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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

V Semester
Scheme & Syllabus of B.E. Programme
Computer Science & Engineering
(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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

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

5th 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	BCS501	Software Engineering and Project Management	PCC	CSE	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BCS502	Computer Networks	IPCC	CSE	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BCS503	Theory of Computation	PCC	CSE	3	2	0	**3**	**50**	**50**	**100**	**4**
4	BCSL504	DevOps	PCCL	CSE	0	0	2	**3**	**50**	**50**	**100**	**1**
5	BCS525x	Professional Elective Course – I	PEC	CSE	3	0	0	**3**	**50**	**50**	**100**	**3**
6	BCS536	Mini Project with Full Stack Development	PROJ	CSE	0	0	4	**3**	**50**	**50**	**100**	**2**
7	BRM507	Research Methodology and IPR	AEC	CSE	2	2	0	**3**	**50**	**50**	**100**	**3**
8	BCE508	Competency Enhancement Course-3	NCMC	CDCAC	0	2	0	-	**100**	**-**	**100**	**0**
9	BNS509	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	**100**	**-**	**100**	**0**
	BPE509	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO509	Yoga		Yoga Teacher								
	BMU509	Music		Music Teacher								
									550	**350**	**900**	**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.

Professional Elective Course – I			
Course Code	**Course Name**	**Course Code**	**Course Name**
BCS525A	Advanced Algorithms	BCS525C	Advanced Java Programming
BCS525B	Computer Graphics	BCS525D	Operation Research

Integrated 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.

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: V					
Software Engineering and Project Management					
Course Code	**:**	BCS501	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Data Structures and Algorithms, Object-Oriented Programming
Knowledge on Fundamental Concepts	Analytical thinking, Critical thinking
Knowledge on Connected Tools (If any)	UML Tools Star UML, Debuggers

Course Learning Objectives: This course will enable the students to	
CLO1	Outline software engineering principles and activities involved in building large software programs.
CLO2	Illustrate the methods used for gathering, categorizing, documenting, and validating software requirements
CLO3	Understand the Unified Modeling Language (UML) and its application in software design.
CLO4	Analyze software requirements to design effective test cases.
CLO5	Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Module – 1	**08Hrs**
Introduction: Professional software development, Software engineering ethics, Case studies. **Software Processes**: Software Process models: The Waterfall model – A Case study, Incremental development, Reuse-oriented software engineering, Process activities: Software specification, Software design and implementation, Software validation, Coping with Change: Prototyping, Incremental Delivery, Boehm's Spiral Model. **Textbook 1: Ch. 1:** 1.1 to 1.3, **Ch. 2:** 2.1 to 2.3	
Module – 2	**08Hrs**
Requirements Engineering: Functional and non-functional requirements: Functional requirements. Non-functional requirements, Introduction to Requirements specification. **Agile Software Development:** Agile methods- Plan driven and Agile Development, Introduction to Extreme Programming. **Textbook 1: Ch. 3:** 3.1 to 3.3, **Ch. 4:** 4.1 to 4.4	
Module – 3	**08Hrs**
Design and Implementation: Object-oriented design using UML: System Context and Interaction, Architectural design, Object Class identification, design Models, Interface Specification, Design Patterns, Implementation issues, Open Source development. **Textbook 1: Ch. 7:** 7.1 to 7.4	
Module – 4	**08Hrs**

Software Testing: Development Testing: Unit Testing, Choosing Unit Test Cases, Component Testing, System Testing, Test Driven Development, Release Testing: Requirements Based Testing, Scenario Testing, Performance Testing, User Testing. A Demo of Selenium. **Textbook 1: Ch. 8:** 8.1 to 8.4

Module – 5	**08Hrs**
Introduction to Project Management: Introduction Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle. **Textbook 2: Ch. 1:**1.1 to 1.17	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the basic principles and practices of Software Engineering.
CO2	Apply Software Engineering Design Techniques and practices for developing Software.
CO3	Integrate requirement analysis, design strategies, and testing techniques to develop high-quality software systems
CO4	Design Models for different phases of software development to solve real world problems
CO5	Develop Projects by Estimating cost and time required for developing the Software Product.

Textbooks	
1	"Software Engineering", Ian Summerville, 9th Edition, Pearson Education, 2017 ISBN-13. 978-0137035151.
2	"Software Project Management", Bob Hughes, Mike Cotterell, Rajib Mall, 6th Edition, McGraw Hill Education, 2017. ISBN 0077122798.

Reference Books	
1	"Software Engineering an Engineering approach", James F. Peters, Witold Pedrycz, John Wiley. ISBN: 978-0-471-18964-0
2	"Software Engineering principles and practice", Waman S Jawadekar, The Mc Graw-Hill Companies. ISBN: 9780070583719
3	"Fundamentals of object-oriented design using UML Meiler page", Jones: Pearson Education. ISBN: 817808344

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc20_cs68/preview
2	https://onlinecourses.nptel.ac.in/noc24_mg01/preview
3	https://nptel.ac.in/courses/106101061

CO – PO – PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2			1								2	1
CO2	3		2		2					1	1	2	1
CO3		3	3	1						2	1	2	1
CO4				3	3					1	2	2	1
CO5			2					1	2	2	1	2	1

Semester: V					
Computer Networks					
Course Code	**:**	BCS502	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:0:2	**CIE**	**:**	50 Marks
Total Hours	**:**	40L+20P	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Digital fundamentals, Basics of communication System, Courses in Programming and IoT.
Knowledge on Fundamental Concepts	Data communication principles.
Knowledge on Connected Tools (If any)	Tools such as Eclipse and network simulation software (NS2). (Optional Check for CISCO Packet Tracker)

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the architecture and protocols in the OSI and TCP/IP models.
CLO2	Learn error detection, framing, and flow control techniques at the data link layer.
CLO3	Explore IP addressing, routing protocols, and functions of the network layer.
CLO4	Comprehend transport layer operations including TCP and UDP.
CLO5	Examine on application layer protocols such as HTTP, FTP, and DNS.

Module – 1	**08Hrs**
Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media, Unguided Media: Wireless. Switching and its types (circuit switching). **Textbook 1: Ch. 1:** 1.1 - 1.3, **Ch. 2:** 2.1 - 2.3, **Ch. 7:** 7.1 – 7.3, **Ch. 8:** 8.3.	
Module – 2	**08Hrs**
Data Link Layer: Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. Data link control: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. Media Access Control: Random Access, Controlled Access. Check Sum and Point to Point Protocol. **Textbook 1: Ch. 10:** 10.1-10.4, **Ch. 11:** 11.1 -11.4, **Ch. 12:** 12.1 - 12.2	
Module – 3	**08Hrs**
Network Layer: Network layer Services, Packet Switching, IPv4 Address, IPv4 Datagram, IPv6 Datagram, Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unicast Routing protocols: RIP, OSPF, BGP, Multicasting Routing-MOSPF **Textbook 1: Ch. 18:** 18.1, 18.2, 18.4, **Ch. 20:** 20.1-20.3, **Ch. 21:** 21.3.2, **Ch. 22:** 22.2	
Module – 4	**08Hrs**

Introduction to Transport Layer: Introduction, Transport-Layer Protocols: Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control, Error control, Congestion control. **Textbook 1: Ch. 23:** 23.1- 23.2, **Ch. 24:** 24.1-24.3.4, 24.3.6-24.3.9

Module – 5	**08Hrs**
Introduction to Application Layer: Introduction, Client-Server Programming, Standard Client Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS), TELNET, Secure Shell (SSH) **Textbook 1: Ch. 25:** 25.1-25.2, **Ch. 26:** 26.1-26.6	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand network models, transmission media, and switching techniques.
CO2	Apply data link layer concepts like error control, framing, flow control, and MAC protocols.
CO3	Implement network layer protocols, IP addressing, and routing algorithms.
CO4	Analyze transport layer protocols (TCP/UDP) and their control mechanisms.
CO5	Examine the application layer protocols and client-server architecture in network applications.

Textbook	
1	"Data Communications and Networking", Behrouz A. Forouzan, 5th Edition, Tata McGraw- Hill,2013. ISBN-10: 1259064751, ISBN-13: 978-1259064753

Reference Books	
1	"Computer Networks – A Systems Approach", Larry L. Peterson and Bruce S. Davie, 4th Edition, Elsevier, 2019. ISBN-10:0-12-370548-7, ISBN-13: 978-0-12-370548-8.
2	"Computer and Communication Networks", 2nd Edition, Pearson Education, Nader F. Mir: 2015. ISBN-10: 0133814742, ISBN-13: 9780133814743
3	"Data and Computer Communication", 10th Edition, William Stallings, Pearson Education, Inc., 2014. ISBN-13: 9780133506488 (Global).

Web links and Video Lectures (e – Resources)	
1	https://www.digimat.in/nptel/courses/video/106105183/L01.html
2	http://www.digimat.in/nptel/courses/video/106105081/L25.html
3	https://nptel.ac.in/courses/106105183

PRACTICAL COMPONENT OF IPCC

Sl#	**Experiments**
1.	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped.
2.	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
3.	Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
4.	Develop a program for error detecting code using CRC-CCITT (16- bits).

5.	Develop a program to implement a sliding window protocol in the data link layer.
6.	Develop a program to find the shortest path between vertices using the Bellman- Ford and path vector routing algorithm.
7.	Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
8.	Develop a program on a datagram socket for client/server to display the messages on client side, typed at the server side.
9.	Develop a program for a simple RSA algorithm to encrypt and decrypt the data.
10.	Develop a program for congestion control using a leaky bucket algorithm.

Note: Experiments 1-3 (NS2/NS3) and Experiments 4-10 (Eclipse)

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1									2	2
CO2	3	3	2		2							2	2
CO3	3	3	2	1	2							2	2
CO4	3	3	2	1	2							2	2
CO5	2	2			2				2	2		2	2

Semester: V					
Theory of Computation					
Course Code	**:**	BCS503	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:2:0	**CIE**	**:**	50 Marks
Total Hours	**:**	50Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Discrete Mathematics, Data Structures, Programming Languages, Algorithms
Knowledge on Fundamental Concepts	Set Theory, Graph Theory, Logical Thinking, Problem-Solving
Knowledge on Connected Tools (If any)	JFLAP (Java Formal Languages and Automata Package)

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce core concepts in Automata and Theory of Computation.
CLO2	Identify different Formal Language Classes and their Relationships.
CLO3	Learn concepts of Grammars and Recognizers for different formal languages.
CLO4	Prove or disprove theorems in automata theory using their properties.
CLO5	Determine the decidability and intractability of computational problems

Module – 1	**10 Hrs**
Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions. **Textbook 1: Ch. 1, Ch. 2.**	
Module – 2	**10 Hrs**
Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions. **Textbook 1: Ch. 3, Ch. 4.**	
Module – 3	**10 Hrs**
Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity in Grammars and Languages, Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata. **Textbook 1: Ch. 5, Ch. 6.**	
Module – 4	**10 Hrs**
Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages.	

Textbook 1: Ch. 7.	
Module – 5	**10 Hrs**
Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undesirability: A Language That Is Not Recursively Enumerable. **Textbook 1: Ch. 8, Ch. 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Model and analyse various abstract computational devices (Finite Automata, Pushdown Automata, and Turing Machines) and their structural behaviours, limitations, and operational characteristics.
CO2	Design appropriate mathematical representations, grammars, and language recognizers to solve specific formal language problems.
CO3	Prove or disprove language properties using mathematical tools and closure properties.
CO4	Design pushdown automata and analyze the properties and normal forms of context-free grammars
CO5	Design Turing Machines to solve computational problems and analyze the limits of decidability

Textbook	
1	"Introduction to Automata Theory, Languages and Computation", John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Third Edition, Pearson Education, 2006, ISBN: 978-0321455369.

Reference Books	
1	"Automata, Computability and complexity", Elain Rich, 1st Edition, Pearson Education,2018.
2	"Theory of Computer Science", K.L.P Mishra, N Chandrasekaran, 3rd Edition, PHI, 2012.
3	"An introduction to Formal Languages and Automata ", Peter Linz, 3rd Edition, Narosa Publishers,1998.
4	"Introduction to the Theory of Computation", Michael Sipser, 3rd edition, Cengage learning,2013.

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/105/106105196/
2	https://archive.nptel.ac.in/courses/106/106/106106049/
3	https://nptelvideos.com/course.php?id=717

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2								1	2	1
CO2	2	3	2	1							1	2	1
CO3	2	2	2								1	2	2
CO4	2	2	2								1	2	2
CO5	2	2	2	1							1	1	2

Semester: V					
DevOps					
Course Code	:	BCSL504	**Credit**	:	1
Hours/Week(L:T:P)	:	0:0:2	**CIE**	:	50 Marks
Total Hours	:	20Hrs	**SEE**	:	50 Marks
Course Type	:	PCCL	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Programming languages, Scripting languages, Operating System
Knowledge on Fundamental Concepts	Software development lifecycle, Version control
Knowledge on Connected Tools (If any)	Git, GitHub

Course Learning Objectives: This course will enable the students to	
CLO1	Illustrate key features of Maven and Gradle such as project creation, POM files, and build scripts.
CLO2	Construct Java applications using Maven and Gradle, and migrate projects from Maven to Gradle.
CLO3	Configure and deploy Jenkins pipelines integrated with Maven/Gradle to automate builds and testing.
CLO4	Design Ansible playbooks to automate server configuration.
CLO5	Design and manage build and release pipelines in Azure/AWS DevOps

Experiments	
Sl. No.	**List of problems for which student should develop program and execute in the Laboratory**
1.	Introduction to Maven and Gradle: Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup
2.	Working with Maven: Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins
3.	Working with Gradle: Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation
4.	Practical Exercise: Build and Run a Java Application with Maven, Migrate the Same Application to Gradle
5.	Introduction to Jenkins: What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use
6.	Continuous Integration with Jenkins: Setting Up a CI Pipeline, Integrating Jenkins with Maven/Gradle, Running Automated Builds and Tests
7.	Configuration Management with Ansible: Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook
8.	Practical Exercise: Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins
9.	Introduction to Azure/AWS DevOps: Overview of Azure/AWS DevOps Services, Setting Up an Azure/AWS DevOps Account and Project
10.	Creating Build Pipelines: Building a Maven/Gradle Project with Azure/AWS Pipelines, Integrating Code Repositories (e.g., GitHub, Azure/AWS Repos), Running Unit Tests and Generating Reports
11.	Creating Release Pipelines: Deploying Applications to Azure/AWS App Services, Managing Secrets and Configuration with Azure/AWS Key Vault, Hands-On: Continuous Deployment with Azure/AWS Pipelines

12.	Practical Exercise and Wrap-Up: Build and Deploy a Complete Azure/AWS DevOps Pipeline, Discussion on Best Practices and Q&A

Course Outcomes: After completing the course, the students will be able to	
CO1	Infer the use of build automation tools like Maven and Gradle for project setup and dependency management.
CO2	Apply Gradle and Maven to build and run Java applications effectively.
CO3	Configure Jenkins for CI and integrate it with build tools for automated testing and deployment.
CO4	Analyze server configuration and deployment requirements and automate them using Ansible.
CO5	Evaluate the effectiveness of build and release pipelines and optimize deployments using Azure/AWS DevOps.

Textbooks	
1	"Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation", First Edition, Jez Humble, David Farley, 2010, ISBN-13: 978-0321601919.
2	"Learning Jenkins", First Edition, Nikhil Pathania, 2016, ISBN-13: 978-1784395438.
3	"Ansible for DevOps: Server and Configuration Management for Humans", First Edition, Jeff Geerling, 2015, ISBN-13: 978-1491939369.
4	"Azure DevOps Explained: Get started with Azure DevOps and deliver software faster", First Edition, Sjoukje Zaa, 2019, ISBN-13: 978-1484242056.

Web links and Video Lectures (e – Resources)	
1	https://www.geeksforgeeks.org/devops-tutorial/
2	https://www.javatpoint.com/devops
3	https://www.youtube.com/watch?v=2N-59wUIPVI
4	https://www.youtube.com/watch?v=87ZqwoFeO88

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	2	1	1	3				2	2	1	1
CO2	3	2	2	1	1	3				2	2	1	1
CO3	3	2	2	1	1	3				2	2	1	1
CO4	3	2	2	3	1	1			3	2	2	1	1
CO5	3	2	2	3	1	1			3	2	2	1	1

Semester: V					
Advanced Algorithms					
Course Code	**:**	BCS525A	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Data Structures and Algorithms
Knowledge on Fundamental Concepts	C Programming Concepts, Algorithm design techniques
Knowledge on Connected Tools (If any)	GCC, Code Blocks

Course Learning Objectives: This course will enable the students to	
CLO1	Review advanced analysis techniques and recurrence solving methods for algorithm performance evaluation.
CLO2	Study advanced algorithms in graphs, polynomials, and number theory.
CLO3	Understand and apply efficient string matching algorithms.
CLO4	Explore probabilistic and randomized algorithms for solving complex problems

Module – 1	**08 Hrs**
Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method. **Textbook 1: Ch. 3**, **Ch. 4**: 4.3-4.6	
Module – 2	**08 Hrs**
Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT. **Textbook 1: Ch. 24**: 24.1-24.3, **Ch. 25**: 25.3, **Ch. 26**: 26.1-26.3, **Ch. 30:** 30.1-30.3	
Module – 3	**08 Hrs**
Number Theoretic Algorithms: Elementary number-theoretic notions, GCD, Modular arithmetic, Solving modular linear equations. The Chinese remainder theorem, Powers of an element RSA Cryptosystem, Primality testing, Integer factorization. **Textbook 1: Ch. 31:**31.1-31.6,31.8,31.9	
Module – 4	**08 Hrs**
String Matching Algorithms: Naive Algorithm; Robin-Karp Algorithm, String matching with Finite Automata, Knuth-Morris-Pratt and Boyer-Moore Algorithms. **Textbook 1: Ch. 32:** 32.1-32.4 **Textbook 2: Ch. 7:** 7.2	
Module – 5	**08 Hrs**

Probabilistic Algorithms and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables. **Textbook 1: Ch. 5:** 5.1-5.3

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze the efficiency of algorithms using asymptotic notations and solve recurrence relations using standard techniques.
CO2	Apply graph algorithms to solve problems involving shortest paths, network flows, and matchings.
CO3	Implement efficient algorithms for polynomial computations using FFT and apply number-theoretic methods in cryptographic problems.
CO4	Compare and implement various string-matching algorithms for pattern detection.
CO5	Apply probabilistic and randomized techniques to analyze and design efficient algorithms under uncertainty.

Textbooks	
1	"Introduction to Algorithms", Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI 4thEdition 2022, ISBN 978-0-262-03384-8.
2	"Introduction to the Design and Analysis of Algorithms", Anany Levitin, 3rd Edition (Indian), 2021, Pearson, ISBN-13: 978-0137541133

Reference Books	
1	"Fundamentals of Computer Algorithms", E. Horowitz, S. Sahni and S. Rajasekaran, University Press, Second edition, 2008, ISBN 978-8173716126.
2	"Cengage Learning, Algorithms", Kenneth A Berman & Jerome L Paul, First Indian reprint, 2008, ISBN: 978-8131505212 (Indian edition).

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	3	2	2						1	1	2	2
CO2	3	3	3	2						1	1	2	2
CO3	3	3	2	2						1	1	2	2
CO4	3	2	2	2						1	1	2	2
CO5	3	3	3	2						1	1	2	2

Semester: V					
Computer Graphics					
Course Code	**:**	BCS525B	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Programming languages (C/C++) and Linear Algebra
Knowledge on Fundamental Concepts	Basic proficiency in C/C++ or Java programming. Understanding of linear algebra concepts such as matrices and vector operations
Knowledge on Connected Tools (If any)	OpenGL API Visual Studio Frame Work

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational principles of computer graphics and visualization systems.
CLO2	Explore the architecture, input/output mechanisms, and programming aspects of graphical systems.
CLO3	Enable students to model, render, and manipulate 2D/3D graphical objects using OpenGL.
CLO4	Design and implementation of algorithms for 2D graphics Primitives and attributes.
CLO5	Infer the representation of lines, surfaces, Color and Illumination models.

Module – 1	**08Hrs**
Graphics Systems and Models: Applications of Computer Graphics, A Graphics System, Images: Physical and Synthetic, Imaging Systems, The Synthetic-Camera Model, The Programmer's Interface, Graphics Architectures, Programmable Pipelines, Performance Characteristics. **Textbook 1: Ch. 1:**1.1 to 1.9	
Module – 2	**08Hrs**
Input and Interaction: Interaction, Input devices, Clients and Servers, Display Lists, Display Lists and Modeling, Programming Event Driven Input, Menus. **Textbook 1: Ch. 3:**3.1 to 3.7	
Module – 3	**08Hrs**
Geometric Objects and Transformations: Three-dimensional Primitives; Coordinate Systems and Frames ,Frames in OpenGL, Modeling a ColoredCube, Affine Transformations, Rotation, Translation and Scaling, Geometric Objects and Transformations, Transformation in Homogeneous Coordinates, Concatenation of Transformations, OpenGLTransformation Matrices. **Textbook 1: Ch. 4:** 4.4 to 4.9	
Module – 4	**08Hrs**
Viewing: Classical and computer viewing; Viewing with a Computer; Positioning of the camera; Simple projections; Projections in OpenGL **Lighting and Shading:** Light and Matter, Light Sources, The Phong Lighting Model, Polygonal	

Shading, Light sources in OpenGL **Textbook 1: Ch. 5:** 5.1, 5.2 and **Ch. 6:** 6.1, 6.2, 6.3 and 6.5	
Module – 5	**08Hrs**
Implementation: Basic Implementation Strategies, Four major tasks, Clipping, Line-segment clipping, Cohen-Sutherland Clipping, Liang-Barsky Clipping. Implementation Algorithms for Graphics Primitives and Attributes: Line-Drawing Algorithms, DDA Algorithm, Bresenham's Line Algorithm and Circle Generating Algorithms: Midpoint Circle Algorithm. **Textbook 1: Ch. 7:** 7.1 to 7.4 **Text Book 2: Ch. 5:** 5.1 to 5.4	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the components of working computer graphics system and models.
CO2	Develop interactive graphics applications using event-driven programming and input devices.
CO3	Apply 2D and 3D transformations on graphical objects using mathematical concepts.
CO4	Implement viewing techniques and lighting/shading models in graphical scenes.
CO5	Evaluate algorithms for rendering graphical primitives like lines and circles.

Textbooks	
1	"Interactive Computer Graphics A Top-Down Approach with OpenGL", Edward Angel and Dave Shreiner, 8th Edition, Pearson Education, 2021, ISBN-13 (Print): 9780136681670**.**
2	"Computer Graphics with OpenGL Version", Donald D. Hearn, M. Pauline Baker, and Warren R. Carithers, 4th Edition, Pearson Education, 2015. ISBN 9780136053583

Reference Books	
1	Computer Graphics Using OpenGL", Francis S. Hill Jr., 2nd Edition, Prentice Hall/Pearson Education, 2001. ISBN 9780023548567.
2	"Computer Graphics: Principles and Practice", James D. Foley, Andries van Dam, Steven K. Feiner, and John F. Hughes, 2nd Edition, Addison-Wesley Publishing Company, 1996. ISBN 9780201848403.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106106090/
2	https://nptel.ac.in/courses/106103224/
3	https://nptel.ac.in/courses/106102065/
4	https://www.youtube.com/watch?v=0xVl2_qvj1I&list=PL338D19C40D6D1732&index=13

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1
CO2	2	2	3	1	2	-	-	-	-	-	1	1	1
CO3	3	2	3	-	2	-	-	-	-	-	2	1	1
CO4	3	2	2	-	2	-	-	-	-	-	1	1	1
CO5	3	2	2	1	2	-	-	-	-	-	2	2	2

Semester: V					
Advanced Java Programming					
Course Code	**:**	BCS525C	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Programming with Java
Knowledge on Fundamental Concepts	Classes, Objects, Data types, Methods, Control Structures, Inheritance, Interfaces, Multithreading and Swings
Knowledge on Connected Tools (If any)	Eclipse.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the concepts and techniques of String handling in Java.
CLO2	Understand the principles and components of Java Swing and GUI-based application development.
CLO3	Apply Swing menus, actions, toolbars, and JavaBeans concepts in Java applications.
CLO4	Analyze the architecture and working mechanisms of Java Servlets for web application development.
CLO5	Develop applications using collection classes, JSP components, request processing, cookies and session management.

Module – 1	**08Hrs**
String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, joining strings, Additional String Methods, StringBuffer, StringBuilder. **Textbook 1: Ch. 18**	
Module – 2	**08Hrs**
Exploring Swing: JLabel and ImageIcon,JTextField,The Swing Buttons-JButton, JToggleButton, Check Boxes, Radio Buttons, JTabbedPane, JScrollPane, JList, JComboBox, Trees, JTable. **Textbook 1: Ch. 33**	
Module – 3	**08Hrs**
Introducing Swing Menus: Menu Basics, An Overview, Create Main Menu, Add Mnemonics and Acceralators, Add Images and Tooltips, Use JRadioButton and JCheckBox, Create Popup Menu, Create Toolbar, Use Actions. **Java Beans:** What is a Java Bean? Advantages, Introspection, Bound and Constrained Properties, Persistence, Customizers, Java Beans API. **Textbook 1: Ch. 34, Ch. 35**	
Module – 4	**08Hrs**
Introducing Servlets: Background, The Life Cycle of a Servlet, Using Tomcat for Servlet Development, A simple Servlet, The Servlet API, The jakarta.servlet Package, Reading Servlet Parameter, The jakarta.servlet.http package, Handling HTTP Requests and Responses; Using	

Cookies; Session Tracking. **Textbook 1: Ch. 36**
Module – 5 **08Hrs**
Collections Framework: The Collection Classes: ArrayList Class, LinkedList Class, HashSet Class, LinkedHashSet Class, TreeSet Class, Priority Class, ArrayDeque Class, EnumSet Class. **Java Server Pages (JSP);** JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String, Parsing other information, User sessions, Cookies, Session Objects. **Textbook 1: Ch. 20** **Textbook 2: Ch. 11**

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts and operations of Java String classes.
CO2	Illustrate the working principles of Swing components and GUI controls used in Java applications.
CO3	Apply Swing menus, actions, toolbars, and JavaBeans concepts to develop Java applications.
CO4	Analyze the servlet life cycle, HTTP request-response mechanism, cookies, and session tracking in Java web applications.
CO5	Apply Collections Framework and Java Server Pages (JSP) for data processing and interactive web development.

Textbooks	
1	"Java: The Complete Reference", Herbert Schildt and Danny Coward, 13th Edition, McGraw Hill, 2024, ISBN: 978-1-265-05843-2.
2	"The Complete Reference J2EE", Jim Keogh, Tata McGraw-Hill 2007, ISBN: 978-0-07-052912-0.

Reference Book	
1	"Introduction to JAVA Programming", Y. Daniel Liang, 7th Edition, Pearson Education, 2007, ISBN: 978-0-13-222158-0.
2	"The J2EE Tutorial", Stephanie Bodoff et al, 2nd Edition, Pearson Education,2004, ISBN: 978-0-321-24575-5.
3	"Advanced JAVA programming", Uttam K Roy, Oxford University press, 2015, ISBN: 978-0-19-945550-8.

Web link and Video Lectures (e – Resources)	
1	https://youtu.be/qGMxs-PbFPk

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	1	1						1	1	2	1	1
CO2	3	2	2	1	2				1	1	2	1	1
CO3	3	2	2	1	2				1	1	2	1	1
CO4	3	2	2	1	2				1	1	2	1	1
CO5	3	2	2	1	2				1	1	2	2	2

Semester: V					
Operation Research					
Course Code	**:**	BCS525D	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Linear Algebra, Calculus, Probability & Statistics & Discrete Mathematical Structures
Knowledge on Fundamental Concepts	Basic Optimization Concepts, Logical and structured problem-solving approach.
Knowledge on Connected Tools (If any)	Excel Solver, LINDO / LINGO.

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the foundational concepts and methodology of Operations Research.
CLO2	Formulate and solve Linear Programming Problems.
CLO3	Learn and apply the Simplex Method to solve optimization problems.
CLO4	Solve the Dual Simplex Method Problems.
CLO5	Utilize Game Theory, Metaheuristics, and Transportation/Assignment methods to solve complex optimization and decision-making problems.

Module – 1	**08Hrs**
Introduction: The origin, nature and impact of Operation Research(OR); Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. **Introduction to Linear Programming Problem (LPP):** Prototype example, Assumptions of LPP, Formulation of LPP and Graphical method various examples. **Textbook 1**: **Ch. 1:** 1.1 – 1.3, **Ch. 2:** 2.1 to 2.6, **Ch. 3:** 3.1 to 3.4	
Module – 2	**08Hrs**
Simplex Method – 1: The essence of the simplex method; Setting up the simplex method; Types of variables, Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Big M method, Two phase method. **Textbook 1**: **Ch. 4:** 4.1 – 4.6	
Module – 3	**08Hrs**
Simplex Method – 2: Duality Theory – The essence of duality theory, Primal dual relationship, conversion of primal to dual problem and vice versa. The dual simplex method. **Textbook 1**: **Ch. 6:** 6.1 – 6.4 **Ch. 7:** 7.1	
Module – 4	**08Hrs**
Transportation and Assignment Problems: The transportation problem, Initial Basic Feasible Solution (IBFS) by North West Corner Rule method, Matrix Minima Method, Vogel's Approximation Method. Optimal solution by Modified Distribution Method (MODI). The Assignment problem: A Hungarian algorithm for the assignment problem, Minimization and Maximization varieties in Transportation and assignment problems. **Textbook 1**: **Ch. 8**	

Module – 5	08Hrs
Game Theory: Game Theory: The formulation of two persons, zero sum games; saddle point, maximin and minimax principle, Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure. **Metaheuristics:** The nature of Metaheuristics, Tabu Search, Simulated Annealing, Genetic Algorithms. **Textbook 1**: **Ch. 13, Ch. 14, Ch.15:** 15.1-15.4	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret Operations Research principles and solve real-world problems using Linear Programming models.
CO2	Determine optimal solutions for LPP using simplex method and its variants.
CO3	Analyze primal-dual relationships and solve optimization problems using Dual simplex method.
CO4	Apply VAM, MODI and Hungarian methods to solve optimization problems.
CO5	Develop effective solutions for decision-making problems using Game Theory and Meta-heuristic algorithms.

Textbook	
1	"Introduction to operations research", Frederick S. Hillier, Gerald J. Lieberman McGraw-Hill Education—9th edition, 2015, ISBN 978-0-07-337629-5.

Reference Books	
1	"Operation Research", S Kalavathy, Vikas Publishing House Pvt Limited,2013, ISBN:978-93-259-6347-4
2	"Operation Research", S D Sharma, KedarNath Ram Nath Publishers 2008. ISBN-10 : 819070110X ISBN-13 : 978-8190701105

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=a2QgdDk4Xjw&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX
2	https://www.youtube.com/watch?v=MrOwmSYqkiE&list=PLLy_2iUCG87Bq8RGMTdeFZiB-87V4i9p1&index=2

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	1		1						2	1
CO2	3	3	2	1		1						3	2
CO3	3	3	2	1		1						3	2
CO4	3	3	3	1		1						3	2
CO5	3	3	3	2		1			1			3	3

Semester: V					
Mini Project with Full Stack Development					
Course Code	**:**	BCS536	**Credits**	**:**	2
Hours/Week(L:T:P)	**:**	0:0:4	**CIE**	**:**	50 Marks
Total Hours	**:**	20Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PROJ	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Web Application Development with HTML and PHP, Database Management Systems, Programming with Java, and Introduction to Python programming.
Knowledge on Fundamental Concepts	Programming concepts on C, DSA, JAVA, PYTHON and DBMS
Knowledge on Connected Tools (If any)	Eclipse, Visual Studio

Course Learning Objectives	
CLO1	Understand the process of analysing real-world problems and gathering requirements for full-stack application development.
CLO2	Learn to design and develop responsive and scalable applications using front-end, back-end, and database technologies.
CLO3	Understand integration, testing, and performance evaluation techniques for full-stack applications.
CLO4	Develop project management, teamwork, and ethical practices in the execution of full-stack software projects.
CLO5	Explore emerging full-stack frameworks, cloud deployment, and self-learning strategies for building sustainable and scalable solutions.

PROJECT WORK (BCS636):

The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To instill responsibilities to oneself and others.

(viii)To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(**2) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college.

Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and

question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze real-world problems and define requirements for developing full-stack applications.
CO2	Design and implement innovative full-stack solutions using front-end, back-end, and database technologies.
CO3	Evaluate full-stack application performance through integration, testing, and validation techniques.
CO4	Execute and manage full-stack project tasks collaboratively while adhering to professional and ethical practices.
CO5	Apply self-learning and emerging full-stack technologies to develop sustainable, scalable, and efficient software solutions.

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	1									2	2
CO2	2	2	3	1	3	1						3	3
CO3	1	2	2	3	2							2	3
CO4							3	3	3	3		1	3
CO5	1	1	2	1	2	2		1	1		3	3	2

Semester: V					
Research Methodology and IPR (Common to all Branches)					
Course Code	**:**	BRM507	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	2:2:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	AEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering / Technical Communication
Knowledge on Fundamental Concepts	Fundamentals of engineering problem solving, technical report writing, information retrieval, analytical thinking, and professional ethics
Knowledge on Connected Tools (If any)	Familiarity with web search engines, digital libraries, scholarly databases (e.g., Google Scholar), reference management tools, and basic office productivity software

Course Learning Objectives: This course will enable the students to	
CLO1	Familiarize students with research methodologies, problem formulation, and research ethics.
CLO2	Equip students with techniques for literature search, review, and analysis using scholarly databases.
CLO3	Strengthen technical reading and interpretation skills for research documents, algorithms, and datasets.
CLO4	Introduce Intellectual Property Rights and innovation protection procedures.
CLO5	Enhance awareness of IP management, commercialization, and significant IPR case studies.

Module – 1	**08Hrs**
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship. **Textbook 1**: **Ch. 1, Ch. 2**	
Module – 2	**08Hrs**
Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments. **Textbook 1**: **Ch. 3, Ch. 4**	
Module – 3	**08Hrs**
Introduction To Intellectual Property: Role of IP in the Economic and Cultural, Development	

of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP History of IP in India. Major Amendments in IP Laws and Acts in India. Patents: Conditions for Obtaining a Patent Protection. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting. Process of Patenting. Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models**.**

Textbook 2: Ch. 2

Module – 4	**08Hrs**

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. @#@26092024 Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases. Trademarks: Eligibility Criteria. Acts and Laws. Classification of Trademarks. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Textbook 2: Ch. 3

Module – 5	**08Hrs**

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co. Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India. Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations in India. Schemes and Programmes.

Textbook 2: **Ch. 4, Ch. 7**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply research methodologies and ethical practices to address engineering research problems.
CO2	Analyze technical literature and synthesize research findings using appropriate citation practices.
CO3	Interpret research articles, algorithms, datasets, and technical documents in computing domains.

CO4	Implement intellectual property rights procedures for protecting technological innovations
CO5	Evaluate intellectual property case studies and determine suitable protection strategies for research outcomes

Textbooks	
1	"Research Methodology: Methods and Techniques", C.R. Kothari and Gaurav Garg, 5th Edition, New Age International Publishers, 2024. ISBN: 9389802555
2	"Intellectual property rights under WTO", T Ramappa, 2nd revised edition, Asia Law House Publisher, 2016, ISBN: 9385556819

Reference Books	
1	"Research Methodology: A Step-by-Step Guide for Beginners", Ranjit Kumar, SAGE Publications 2018, ISBN: 9781526457080
2	"Principles of Intellectual Property", Dr. N. S. Gopalakrishnan and T. G. Agitha, Eastern Book Company Publisher, 3rd edition, 2023. ISBN: 9788170121572

Web links and Video Lectures (e – Resources)	
1	https://online.vtu.ac.in/course/1-research-methodologies-and-ipr
2	https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr24_ed08

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3		3			3				2	2	3
CO2	2	3		3	1		2		2		3	3	2
CO3	2	3		2	2				2		3	3	2
CO4	1	1	2			2	3			2	2	2	3
CO5	1	3	2	2		2	3		1	2	2	2	3

Semester: V					
Competency Enhancement Course-3					
Course Code	**:**	BCE508	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:2:0	**CIE**	**:**	100 Marks
Total Hours	**:**	40 Hrs	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Prerequisites:	
Courses	Fundamentals of C Programing
Knowledge on Fundamental Concepts	Programming fundamentals, including variables, data types, control structures (if, loops), and syntax
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply fundamental programming concepts using C
CLO2	Develop object-oriented programs in C++
CLO3	Write and debug multi-file programs in C and C++
CLO4	Design and manage databases using SQL in Oracle and MySQL
CLO5	Compare and analyze different database models (RDBMS vs NoSQL)

Module – 1	**8 Hrs**

C programming (A)

Data Types, Operators and Expressions Input and output Operations Control Flow – Branching, Control Flow – Looping, Statements and Blocks, If Else, Switch, Nesting of If Else, GOTO statement, The while statement, The For statement, The Do statement, Jumps in loops

C programming (B)

Arrays, Strings, One-dimensional arrays, Initialization of one-dimensional arrays, Two-dimensional Arrays, Initializing Two-dimensional arrays, Multi-dimensional arrays, Dynamic arrays, Declaring and Initializing string variables, Reading Strings from Terminal, Writing Strings to screen, String handling functions, Operations on strings

C programming (C)

User-defined Functions, Structures, Basics of Functions, Functions Returning Non-integers, External Variables, Scope Rules, Header Files, Static Variables, Register Variables, Block Structure, Initialization, Recursion, Category of functions, Functions that return multiple values, Nesting functions, Multi-file programs, Structures and Functions, Arrays of Structures, Pointers to Structures, Self-referential structures

Textbook 1, Ch1-11

Module – 2	**8 Hrs**

C Programming (D)

Unions, Pointers, Difference between Structures and Unions, Accessing the address of a variable, Declaring and Initializing pointer variables, Accessing a variable through its pointers, Chain of pointers, Pointer Expressions, Pointer Increments and Scale Factors, Pointers and character strings, Array of pointers, Pointers as function arguments, Functions returning pointers, Pointers to functions, Drawback of Pointers

File Management in C

The Preprocessor, Defining and Opening a File, Closing a File, Input / Output Operations on Files, Random Access to Files, Command Line Arguments. Macro Substitution, File Inclusion,

Compiler Control Directives, ANSI Additions **Textbook 1- Ch2-16**	
Module-3	**8 Hrs**
C++ Object oriented Programming, Class and Objects, Dynamic Memory Management POP,OOPs in C++, Console Input / Output in C++, Comment lines in C++, Importance of function prototyping in C++, Function overloading, Inline functions and default arguments **Textbook 2 –Ch1-6**	
Module-4	**8 Hrs**
C++ Scope Resolution Operator, Structures, Defining function outside the class , Friend functions, Friend class, Array of class objects, Passing class objects to and returning class objects from functions, Nested classes, Namespaces, Dynamic memory allocation using new and deallocation, new handler function **Textbook 2- Ch7-11**	
Module-5	**8 Hrs**
Database Management System : Types of DBMS – Merits and Demerits Oracle and MySQL, SDLC, Architecture (Oracle 10g) - Instance, User Accounts, Client Applications IP, Port Number, SQL Introduction Tables, DDL and DML, Pluggable Databases – Oracle 19c, Architecture Undo and Redo, Operators Constraints Sequences Triggers, Functions – Conversion, String, Math, Aggregate Clauses, Joins, Views, Synonyms, Indexes Stored Procedures, Normalization, Triggers and stored procedures, NoSQL Db, normalisation – tables **Textbook 3 – Ch1-8**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate basic C programming skills in data types, control flow, arrays and strings to solve problems.
CO2	Apply advanced C features like functions, structures, pointers, unions and file handling for modular coding
CO3	Apply C++ OOP concepts, including classes, function overloading, friend functions and dynamic memory management.
CO4	Design and manage databases with Oracle/MySQL, write SQL queries, normalize data and use stored procedures.
CO5	Combine C/C++ programming with database operations to build applications for data storage and retrieval.

Text Books	
1	**Let Us C** by Yashavant Kanetkar (ISBN- 978-8183331630), 15th Edition, BPB Publications- 2016
2	**Object-Oriented Programming with C++** by E. Balagurusamy (ISBN- 978-9389949186), 8th Edition, Tata McGraw-Hill - 2020
3	**Database System Concepts** by Abraham Silberschatz, Henry Korth, S. Sudarshan(ISBN- 978-9332901384),6th Edition, McGraw Hill Education- 2013

Reference Books	
1	**Programming in ANSI C,** by E. Balaguruswamy, (ISBN- 978-9339219666), 7th Edition, Tata McGraw-Hill - 2017
2	**C PROGRAMMING LANGUAGE** by Brian W. Kernighan / Dennis Ritchie(ISBN- 978-9332549449), 2nd Edition, Pearson Education India - 2015

Web links and Video Lectures (e – Resources)

1	https://www.softprayog.in/programming/c-programming-tutorial-data-types-and-expressions
2	https://www.geeksforgeeks.org/array-of-strings-in-c/
3	https://www.programiz.com/c-programming/c-structures-pointers
4	https://www.w3schools.com/cpp/cpp_oop.asp
5	https://www.geeksforgeeks.org/dbms/

CO – PO MAPPING

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

Semester: V					
National Service Scheme (NSS)					
Course Code	**:**	BNS509	**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.
CLO5	Appraise the importance of ethical issues and team working abilities pertaining to the social services.

Activity– 1	**06Hrs**
Developing Sustainable Water management system for rural areas and implementation approaches.	
Activity – 2	**06 Hrs**
Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	
Activity – 3	**06 Hrs**
Spreading public awareness under rural outreach programs.(Minimum 3 programs).	
Activity – 4	**06 Hrs**
Social connect and responsibilities.	

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.	Developing Sustainable Water management system for rural areas and implementation approaches.	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.	Contribution to any national level initiative of	May be individual or team	Villages/ City Areas / Grama panchayat/ public	Group selection /proper consultation/	Report should be submitted by	Evaluation as per the rubrics Of scheme and

	Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.		associations/Government Schemes officers/ campus etc.	Continuous monitoring/ Information board	individual to the concerned evaluation authority	syllabus by NSS officer
3.	Spreading public awareness under rural outreach programs. (minimum5 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ 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
4.	Social connect and responsibilities.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ 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 5th 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 5th 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 5th 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 Matrix

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

Semester: V						
Physical Education (PE) (Sports & Athletics)						
Course Code	**:**	BPE509		**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:1		**CIE**	**:**	100 Marks
Total Hours	**:**	24		**SEE**	**:**	-
Course Type	**:**	NCMC		**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	Impart foundational knowledge on the importance of physical fitness, food, and nutrition for a healthy lifestyle and personal well-being.
CLO2	Develop awareness and proficiency in general fitness components such as agility, flexibility, and cardiovascular endurance through standardized physical fitness tests.
CLO3	Enhance motor skills and techniques in a selected sport (Badminton, Basketball, or Athletics) through structured practice and application of fundamental game-specific skills.

Module – 1	**4 Hrs**
Orientation A. Fitness B. Food & Nutrition	
Module – 2	**4 Hrs**
General Fitness & Components of Fitness A. Agility – Shuttle Run B. Flexibility – Sit and Reach C. Cardiovascular Endurance – Harvard step Test	
Module-3	**16 Hours**
Specific games (Any one to be selected by the student) A. Badminton (Fore hand low/high service, back hand service, smash, drop) B. Basketball (Dribbling, passing, shooting etc.) C. Athletics (Field events – Throws)	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals of fitness, food and nutrition and their role in a healthy lifestyle.
CO2	Demonstrate understanding of general fitness components such as agility, flexibility and cardiovascular endurance through standard fitness tests
CO3	Apply basic techniques, rules and strategies in the chosen sport (Badminton, Basketball, or Athletics)
CO4	Develop sport-specific skills to enhance performance in both practice and competitive situations
CO5	Exhibit teamwork, discipline and sportsmanship during training and game play

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

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

Semester: V					
Yoga					
Course Code	**:**	BYO509	**Credits**	**:**	0
Hours/Week(L:T:P:S)	**:**	0:0:2	**CIE**	**:**	100 Marks
Total Hours	**:**	15 Hrs	**SEE**	**:**	-
Course Type	**:**	NCMC	**SEE Duration**	**:**	-

Course Learning Objectives: This course will enable the students to	
CLO1	**Adopt** healthy lifestyle practices and maintain mental hygiene to promote physical and mental well-being
CLO2	**Develop** emotional intelligence and foster emotional stability through self-awareness and mindfulness practices.
CLO3	**Impart** moral values and enhance self-awareness to facilitate personal growth and attain higher levels of consciousness.

Module - 1	**03 Hrs**
Ashtanga Yoga Basics: Patanjali's Ashtanga Yoga – definition, need & importance, Introduction to 3 limbs: Asana, Pranayama, Pratyahara	
Module - 2	**03 Hrs**
Asana Overview: Meaning, need & benefits of Asanas, Classification: Sitting, Standing, Prone , Supine	
Module - 3	**03 Hrs**
Sitting & Standing Asanas: *Sitting Asanas*: Ardha Ushtrasana, Vakrasana, Yogamudra in Padmasana, *Standing Asanas*: Urdhva Hastothanasana, Hastapadasana, Parivritta Trikonasana Utkatasana, Technique, precautions & benefits	
Module - 4	**03 Hrs**
Prone & Supine Asanas: Prone Asanas: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana, Supine Asanas: Sarvangasana, Chakrasana, Navasana / Noukasana, Pavanamuktasana Technique, precautions & benefits	
Module - 5	**03 Hrs**
Pranayama Practice: Meaning, need & benefits of Pranayama, Breathing practice: 60 strokes/min, 3 rounds, Types of Pranayama:Ujjayi, Sheetali, Sheektari, Technique, precautions & benefits	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the origin, history, objectives, and fundamental concepts of Yoga and its various schools.
CO2	Demonstrate Suryanamaskara and various types of Asanas with correct techniques, precautions, and benefits.
CO3	Differentiate between yogic and non-yogic practices
CO4	Apply yogic principles to promote physical and mental well-being.

Text Books
1. Light on Yoga by BKS Iyengar, Thorsons Publishers, ISBN-10 : 8172235011
2. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly, 4th

Edition, Kaivalyadhama Publishers, ISBN-10 : 9788189485245
3. Yoga Instructor Course hand book published by SVYASA University, Bengaluru

Reference Books	
1	"Yogapravesha", in Kannada by Ajitkumar
2	"Yoga for Children –step by step – ",by Yamini Muthanna

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=KB-TYlgd1wE
2	https://www.youtube.com/watch?v=aa-TG0Wg1Ls

Semester: III-VI					
Music Stream: CSE/ECE/CV/ME					
Course Code	:	BMU310/410/509/610	**Credits**	:	0
Hours/Week(L:T:P)	:	0:0:2	**CIE**	:	**100 Marks**
Total Hours	:	26	**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, Mysoro asudevacharya, 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

	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

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Building Proficient Computer Science Engineers having Core Values to Solve Real Life Problems

Department Mission

- Strengthening Students with Fundamental and Applied aspects in Design and Implementation of Computational Systems.
- Empowering the Students with Sound Knowledge in AI &ML, Data Analytics, Block Chain, AR and VR systems to Solve Multidisciplinary Problem.
- Developing Analytical Skills to meet the Complex, Societal and Industrial needs.
- Promoting Research blend of mind among Students enabling Continuous Learning.
- Encouraging Entrepreneurship including Ethical Values and Team building abilities.

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

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