-0201423006.
2	“LEX and YACC”, 2 nd edition, O'Reilly, John R Levine, Tony Mason and Doug Brown SPD, 1998, ISBN: 9781565920002.

Reference Books	
1	“Systems programming”, Srimanta Pal, Oxford university press, 2016
2	“System programming and Compiler Design”, K C Loudon, Cengage Learning
3	“System software and operating system”, D. M. Dhamdhere, TMG

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106105214
2	https://nptel.ac.in/courses/106106144

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2									1
CO2	2	2	2								1
CO3	2	2	1								1
CO4	2	2	2		2		1				1
CO5	2	2	2		2		1				1

Semester: IV					
Programming with Java					
Course Code	:	BCS406C	Credits	:	3
Hours/Week(L:T:P)	:	2:0:2	CIE	:	50 Marks
Total Hours	:	30+14 Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming.
Knowledge on Fundamental Concepts	Basic understanding of programming logic, data types, control structures, operators and functions.
Knowledge on Connected Tools (If any)	Eclipse.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand object-oriented principles and basic Java constructs such as classes, objects, data types, methods, and control structures.
CLO2	Use the concepts of inheritance and interfaces to achieve code reusability and polymorphism in Java programs.
CLO3	Develop modular Java programs using packages and handle runtime errors using appropriate exception handling techniques.
CLO4	Implement concepts of multithreading and Swings program development.
CLO5	Implement database application in Java using JDBC.

Module – 1	06Hrs
Introduction to Java: Object oriented programming (Two Paradigms, Abstraction, and The Three OOP Principles), Using Blocks of Code, The Bytecode, The Java Buzzwords, and Structure of a Java Program, Data types, variables, operators, control statements and Arrays. Introducing classes: Class fundamentals, declaring objects, assigning object reference variables, Introducing methods, Constructors, this keyword, Garbage Collection,. Methods and classes: Overloading methods, Objects as parameters, argument passing, Returning objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.	
Text Book 1: Ch.1.4, Ch.1.8, Ch.2, Ch.3, Ch.4, Ch.5, Ch.6, Ch.7	
Module – 2	06Hrs
Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class. Interfaces: Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.	
Text Book 1: Ch.8, Ch.9.4 - 9.7	
Module – 3	06Hrs

Packages: Packages, Packages and Member Access, Importing Packages. Exceptions: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions.	
Text Book 1: Ch.9: 9.1-9.3, Ch.10: 1-10.12	
Module – 4	06Hrs
Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State. Introducing Swing: The Origin of Swing, Swing Is Built on AWT, Two Key Swing Features, The MVC Connection, Components and Containers, The Swing Packages, A Simple Swing Application.	
Text Book 1: Ch.11: 11.1 - 11.10, Ch. 32: 32.1-32.7	
Module – 5	06Hrs
JDBC Objects: The concept of JDBC, JDBC Driver Types, JDBC packages, A brief overview of the JDBC Process, Database Connection, Associating the JDBC/ODBC Bridge with the Database, Statement Objects, ResultSet, Transaction Processing, Metadata, Data Types, Exceptions.	
Text Book 2: Ch. 6	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the core object-oriented programming principles in Java through the use of classes, objects, methods, and arrays.
CO2	Illustrate how inheritance and packages can be applied to solve real-world problems.
CO3	Apply the concept of interfaces and exception handling to address complex real-world problems.
CO4	Develop Java applications using multi-threaded programming and Swings.
CO5	Apply JDBC to build database applications.

Text Books	
1	Java: "The Complete Reference", Herbert Schildt, 13 th Edition, 2024, McGraw-Hill, ISBN: 9781265058432
2	J2EE – "The Complete Reference" – Jim Keogh, 1 st Edition, 2017, Tata McGraw Hill, ISBN: 978-0070529120

Reference Books	
1	"Programming with Java", E Balagurusamy, 6th Edition, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
2	"Thinking in Java, Bruce Eckel", Fourth Edition, 2006, Prentice Hall, (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)
3	Introduction to Java Programming, Y. Daniel Liang, 6th Edition, 2007, Pearson Education.

Web links and Video Lectures (e - Resources)	
1	Java Tutorial: https://www.geeksforgeeks.org/java/
2	Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-

	2010/
3	Java Tutorial: https://www.w3schools.com/java/
4	Java Tutorial: https://www.javatpoint.com/java-tutorial
5	Programming in Java: https://onlinecourses.nptel.ac.in/noc20_cs58/preview

Practical Components:

Sl.NO	Experiments
1.	Create a class namely Account with the data members (Accno : integer, name :String, Phone No: integer, balance_amt:float), and following methods : a. CreateAccount() method to create an account. b. Deposit() method to deposit amount to an account. c. Withdraw() method which gets the amount to be withdrawn from his/her account. d. PrintAccount() method to display account details.
2.	Write a Java Program that does the following related to Inheritance: a) Create an abstract class called Vehicle which contains the 'year of manufacture' data member and two abstract methods getData() and putdata() with a constructor. b) Create two derived classes 'Two-wheeler' and 'Four-wheeler' and implement the abstract methods. Make 'Four-wheeler' as final class. c) Create class 'MyTwoWheeler' which is a subclass of 'Two-wheeler' and demonstrate the use of super keyword to initialize data members of 'MyTwoWheeler'.
3.	Write a JAVA program to create an interface Resizable with methods resize Width (int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
4.	Create a package CIE which has two classes - Personal and Internals. The class Personal has members like usn, name, sem. The class Internals has an array that stores the internal marks scored in five courses of the current semester of the student. Create another package SEE which has the class External which is a derived class of Personal. This class has an array that stores the SEE marks scored in five courses of the current semester of the student. Import the two packages in a file that declares the final marks of n students in all five courses.
5.	Write a JAVA program to read two integers a and b. Compute a/b and print, when b is not zero. Raise an exception when b is equal to zero. Also demonstrate working of ArrayIndexOutOfBoundsException
6.	Write a java program that implements a multi-thread application that has two threads. one thread displaying "SJC Institute of Technology" once every ten seconds and another displaying "ISE" once every two seconds.
7.	Demonstrate a swing event handling application that creates 2 buttons Alpha and Beta and displays the text "Alpha pressed" when alpha button is clicked and "Beta pressed" when beta button is clicked.
8.	Write a JAVA Program to insert data into Student DATA BASE and retrieve info based on particular queries(For example update, delete, search etc...).

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									1
CO2	3	3	2								1
CO3	3	3	2	2	3						1
CO4	3	3	2	2	3						2
CO5	3	2	2	2	2				1		1

Semester: IV					
Linear Algebra					
Course Code	:	BCS406D	Credits	:	3
Hours/Week(L:T:P:S)	:	3:0:0	CIE	:	50 Marks
Total Hours	:	40Hrs	SEE	:	50 Marks
Course Type	:	ESC	SEE Duration	:	3 Hours

Prerequisites:	
Courses	Engineering Mathematics
Knowledge on Fundamental Concepts	Understanding of vectors, matrices, systems of linear equations, vector spaces, and matrix operations
Knowledge on Connected Tools (If any)	MATLAB, Octave for matrix calculations and visualization

Course Learning Objectives: This course will enable the students to	
CLO1	Define the fundamental properties of vector spaces, subspaces, and linear dependence concepts.
CLO2	Interpret linear transformations and their matrix representations including kernel and image.
CLO3	Apply concepts of eigenvalues, eigenvectors, and the Cayley-Hamilton theorem to solve matrix-related problems.
CLO4	Construct orthogonal bases and solve least square problems using inner product space techniques.
CLO5	Analyze and implement optimization techniques using diagonalization, SVD, and PCA.

Module – 1	08Hrs
Vector Spaces: Introduction, Vector spaces, Subspaces, Linear Combinations, Linear Spans, row space and column space of a Matrix, Linear Dependence and Independence, Basis and Dimension, Coordinates.	
Text Book 1: Ch. 4: 4.1 - 4.5	
Module – 2	08Hrs
Linear Transformations: Introduction, Linear Mappings, Geometric linear transformation of \mathbb{R}^2 , Kernel and Image of a linear transformations, Rank-Nullity Theorem (No proof), Matrix representation of linear transformations, Singular and Non-singular linear transformations, Invertible linear transformations.	
Text Book 1: Ch. 1	
Module – 3	08Hrs
Eigenvalues and Eigenvectors: Introduction, Polynomials of Matrices, Applications of Cayley-Hamilton Theorem, Eigen spaces of a linear transformation, Characteristic and Minimal Polynomials of Block Matrices, Jordan Canonical form.	
Text Book 1: Ch. 5: 5.1 - 5.4	
Module – 4	08Hrs

Inner Product Spaces: Inner products, inner product spaces, length and orthogonality, orthogonal sets and Bases, projections, Gram-Schmidt process, QR-factorization, least squares problem and least square error.	
Text Book 1: Ch. 6	
Module – 5	08Hrs
Optimization Techniques in Linear Algebra: Diagonalization and Orthogonal diagonalization of real symmetric matrices, quadratic forms and its classifications, Hessian Matrix, Method of steepest descent, Singular value decomposition. Dimensionality reduction — Principal component analysis.	
Text Book 1: Ch. 5: 5.3, Ch. 7	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure of vector spaces and determine the basis and dimension of subspaces.
CO2	Illustrate the effect of linear mappings and examine their invertibility through transformation matrices.
CO3	Analyze problems involving eigenvalues, minimal polynomials, and Jordan canonical forms.
CO4	Use the Gram-Schmidt process and QR factorization in projection and approximation contexts.
CO5	Evaluate quadratic forms and use SVD and PCA for optimization and dimensionality reduction in real-world applications.

Text Book	
1	“Linear Algebra and its applications”, David C. Lay, Steven R. Lay, Judi J Mc. Donald: 6th Edition, Pearson Education, 2021, 978-0-13-585125-8.

Reference Books	
1	“Linear Algebra: An Introduction”, Richard Bronson & Gabriel B. Costa 2nd edition. Academic Press, 2014, 978-0120887842.
2	“Theory and problems of linear algebra”, Seymour Lipschutz, Marc Lipso: 6th edition, McGraw-Hill Education, 2017, 978-1260011449 .
3	“Linear Algebra and its applications”, Gilbert Strang, 4th edition, Brooks Cole, 2005, 978-0-03-010567-8.

Web links and Video Lectures (e - Resources)	
1	https://ocw.mit.edu/courses/_mathematics/18-06sc-linear-algebra-fall_2011/_index_.html
2	https://www.math.ucdavis.edu/linear/linear.pdf
3	https://www.coursera.org/learn/linear-algebra-machine-learning
4	https://nptel.ac.in/syllabus/111106051/
5	http://nptel.ac.in/courses.php?disciplineID=111
6	http://www.class-central.com/subject/math(MOOCs)
7	http://academicearth.org/
8	VTU e-Shikshana Program
9	VTU EDUSAT Program.

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	2										1
CO2	3	2									1
CO3	3	2	2	1							1
CO4	3	2		1							1
CO5	3	2		1							1

Semester: IV					
Universal Human Values (UHV)					
Course Code	:	BUH408	Credits	:	01
Hours/Week(L:T:P)	:	1:0:0	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	UHV	SEE Duration	:	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the need, purpose, and content of value-based education.
CLO2	Facilitate self-exploration as a process to understand human aspirations and their fulfillment.
CLO3	Understand harmony at various levels – individual, family, society, nature, and existence.
CLO4	Promote ethical competence and awareness of professional ethics.
CLO5	Encourage the adoption of a holistic and humanistic approach in personal and professional life.

Module-1	03 Hrs
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. Textbook1- Ch.1&2	
Module-2	03 Hrs
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. Textbook1- Ch.3	
Module-3	03 Hrs
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. Textbook1- Ch.4&5	
Module-4	03 Hrs
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 and The Holistic Perception of Harmony in Existence. Textbook1- Ch.6&7	
Module-5	03 Hrs

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

Textbook1- Ch.8&9

Course Outcomes: After completing the course, the students will be able to

CO1	Describe the need and importance of value education and the process of self-exploration.
CO2	Explain the concept of harmony in the human being, differentiating the needs of the self and the body.
CO3	Apply the principles of trust, respect, and justice to improve relationships within the family and society.
CO4	Analyze and appreciate the interconnectedness and mutual fulfillment among the four orders of nature.
CO5	Demonstrate ethical behavior and decision-making in professional and personal contexts by integrating human values.

Text Books

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 978-93-87034- 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 kantik, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The 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. Susan 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 Nagaraj, 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. SubhasPalekar, 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.

Web links and Video Lectures (e - Resources)

- Value Education websites,
- <https://www.uhv.org.in/uhv-ii>,
- <http://uhv.ac.in>,
- <http://www.uptu.ac.in>
- Story of Stuff,
- <http://www.storyofstuff.com>
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- <https://www.youtube.com/watch?v=8ovkLRYXljE>
- <https://www.youtube.com/watch?v=OgdNx0X923I>
- <https://www.youtube.com/watch?v=nGRcbRpvGoU>
- <https://www.youtube.com/watch?v=sDxGXOgYEKM>

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	1					2	3	2	2		2
CO2	2	2				2	3		1		2
CO3						3	3	3	2		2
CO4						2	2		1		2
CO5						3	3	2	2		3

Semester: IV					
Green IT and Sustainability					
Course Code	:	BCS408A	Credits	:	01
Hours/Week(L:T:P)	:	1:0:0	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	AEC/SEC	SEE Duration	:	1 Hours

Prerequisites:	
Courses	Principles of c Programming
Knowledge on Fundamental Concepts	Computer Organization
Knowledge on Connected Tools (If any)	

Course Learning Objectives: This course will enable the students to	
CLO1	Classify the challenges for Green ICT
CLO2	Relate the environmental impact due to emerging technologies.
CLO3	Demonstrate different aspects of ICT metrics
CLO4	Compare the various parameters related to Sustainable Cloud Computing
CLO5	Interpret the effects of software design on the sustainability

Module - 1	08Hrs
Green ICT -History, Agenda, and Challenges Ahead: Introduction, Industrial Revolution, The Emergence of Information and Communication Technologies, The Agenda and Challenges Ahead.	
Module - 2	08Hrs
Emerging Technologies and Their Environmental Impact: Introduction, Number of Connected Devices, Increased, Functionality, Increased Number of Separate Functions, Increased Demand for Speed and Reliability, Obsolescence—The Problem of Backward Compatibility, The Other Side of the Balance Sheet, Videoconference as an Alternative to Business Travel, Dematerialization of Product Chain, Travel Advice/Road Traffic Control, Intelligent Energy Metering, Building Management Systems, Saving IT	
Module - 3	08Hrs
Measurements and Sustainability: Introduction, ICT Technical Measures, Ecological Measures and Ethical Consideration, Systems Engineering for Designing Sustainable ICT-Based Architectures.	
Module - 4	08Hrs
Sustainable Cloud Computing: Introduction, Challenges in the Use of Cloud Computing As Green Technology, Cloud Computing and Sustainability, Sustainable Applications of Cloud Computing, Technologies Associated With Sustainable Cloud Computing, Future Prospects of Sustainable Cloud Computing, Reflections on Sustainable Cloud Computing Applications.	
Module - 5	08Hrs
Sustainable Software Design: Overview and Scope, Evaluating Sustainability Effects , Sustainability and the Product Life Cycle , Direct Effects: Sustainability During Use, Runtime Energy Consumption Basics , Analysing the Energy Consumption of an Application , Energy Consumption Reduction Using Physical Properties of Semiconductors, Optimizing the Energy Consumption of an Application: Compiler Techniques, Optimizing the Energy Consumption of an Application: Runtime Approaches.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the Green IT and environmental impact of traditional IT practices.
CO2	Apply the concepts of green hardware and software methodologies.
CO3	Illustrate the dimensions of sustainability development
CO4	Analyze the strategies for implementing Green IT and sustainability initiatives
CO5	Identify sustainable computing technologies and practices

Text Books	
1	"The Greening of IT", John Lamb, Pearson Education, 2009, ISBN 10: 0137150830
2	"Green Computing and Green IT- Best Practices on regulations & industry", Jason Harris, Lulu.com, 2008, ISBN: 1558604898

Reference Books	
1	"Information Technology for Environmental Sustainability" Greening through IT: by Bill Tomlinson 2019, ISBN-10 : 366257683X, ISBN-13 : 978-3662576830
2	"Harnessing Green IT Principles and Practices", San Murugesan, G.R. Gangadharan, Wiley Publication, 2012. ISBN:9788126539680

Web links and Video Lectures (e - Resources)	
1	https://www.youtube.com/watch?v=kvn-mJ2tSo
2	https://www.brightest.io/sustainability-measurement

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	2						1				1
CO2	2	1					1				1
CO3	2	2	1	1	2		1				1
CO4	1	1	1	2			1				2
CO5	1	1	1	1	2		1				1

Semester: IV			
Capacity Planning for IT			
Course Code	:	BCS408B	Credits : 1
Hours/Week(L:T:P)	:	1:0:0	CIE : 50 Marks
Total Hours	:	15 Hrs	SEE : 50 Marks
Course Type	:	AEC	SEE Duration : 1 Hours

Prerequisites:	
Courses	Computer Networks, Operating System
Knowledge on Fundamental Concepts	Understanding of resource allocation, workload forecasting, performance metrics, and scalability principles
Knowledge on Connected Tools (If any)	Nagios, SolarWinds, or cloud platform dashboards

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the fundamental goals, metrics and issues in capacity planning and monitoring.
CLO2	Illustrate how measurement data supports capacity prediction and planning.
CLO3	Use principles of automated deployment, installation, and configuration in IT systems.
CLO4	Analyze Role of virtualization and cloud services in capacity planning.
CLO5	Apply virtualization and cloud computing concepts to evaluate resource usage and cost through real-world use cases

Module - 1	03Hrs
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. Text Book 1: Ch. 1, Ch. 2: 2.1, 2.6	
Module - 2	03Hrs
Measurement: Units of Capacity: Aspects of Capacity Tracking Tools, Applications of Monitoring. Text Book 1: Ch. 3: 3.1, 3.10	
Module - 3	03Hrs
Measurement: API Usage and Its Effect on Capacity, Examples and Reality. Predicting Trends: Riding Your Waves. Text Book 1: Ch. 3: 3.17, 3.18; Ch. 4: 4.1	
Module - 4	03Hrs
Predicting Trends: Procurement, The Effects of Increasing Capacity, Long-Term Trends, Iteration and Calibration. Deployment: Automated Deployment Philosophies, Automated Installation Tools, Automated Configuration. Text Book 1: Ch. 4: 4.8, 4.11, 4.12, 4.15; Ch. 5: 5.1, 5.2, 5.3	
Module - 5	03Hrs

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.

Text Book 1: Ch. 6

Course Outcomes: After completing the course, the students will be able to

CO1	Recall key concepts, goals, and issues related to capacity planning and system performance.
CO2	Explain various capacity measurement techniques and tools used for tracking and monitoring system performance.
CO3	Explore measurement data for prediction towards overall planning process.
CO4	Analyze deployment and configuration approaches for efficient system management.
CO5	Apply virtualization and cloud solutions for designing scalable and cost-effective capacity plans.

Text Book

1	"The Art of Capacity Planning", John Allspaw, 2 nd Edition, O'Reilly, 2008, 978-0-596-51857-8
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Reference Books

1	"Web Operations: Keeping the Data On Time", John Allspaw and Jesse Robbins 1st Edition, O'Reilly Media, 2010, 978-0-596-80264-2
2	"Cloud Computing: Concepts, Technology & Architecture", Thomas Erl, 1st Edition, 2013, 978-0-13-338752-0

Web links and Video Lectures (e - Resources)

1	https://www.youtube.com/watch?v=w0cD26CLBAQ
2	https://www.youtube.com/watch?v=S-hhfBXykec
3	https://www.youtube.com/watch?v=9e4IohiFmZ8&t=63s
4	https://www.youtube.com/watch?v=qj4ziswxupE
5	https://www.youtube.com/watch?v=jTW79ofC6Go
6	https://www.youtube.com/watch?v=_pPlanXSwQY

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	2		2								1
CO2	2	2	2	2							1
CO3	2	3	2	2							1
CO4	2	2	2	2	2	1		1	2		1
CO5	3		2	2	2	1		1	1	2	1

Semester: IV					
Javascript and JQuery					
Course Code	:	BCS408C	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	12-15 Hrs	SEE	:	50 Marks
Course Type	:	AEC	SEE Duration	:	2 Hours

Prerequisites:	
Courses	Object Oriented Programming with JAVA
Knowledge on Fundamental Concepts	Variables, Functions, Control Structures, HTML and CSS
Knowledge on Connected Tools (If any)	Visual Studio Code (VS Code)

Course Learning Objectives: This course will enable the students to	
CLO1	Understand primitives of JavaScript Programming.
CLO2	Implement arrays and objects in JavaScript to create structured and functional programs.
CLO3	Make Use of basic jQuery methods to access and manipulate HTML elements in web pages.
CLO4	Demonstrate jQuery methods to manipulate HTML elements and handling events.
CLO5	Apply JavaScript and jQuery techniques to build interactive web applications with form handling, animations, and dynamic styling.

SLNO	Experiments
1.	a. Develop a JavaScript program to Capitalize the first letter of each Word of a sentence (String). b. Develop a JavaScript program to Check a string starts with 'Java'.
2.	a. Develop a JavaScript program to display the current day and time. b. Develop a JavaScript program to reverse a given string
3.	a. Develop a JavaScript program to display a message using alert. b. Develop a JavaScript program to display a confirm message on a button click. c. Develop a JavaScript program to read value through prompt window and display the value on a button click.
4.	a. Develop a JavaScript program to display (on respective button clicks) multiplication and division of two numbers. Read values from the textboxes and design two buttons (use DOM). b. Develop a JavaScript program to highlight with red color the HTML links () having class name "high" (use DOM).
5.	a. Develop a JavaScript program to read the content of HTML paragraph and update (on button click event) with the suitable Text read from the HTML Textbox (Use innerHTML) b. Develop a JavaScript program to check for an attribute ('href' in) and get its value/display on the Web page on a button click.
6.	a. Develop a JavaScript program to sort a list of numbers (Use arrays and functions) b. Develop a JavaScript program to create a hotel object using object literal syntax having properties (name, location, room rate, discount etc), constructors and method (offer-price). Create few objects to demonstrate the access of properties and an associated method.
7.	a. Develop a jQuery program to disable/enable the form and disable right click menu. b. Develop a jQuery program to Underline all the words and first word bold.

8.	a. Develop a jQuery program to Add options to a drop-down list. b. Develop a jQuery program to Change the button text.
9.	a. Develop a jQuery program to Disable a link. b. Develop a jQuery program to Delete all table rows except first one.
10.	a. Develop a jQuery program to Change a CSS class. b. Develop a jQuery program to Set the background color.
11.	a. Develop a jQuery program to Add two classes. b. Develop a jQuery program to Add a specified class.
12.	a. Develop a jQuery program to read and display the value entered in a Textbox and option chosen in dropdown list with relevant events. b. Develop a jQuery program to Animate paragraph element.

Course Outcomes: After completing the course, the students will be able to

CO1	Apply fundamental concepts of JavaScript to develop simple programs.
CO2	Design programs to handle structured data (object) and data items (array).
CO3	Develop programs to access and manipulate HTML with DOM and event handling.
CO4	Demonstrate the role of jQuery selectors to access HTML elements of Web pages.
CO5	Implement jQuery methods to manipulate HTML and trigger events in Web pages.

Text Book

1	"Interactive Front-End Web Development", Javascript and jQuery: Jon Duckett, 1st Edition, 2014, Willey, ISBN-13: 978-1118871652.
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Reference Books

1	"Learning Web Design: A Beginners Guide to HTML, CSS, JavaScript, and Web Graphics", Jennifer Robbins, 5th Edition, 2018, O'Reilly Media, ISBN-13: 978-1491960202
2	"JavaScript: The Definitive Guide, David Flanagan", 7th Edition, 2020, O'Reilly Media, ISBN-13 978-14 91952023.
3	"JavaScript: The Good Parts", Douglas Crockford", 1st Edition, 2008, O'Reilly Media, ISBN-13: 978-0596517748.

Web links and Video Lectures (e - Resources)

1	https://www.w3schools.com/js/
2	https://www.javascript.com/learn/


CO – PO MAPPING

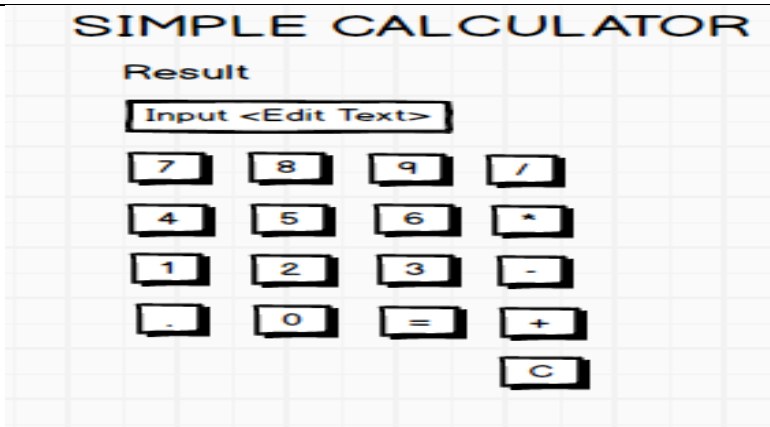

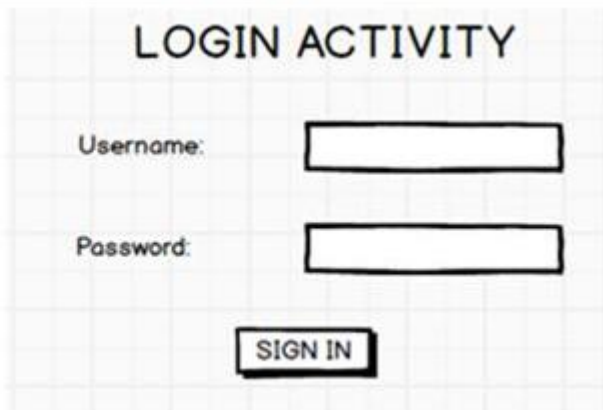
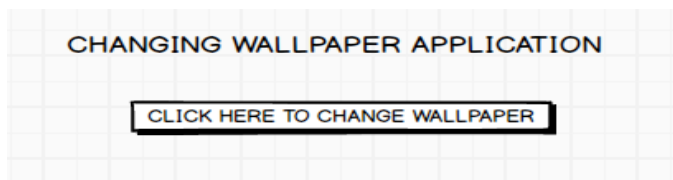
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	2		1				2
CO2	3	2	2	2	2		1		1		2
CO3	3	2	2	2	2		1		1		2
CO4	3	2	2	2	2		1	1	1		2
CO5	3	2	2	2	2		1		1		2


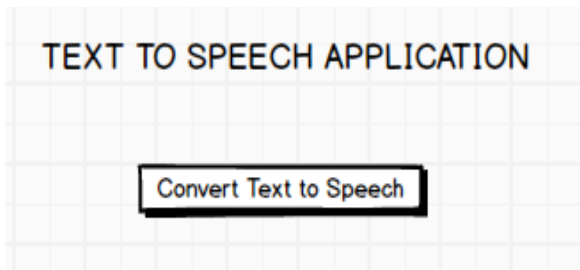
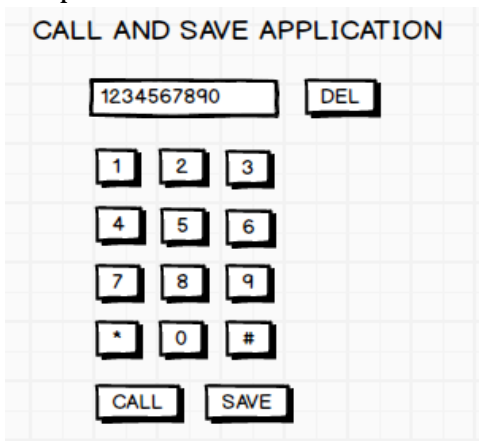
Semester: IV					
Mobile Application Development					
Course Code	:	BCS408D	Credits	:	01
Hours/Week(L:T:P)	:	0:0:2	CIE	:	50 Marks
Total Hours	:	14 Hrs	SEE	:	50 Marks
Course Type	:	AEC	SEE Duration	:	02 Hours

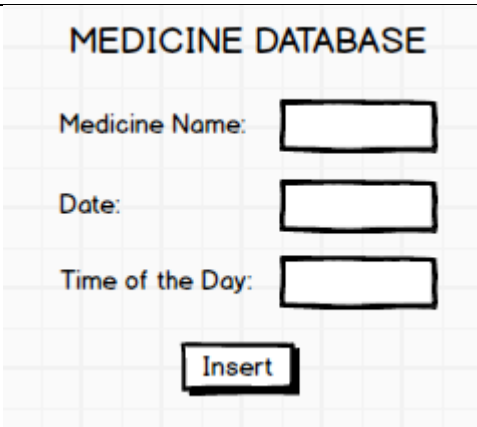
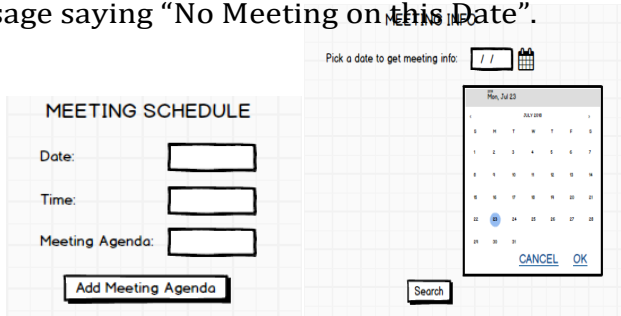
Prerequisites:	
Courses	Problem Solving Through Programming, Web Application Development with HTML and PHP, Object-Oriented Programming With Java, DBMS
Knowledge on Fundamental Concepts	Fundamental concepts of XML & DBMS , CSS, JavaScript, forms, Frames
Knowledge on Connected Tools (If any)	Android Studio, Xcode, emulators, Git.

Course Learning Objectives: This course will enable the students to	
CLO1	Describe the core concepts of Android programming and the Android application lifecycle.
CLO2	Set up and configure Android Studio to develop and run basic Android applications.
CLO3	Design and implement interactive user interfaces using Android's UI components and layouts.
CLO4	Construct and manipulate SQLite databases to store, retrieve, and update application data.
CLO5	Analyze and integrate Android components such as services and content providers for data sharing and communication.

Experiments	
Sl.No.	List of problems for which student should develop program and execute in the Laboratory
1.	<p>Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone Number.\</p> 
2.	Develop an Android application using controls like Button, Text View, Edit Text for designing a calculator having basic functionality like Addition, Subtraction, Multiplication, and Division.

	
3.	<p>Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules:</p> <ul style="list-style-type: none"> • Password should contain uppercase and lowercase letters. • Password should contain letters and numbers. • Password should contain special characters. • Minimum length of the password (the default value is 8). <p>On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying “Successful Login” or else display a toast message saying “Login Failed”. The user is given only two attempts and after that display a toast message saying “Failed Login Attempts” and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div>
4.	<p>Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.</p> <div style="text-align: center;">  </div>
5.	<p>Write a program to create an activity with two buttons START and STOP. On pressing of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a Text View control.</p>

	
6.	Create two files of XML and JSON type with values for City_ Name, Latitude, Longitude, Temperature, and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side.
7.	<p>Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called “Convert Text to Speech” that converts the user input text into voice.</p> 
8.	<p>Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.</p> 
9.	Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

	
10.	<p>Develop a content provider application with an activity called “Meeting Schedule” which takes Date, Time and Meeting Agenda as input from the user and store this information into the SQLite database. Create another application with an activity called “Meeting Info” having Date Picker control, which on the selection of a date should display the Meeting Agenda information for that particular date, else it should display a toast message saying “No Meeting on this Date”.</p> 

Course Outcomes: After completing the course, the students will be able to

CO1	Develop, test, and debug Android applications by setting up and using the Android development environment.
CO2	Implement adaptive, responsive user interfaces suitable for various screen sizes and devices.
CO3	Analyze and Implement solutions for managing long-running tasks and background processes in Android applications.
CO4	Apply appropriate methods for storing, retrieving, and sharing data in Android applications using databases and content providers.
CO5	Develop security features and permission handling mechanisms in Android applications.

Text Book

1	“Android Programming – Pushing the Limits”, Erik Hellman, 1 st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197
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Reference Books

1	“Head First Android Development”, Dawn Griffiths and David Griffiths, 1 st Edition, O’Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
2	“Android Programming: The Big Nerd Ranch Guide”, Bill Phillips, Chris Stewart and Kristin Marsicano, 3 rd Edition, Big Nerd Ranch Guides, 2017. ISBN-13: 978-0134706054

Web links and Video Lectures (e - Resources)	
1	https://legacy.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts
2	https://youtu.be/y3kKoG5hO20?si=q8wXy4N8bVt1_Exq
3	https://youtu.be/nvrA57SMqxI?si=vKazTQL2BmzJg7Vf
4	https://youtu.be/iRfw3OPVJ0Q?si=016Hak9P0ZAog1zO
5	https://youtu.be/HM8ttKXUGA0?si=EhfkMY0RT7K-iMHo

CO - PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	2	2	2	1	3		1	1	1	1	1
CO2	2	2	2	1	3		1	1	1	1	1
CO3	2	2	2	1	3		1	1	1	1	1
CO4	2	2	2	1	3		1	1	1	1	1
CO5	2	2	2	1	3		1	1	1	1	1

Semester: IV					
Metaphysical Science					
Course Code	:	BMP409	Credits	:	1
Hours/Week(L:T:P)	:	1:0:0	CIE	:	50 Marks
Total Hours	:	15 Hrs	SEE	:	50 Marks
Course Type	:	HSSMC	SEE Duration	:	1 Hr.

Course Learning Objectives: This course will enable the students to	
CLO1	Explore the philosophical and spiritual aspects of the universe.
CLO2	Compare and contrast ontological & Epistemology theories
CLO3	Analyze metaphysical perspectives on time, space, and the origin of the universe.
CLO4	Inculcate the Metaphysical inquiries into the nature of mind and consciousness.
CLO5	Apply and analyze the nature of reality, existence, and universe beyond the physical sciences.

Module 1	03 Hrs
Introduction to Metaphysics: Definition of Metaphysics , scope, and historical roots (Aristotle, Plato, Kant). Distinction between metaphysics, physics and spirituality. Branches of Metaphysics: Ontology, cosmology, epistemology, and their interconnections. Key Metaphysical Questions: Why is there something rather than nothing? The nature of abstract entities (numbers, moral values). Textbook2, Ch.1&2	
Module 2	03 Hrs
Ontology & Epistemology Ontology (Study of Being): Materialism vs. Idealism vs. Dualism, The Problem of Universals (Realism vs. Nominalism). Epistemology (Study of Knowledge): Rationalism (Descartes) vs. Empiricism (Locke, Hume). Theories of truth (Correspondence, Coherence, Pragmatic). Skepticism & Constructivism: Can we truly know reality? (Descartes' Evil Demon, Simulation Theory). Textbook2, Ch.3-5	
Module 3	03 Hrs
Cosmology – Metaphysical Perspectives on the Universe Philosophical cosmology vs. physical cosmology, Metaphysical views on time, space, and the origin of the universe, The Anthropic Principle and Fine-Tuning debate, Creation, causality, and the infinite regress problem, Multiverse theory and its metaphysical implications, Spiritual and ancient cosmologies: Vedic, Taoist, and Indigenous models. Textbook1, Ch.1, Textbook2, Ch.6-7	
Module 4	03 Hrs
Mind and Consciousness Definition of mind and consciousness, Mind-body problem: Dualism vs. Physicalism, Theories of consciousness: Integrated Information Theory (IIT), Global Workspace, Panpsychism, Eastern and Western views of the self and mind; Artificial intelligence and machine consciousness, Role of consciousness in observation and decision-making. Textbook1, Ch.2, Textbook2, Ch.8	

Module 5	03 Hrs
Quantum Healing and Energy Medicine Basics of quantum mechanics (superposition, entanglement, observer effect), Quantum theory and the mind: Role of consciousness in quantum collapse, Overview of Quantum Healing – Deepak Chopra's model, Energy fields: Biofield theory, chakras, subtle energy systems, Placebo effect, intention and non-local healing, Implications for engineering bio-resonant technologies. Textbook1, Ch. 3-15	

Course Outcomes: After completing the course, the students will be able to	
CO1	Assess the nature of reality, existence and the universe.
CO2	Evaluate the competing ontology and epistemological frameworks.
CO3	Interpret the various multiverse models and their philosophical significance.
CO4	Analyze the <i>mind-body problem</i> and theories of consciousness.
CO5	Differentiate the theoretical and practical intersections between quantum physics, quantum healing and meditation.

Text Books	
1	Quantum Metaphysics, Tarja Kallio-Tamminen, Oy 2004, ISBN 952-10-1927-1 Otamedia
2	Metaphysics-A Very Short Introduction, Stephen Mumford, Sl. No. 20129780191640261, 2012, 0191640263, OUP Oxford,

Reference Books	
1	Deepak Chopra M.D., Quantum Healing (Revised and Updated): Exploring the Frontiers of Mind/Body Medicine, 2015.
2	Deepak Chopra M.D., Quantum Body: The New Science of Living a Longer, 2023, Healthier, More Vital Life

Weblinks	
1	https://www.yogajournal.com/meditation/
2	https://youtube.com/shorts/JgCVh6wwgNg?si=R87-PGlrUSII774w
3	https://www.youtube.com/watch?v=XvyuUqlX7fE
4	https://core.ac.uk/download/pdf/14914967.pdf
5	https://www.youtube.com/watch?v=ba0yIAZ9ok
6	https://www.youtube.com/watch?app=desktop&v=fzxohf49loU
7	https://www.youtube.com/watch?v=SSGKowtXS3Y
8	https://www.youtube.com/watch?v=r_piRatnFLY

CO-PO Mapping

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3	2				2	2				3
CO2	3	2	2	2		2	2				3
CO3		3				2	2				2
CO4		3				2	2				
CO5		3				2	2				

Semester: IV					
National Service Scheme					
Course Code	:	BNS410	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the community in general in which they work
CLO2	Identify the needs and problems of the community and involve them in problem –solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions t
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CL05	Appraise the importance of ethical issues and team working abilities pertaining to the social services

Activity- 1		08 Hrs
Water conservation techniques – Role of different stakeholders- Implementation		
Activity - 2		08 Hrs
Preparing an actionable business proposal for enhancing the village income and approach for implementation.		
Activity - 3		08 Hrs
Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.		

Pedagogy – Guidelines, it may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution

Sl.	Topic	Group Size	Location	Activity Execution	Reporting	Evaluation of the Topic
1	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Site selection /proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer
2	Preparing an actionable business proposal for	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus	Group selection /proper consultation/ Continuous monitoring/	Report should be submitted by individual to the	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

	enhancing the village income and approach for implementation.		etc.....	Information board	concerned evaluation authority	
3	Helping local schools to achieve good results and enhance their enrolment in Higher/technical/vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers/ etc.....	School selection/proper consultation/Continuous monitoring/Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by NSS officer

Plan of Action (Execution of Activities for 4th Semester)

Sl. No.	Practice Session Description
1.	Lecture session by NSS Officer
2.	Selection of topic, Commencement of activity and its progress
3.	Execution of Activity
4.	Case study based Assessment, Individual performance
5.	Sector wise study and its consolidation
6.	Video based seminar for 10 minutes by each student At the end of semester with Report.
<p>➤ In the 4th semester, each student should do activities according to the scheme and syllabus.</p> <p>➤ At the end of the semester student performance has to be evaluated by the NSS Officer for the assigned activity progress and its completion.</p> <p>➤ At the end of the 4th semester, consolidated report of all activities compiled report should be submitted as per the instructions.</p>	

Course Outcomes: After completing the course, the students will be able to	
C01	Exploit the importance of his / her responsibilities towards society.
C02	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
C03	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
C04	Implement government or self-driven projects effectively in the field of societal problems.
C05	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Assessment Details for CIE (100 Marks)

Weightage	CIE- 100 Marks
Selection of Topic, Commencement of activity and its progress	40 Marks
Case study based Assessment	20 Marks
Sector wise study and its consolidation	20 Marks
Video based seminar for 10 minutes by each student at the end of semester with Report	20 Marks
Total Marks for the course in each semester	100 Marks

Suggested Learning Resources:**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.

CO-PO Mapping

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1						3					3
CO2						3					3
CO3						3					3
CO4						3					3
CO5						2	3	3			3

Semester: IV					
Physical Education (PE) (Sports & Athletics)					
Course Code	:	BPE410	Credits	:	0
Hours/Week(L:T:P)	:	0:0:1	CIE	:	100 Marks
Total Hours	:	24 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Develop an understanding of ethical principles and moral values and their importance in sportsmanship, fair play, and personal conduct in games and athletic activities.
CLO2	Acquire practical skills and demonstrate technical proficiency in selected sports or athletic events through structured physical training and performance.
CLO3	Understand the role of effective organization, administration, and management in the successful conduct of sports events and athletic programs.

Module - 1		4 Hrs
Ethics and Moral Values		
A. Ethics in Sports		
B. Moral Values in Sports and Games		
Module - 2		16 Hrs
Specific Games (Any one to be selected by the student)		
A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass.		
B. Athletics (Track Events) – Any event as per availability of Ground		
Module-3		4 Hrs
Role of Organization and administration		

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principles of ethics and moral values and their application in sports and games.
CO2	Demonstrate fundamental skills, techniques and rules of the selected game or athletic event.
CO3	Apply sportsmanship, fairness and respect for rules during practice and competition
CO4	Analyze the role of organization and administration in conducting sports events effectively
CO5	Develop teamwork, leadership and decision-making skills through participation in sports activities

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes – 2, each of 15 marks	30
3.	Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	50
Total		100

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	2						3	3			
CO2	3		2		2		1	2	3		
CO3	2		1				3	3	2		
CO4	2	2				2		2	3		2
CO5	1	2							3		2

Semester: IV					
Yoga					
Course Code	:	BYO410	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	12 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Learning Objectives: This course will enable the students to	
CLO1	Describe patanjali's ashtanga yoga and its role in holistic well-being.
CLO2	Perform the suryanamaskar sequence with correct breathing and posture.
CLO3	Identify different types of asanas with their techniques and benefits.
CLO4	Utilize the knowledge of kapalabhati with proper technique and safety measures.
CLO5	Apply pranayama techniques to enhance physical and mental health.

Module - 1		02 Hrs
Patanjali's Ashtanga Yoga: Introduction, its need and importance, Eight limbs of Yoga – overview, Yama: Ahimsa, Satya, Asteya, Brahmacharya, Aparigraha Niyama: Shoucha, Santosha, Tapa, Svaadhyaya, Eshvarapranidhana Text Book 1: Ch. 1 (Part 1)		
Module - 2		02 Hrs
Surya Namaskar: Concept and significance of Surya Namaskar, 12-step Surya Namaskar sequence, Practice - 4 rounds of Surya Namaskar, Breathing coordination and posture alignment. Text Book 1: Ch. 2 (Part 2)		
Module - 3		03 Hrs
Asanas: Meaning of Asana, Need and importance of practicing Asanas, Classification of Asanas, Sitting Asanas - Sukhasana, Paschimottanasana, Standing Asanas - Ardhakati Chakrasana, Parshva Chakrasana, Prone Line Asana - Dhanurasana, Supine Line Asanas - Halasana, Karna Peedasana, For each Asana - Meaning by name, Technique of performing, Precautionary measures, Benefits Text Book 1: Ch. 2 (Part 2)		
Module - 4		02 Hrs
Kriyas: Introduction to Shatkarmas (Cleansing practices), Meaning and importance of Kapalabhati, Technique of Kapalabhati (40 strokes/min, 3 rounds), Precautionary measures and benefits. Text Book 1: Ch. 3 (Part 3)		
Module - 5		03 Hrs
Pranayama: Meaning, need, and importance of Pranayama, Types of Pranayama and their benefits, For each type - Meaning by name, Technique, Precautionary measures, Benefits, Types included – Suryanuloma-Viloma, Chandranuloma-Viloma, Suryabhedana, Chandra Bhedana, Nadishodhana Text Book 1: Ch. 3 (Part 3)		
Course Outcomes: After completing the course, the students will be able to		

CO1	Summarize patanjali's ashtanga Yoga and its significance in promoting daily well-being.
CO2	Demonstrate surya namaskar with correct sequence, breathing and posture alignment.
CO3	Classify various types of asanas with their benefits and precautions.
CO4	Utilize the knowledge to practice kapalabhati with correct technique, breathing rhythm and safety guidelines.
CO5	Apply pranayama to improve overall physical fitness and mental wellness.

Text Book	
1	"The Illustrates Light on Yoga" by BKS Iyengar, HarperCollins Publishers, ISBN-81:7223-606-9

Reference Books	
1	Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4 th Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
2	Yoga Instructor Course hand book published by SVYASA University, Bengaluru
3	Yogapravesha in Kannada by Ajitkumar
4	Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/playlist?list=PLzF4lOyPf_Z9yQ_Gphjh1wZ5fEhMg6hmP
2	https://www.youtube.com/playlist?list=PL0zRYVm0a65cCcY4qKX5MIyJxBt7hJgQY
3	https://youtu.be/KB-TYlgd1wE
4	https://youtu.be/aa-TG0Wg1Ls

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1						2			2		
CO2						2	2	3	2		2
CO3						2	2	3	2		2
CO4						2	2	3	2		2
CO5						2	2	3	2		2

Semester: III-VI					
Music					
Course Code	:	BMU310/410/509/610	Credits	:	0
Hours/Week(L:T:P)	:	0:0:2	CIE	:	100 Marks
Total Hours	:	26 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Course Objectives: This course will enable the students to	
1	Understand the foundational concepts of Indian classical music, including the evolution and structure of Shruthi, Nada, Swara, Laya, Raga, Tala and Mela systems.
2	Recognize and describe various types of Carnatic compositions such as Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, along with the basics of the notation system.
3	Appreciate the contributions of key composers like Purandaradasa, Thyagaraja and Mysore Vasudevacharya to Indian music and understand their musical legacy.
4	Identify and explain the classification and basic construction of traditional Indian musical instruments, including string, wind, percussion and idiophones, with appropriate examples.
5	Demonstrate basic vocal proficiency through the practice of Sarale Varase exercises, notations for Suladi Sapta Tala in Mayamalavagowla raga and performance of selected compositions such as Geethe, Jathi Swara and Krithi.

Module -I	03 Hrs
Preamble Contents of the curriculum intended to promote music as 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 Textbook1, V-1 Ch. 1-4	
Module - II	03 Hrs
Compositions Introduction to the types of composition in Carnatic Music – Geethe, Jathi, Swara, Swarajathi, Varna, Krithi and Thillana, Notation System. Textbook2 – Ch. 4-7	
Module -III	03 Hrs
Composers Biography and contributions of Purandaradasa, Thyagaraja, Mysore Vasudevacharya, Kanakadasa Textbook3 – Ch. 2-5	
Module -IV	03 Hrs
Music Instruments Classification and construction of string instruments, wind instruments, percussion Instruments, Idiophones (Ghana Vaadya), Examples of each class of instruments. Textbook1,V-4 – Ch. 2-6	
Module -V	14 Hrs
Abhyasa Gana Singing the swara exercises (Sarale Varase Only), Botatio writing for sarale varase and sulafi sapta tala (Only in mayamalavagowla raga), singing 4 geethe in malahari and one	

jathi swara, oe krithi in a mela raga

Textbook1, V-1&2

Course Outcomes: After completing the course, the students will be able to

CO1	Outline the evolution of Indian music and key concepts like Shruthi, Swara, Raga and Tala.
CO2	Identify and interpret basic Carnatic compositions using standard notation.
CO3	Summarize the contributions of composers.
CO4	Classify Indian musical instruments and describe their construction and use.
CO5	Demonstrate basic Carnatic vocal skills through selected exercises and compositions.

Text Books

1	South Indian Music – Vol. I to VI, Prof. P. Sambamoorthy, The Indian Music Publishing House, Chennai.
2	A Textbook of Carnatic Music, Dr. S. Bhagyalekshmy, CBH Publications
3	Karnataka Sangeetha Charitre, Dr. V. S. Sampathkumaracharya, Kannada University, Hampi.

Reference Books

1	Music of India, B. Chaitanya Deva, Munshiram Manoharlal Publishers
2	Essentials of Musicology in South Indian Music, Prof. S. R. Janakiraman, Asian Educational Services

CO – PO MAPPING

	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010	P011
CO1	3		1		1		1	1	1		1
CO2	3		3	1	2	1	2	1	1		1
CO3	1				1	1	1		1		
CO4	2		2		3	1	1	1	1		1
CO5	3			1	2	1	1	1	1		1

Semester: IV					
Competency Enhancement Course-2					
Course Code	:	BCE411	Credits	:	0
Hours/Week(L:T:P)	:	2:0:0	CIE	:	100 Marks
Total Hours	:	40 Hrs	SEE	:	-
Course Type	:	NCMC	SEE Duration	:	-

Prerequisites:	
Courses	Competency enhancement course-1
Knowledge on Fundamental Concepts	Arithmetic operations, fractions, decimals and elementary algebra. comprehension of basic English
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Enhance Quantitative Problem-Solving Skills
CLO2	Master Data Interpretation and Visual Analysis
CLO3	Strengthen Logical Reasoning and Spatial Intelligence
CLO4	Develop Advanced Verbal Aptitude and Communication Accuracy
CLO5	Sharpen Critical Thinking through Assumptions and Analytical Judgement

Module - 1	8 Hrs
Partnership Definition of Partnership, Types of Partnerships (Simple and Compound), Calculation of Profit Sharing Ratio, Capital and Time of Investment, Working and Sleeping Partners, Admission and Retirement of Partners, Distribution of Profits and Losses, Partnership Formulas, Complex Partnership Problems.	
Time and Work Definition and Concept of Time and Work, Relation between Work, Time, and Efficiency, Calculation of Individual and Combined Work, Work Rate and Work Done in a Given Time, Efficiency Comparison of Different Workers, Time Taken by Individuals or Groups, Alternate Work and Negative Work (Destructive Work), M:W:D Rule (Men:Work:Days Problems), Work Equivalence Formula, Problems Involving Wages Based on Work, Pipes and Cisterns (Work with Inlets and Outlets), Successive Work Distribution, Complex Time and Work Questions	
Coding and Decoding Letter Coding, Number Coding, Symbol Coding, Mixed Letter-Number Coding, Substitution Coding, Decipher Coding, Direct Coding-Decoding, Conditional Coding, Message Coding, Operations-Based Coding-Decoding, and Complex Coding-Decoding Problem	
Analogy Number Analogy, Alphabet Analogy (using letter sequences or codes), Symbol Analogy, Figure/Pattern Analogy, Geometrical Shapes Analogy, Matrix-Based Analogy, Series-Based Numeric Analogy, Mirror and Water Image Analogy, Classification-Based Figure Analogy, Embedded Figure Analogy, Complex Numerical and Visual Analogy Problems.	
Textbook-1, Ch-36	
Module - 2	8 Hrs

Time, Speed and Distance

Definition and Relationship of Time, Speed, and Distance, Units and Conversion of Speed and Distance, Average Speed, Relative Speed, Problems on Trains, Problems on Boats and Streams, Upstream and Downstream Concepts, Races and Games, Time to Meet/Opposite Direction Problems, Circular Tracks, Shortcut Tricks and Application-Based Problems.

Trains, Boats and Streams, Races

Trains: Problems on Trains, Time Taken to Cross a Stationary Object, Time Taken to Cross Another Moving Train, Relative Speed in Same and Opposite Direction, Length of Train and Platform Calculations, Speed and Time Conversions, Overtaking and Passing Scenarios, Shortcut Tricks for Train Problems.

Boats and Streams: Upstream and Downstream Concepts, Speed of Boat in Still Water, Speed of Stream, Calculation of Effective Speed (Upstream and Downstream), Time and Distance in Streams, Problems on Boats Overtaking/Meeting, Relative Speed in Water, Application-Based Boat and Stream Questions.

Races: Types of Races (Straight, Circular, Relay), Start Types (Head Start, Dead Heat), Calculating Winner and Margin, Calculation of Lead or Lag, Relative Speed in Races, Time Calculations to Meet or Overtake, Race Completion Time, Use of Ratio and Proportion in Races, Application-Based Race Problems.

Seating Arrangement

Linear Arrangement, Circular Arrangement, Square/Rectangular Arrangement, Single-Row and Double-Row Arrangements, Facing Inside and Outside Arrangements, Arrangement Based on Directions (Left/Right/Clockwise/Counterclockwise), Seating Based on Conditions or Constraints, Position and Order Determination, Seating with Blood Relations or Attributes, Arrangement with Vacant Seats.

Data Arrangement

Linear Data Arrangement, Circular Data Arrangement, Matrix/Table-Based Data Arrangement, Parallel/Double Row Arrangement, Attributes/Property-Based Arrangement (with multiple characteristics), Sequencing and Ranking Arrangement, Floor/Building Arrangement, Conditional Arrangement (with Direct and Indirect Clues), Application of Consolidated Table and Matrix Methods.

Textbook -1, Ch-14-18**Module-3****8 Hrs****Permutation and Combination**

Understanding the difference between the permutation and combination, Rules of Counting- rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of $2n$, Arrangement in a circle.

Probability

Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.

Clocks and Calendars

Clocks: Calculation of Angle Between Hands (Hour, Minute, Second), Time Gains and Losses by Clocks, Number of Times Hands Coincide or Oppose, Incorrect/Slow/Fast Clocks, Mirror and Water Image Questions on Clocks, Alarm and Time Calculation Problems, Calculation of Overlapping/Adjacent Hands, Problems on Clock Striking.

Calendars: Odd Days Concept, Leap Year and Ordinary Year Calculation, Counting Odd Days in Multiple Years, Day of the Week Calculation for a Given Date, Calendar Repetition, Month and Year Code Methods, Finding Dates with Same Day, Calculation of Future/Past Day from a Given Day, Number of Sundays/Saturdays/Specific Weekdays in a Period, Day-Difference

Problems. Textbook -1, Ch6-9 & 13-16	
Module-4	8 Hrs
Data Interpretation Tables, Bar Graphs, Line Graphs, Pie Charts, Caselets (Paragraph-based Data Sets), Radar Charts, Mixed or Combination Graphs (Multiple Data Forms Together), Data Comparison and Analysis, Calculation-Based Data Interpretation, Ratio and Percentage Interpretation, Data Sufficiency in Data Interpretation. Ages Present age and future age calculations, past age calculations, age problems in ratios, age difference problems, multiple or submultiple age relations, product of ages problems, age problems involving sum of ages, age relationships in family contexts, age-based word problems with equation formulation, and age problems involving time intervals such as years ago or years hence. Crypt arithmetic Basic concepts, addition, subtraction, multiplication of coded alphabets, Types of cryptarithm. Syllogisms Basic Concepts of Syllogism, Types of Statements (A, E, I, O), Venn Diagram Representation, Rules of Syllogism, Direct and Indirect Syllogism Questions, Condition-based Syllogism, Coded Syllogism, Double/Triple Syllogism Problems, Syllogism with Quantifiers, Syllogism in Data Interpretation, and Conclusions Drawing from Statements. Textbook -1, Ch28-29	
Module-5	8 Hrs
Mensuration Basic Geometrical Figures, Perimeter and Area of Plane Figures (Square, Rectangle, Triangle, Parallelogram, Rhombus, Trapezium), Area and Circumference of Circle, Area of Sector and Segment of a Circle, Surface Area and Volume of Cuboid, Surface Area and Volume of Cube, Surface Area and Volume of Cylinder, Surface Area and Volume of Cone, Surface Area and Volume of Sphere and Hemisphere, Frustum of a Cone, Conversion between Units of Measurement, Application-Based Problems on Mensuration. Data sufficiency Statement Evaluation, Identifying Sufficient and Insufficient Statements, Dealing with Irrelevant Information, Definite vs. Indefinite Information, Elimination Method, Data Sufficiency on Blood Relations, Data Sufficiency on Order and Ranking, Data Sufficiency on Direction and Distance, Data Sufficiency on Coding-Decoding, Data Sufficiency on Seating Arrangement, Data Sufficiency on Puzzles, Data Sufficiency on Syllogism, Data Sufficiency on Alphanumeric Series. Visual Reasoning and Cubes Visual Reasoning: Figure/Image Series Completion, Odd-One-Out (Visual Discrimination), Mirror Images, Water Images, Embedded Figures, Paper Folding and Cutting, Analytical Puzzles with Patterns, Figure Counting, Pattern Completion, Analogy in Figures, Classification of Visual Data, Venn Diagrams, Direction and Distance with Visuals. Cubes: Basic Properties of Cubes (Faces, Vertices, Edges), Cube and Dice Basics, Counting of Smaller Cubes, Painted Cube Problems (Counting Cubes with 0/1/2/3 Painted Faces), Cube Cutting and Partitioning, Dice (Number/Colour/Letter Arrangements), Unfolded (Net) Cube to Folded Cube Problems, Opposite and Adjacent Faces of Dice, Identification of Hidden Surfaces, Face Rotation and Positioning, Shortcuts and Tricks for Cubes and Dice Problems Para Jumbles and Cloze Test Sentence Jumble/Ordering, Identification of Opening/Closing Sentences, Logical Sequencing and Linking, Transitional Words and Connectors, Theme Identification in Jumbled Passages, Cloze Test with Contextual Blanks, Vocabulary and Grammar-based Blanks, Contextual Inference for Blank Filling, Error Detection in Cloze Test. Reading Comprehension	

Main Idea Identification, Factual/Inference-based Questions, Tone and Attitude Analysis, Vocabulary in Context, Passage Summarization, Structure and Organization of Passage, Logical Completion of Paragraphs, Supporting/Contradicting Evidence, Eliminating Irrelevant Information, Comparative Comprehension Passages.

Critical Reasoning

Assumption-Based Questions, Strengthen/Weaken the Argument, Inference Drawing, Conclusion Identification, Evaluating Arguments and Evidence, Identifying Flaws in Reasoning, Paradox/Discrepancy Resolution, Cause-and-Effect Reasoning, Analogy and Parallel Reasoning, Application of Logical Principles.

Textbook 1, Ch22-25, Textbook 2 & 3

Course Outcomes: After completing the course, the students will be able to

CO1	Apply arithmetic and logical reasoning to solve problems.
CO2	Develop spatial and logical skills to solve cube, dice, puzzle and seating arrangement questions.
CO3	Develop reading, vocabulary and grammar through para jumbles, sentence completion and idioms.
CO4	Enhance verbal reasoning by solving analogies, rearranging sentences and identifying assumptions and conclusions.
CO5	Apply combinatorics and probability to solve permutation, combination and crypt arithmetic problems.

Text Books

1	Quantitative Aptitude for Competitive Examinations , R.S. Aggarwal Chand Publishing. – 2023.
2	Word Power Made Easy , Norman Lewis, Published by PENGUIN INDIA – 2015, (ISBN- 978-0143424680)
3	How to Prepare for Quantitative Aptitude for the CAT , Arun Sharma 6 th Edition, McGraw-Hill Education – 2014, (ISBN- 978-9339205126)

Reference Books

1	Puzzle Test & Seating Arrangements , K. Kundan, 1 st Edition, BSC Publishing Company Pvt Ltd. – 2023, (ISBN: 9789394666023)
2	A Modern Approach to Verbal & Non-Verbal Reasoning , R.S. Aggarwal, 2025-26 Edition, S. Chand Publishing -2024

Web links and Video Lectures (e - Resources)

1	https://youtu.be/KWZ0lR8cCwc
2	https://youtu.be/mBtBD1N7ywQ
3	https://youtu.be/B9MhxmCwnpQ
4	https://youtu.be/VaEbefWFlc
5	https://youtu.be/3AL_6EQmnkY

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									1
CO2	2	2									
CO3	1	1							3		
CO4	2	2	2						2		1
CO5	3	3	2								1