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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

VI 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

NAAC A+

QS I-GAUGE GOLD

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)

6th 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	BCS601	Artificial Intelligence and Machine Learning Techniques	PCC	CSE	3	2	0	**3**	**50**	**50**	**100**	**4**
2	BCS602	Compiler Design	IPCC	CSE	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BCS623x	Professional Elective Course – II	PEC	CSE	3	0	0	**3**	**50**	**50**	**100**	**3**
4	BCS624x	Professional Elective Course – III	PEC	CSE	3	0	0	**3**	**50**	**50**	**100**	**3**
5	BXX645x	Open Elective Course – I	OEC	CSE	3	0	0	**3**	**50**	**50**	**100**	**3**
6	BCS636	Major Project Phase – I	PROJ	CSE	0	0	4	-	**100**	-	**100**	**2**
7	BCSL607	Machine Learning Lab	PCCL	CSE	0	0	2	**3**	**50**	**50**	**100**	**1**
8	BCE608	Competency Enhancement Course-4	NCMC	CDCAC	0	2	0	-	**100**	-	**100**	**0**
9	BIK609	Indian Knowledge System	NCMC	Any Dept.	1	0	0	-	**100**	-	**100**	**0**
10	BNS610	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	**100**	-	**100**	**0**
	BPE610	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO610	Yoga		Yoga Teacher								
	BMU610	Music		Music Teacher								
									700	**300**	**1000**	**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 – II

Course Code	Course Name	Course Code	Course Name
BCS623A	Blockchain Technology	BCS623C	Data Mining and Data Warehousing
BCS623B	Computer Vision and Image Processing	BCS623D	Introduction to Quantum Computing

Professional Elective Course – III

Course Code	Course Name	Course Code	Course Name
BCS624A	Cloud Computing	BCS624C	NoSQL Database
BCS624B	Advanced Computer Architecture	BCS624D	Internet of Things

Open Elective Course – I

Course Code	Course Name	Course Code	Course Name
BCS645A	Introduction to Data Structures	BIS645C	Mobile Application Development
BCS645B	Fundamentals of Operating Systems	BCI645D	Introduction to Artificial Intelligence

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.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I: Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work

Semester: VI					
Artificial Intelligence and Machine Learning Techniques					
Course Code	**:**	BCS601	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:2:0	**CIE**	**:**	50 Marks
Total Hours	**:**	50 Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Linear Algebra, Probability and Statistics, Calculus
Knowledge on Fundamental Concepts	Mathematics, Statistics, Algorithms, Probability, Logical Connectives.
Knowledge on Connected Tools (If any)	Jupyter, IDLE.

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce the foundational concepts, historical evolution, and core philosophies driving Artificial Intelligence and Machine Learning.
CLO2	Impart knowledge on problem-solving agents and formulation strategies using both blind (uninformed) and heuristic (informed) search algorithms.
CLO3	Provide a deep understanding of data preprocessing, exploratory data analysis, descriptive statistics, and feature engineering workflows.
CLO4	Explore the mathematical and algorithmic frameworks of supervised learning techniques, including regression, decision trees, and Bayesian classifiers.
CLO5	Explore the architectures of Artificial Neural Networks (ANNs) and unsupervised clustering techniques alongside their evaluation frameworks.

Module – 1	**08Hrs**
Introduction: What is AI? Foundations and History of AI Problem-solving: Problem-solving agents, Example problems, Searching for Solutions, Uninformed Search Strategies: Breadth First search, Depth First Search, **Textbook 1: Ch. 1:** 1.1, 1.2, 1.3 **Textbook 1: Ch. 3:** 3.1, 3.2, 3.3, 3.4.1, 3.4.3	
Module – 2	**08Hrs**
Informed Search Strategies: Greedy best-first search, A*search, Heuristic functions. **Introduction to Machine Learning:** Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications. **Understanding Data**: What is Data?, Big Data Analytics and Types of Analytics, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Overview of Hypothesis, Feature Engineering and Dimensionality Reduction Techniques. **Textbook 1: Ch. 3:** 3.5, 3.5.1, 3.5.2, 3.6 **Textbook 2: Ch. 1, Ch. 2**	
Module – 3	**08Hrs**

Basics of Learning Theory: Introduction to Learning and its Types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning.

Similarity Based Learning: Introduction to Similarity or Instance-based Learning, Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR).

Regression Analysis: Introduction to Regression, Introduction to Linearity, Correlation, and Causation, Introduction to Linear Regression, Validation of Regression Methods.

Textbook 2: Ch. 3: 3.1 to 3.4**, Ch. 4, Ch. 5:** 5.1 to 5.4

Module – 4	**08Hrs**

Decision Tree Learning: Introduction to Decision Tree Learning Modules, Decision Tree Induction Algorithms, Validating and Pruning of Decision Trees.

Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Modules, Naïve Bayes Algorithm for Continuous Attributes, Other Popular Types of Naïve Bayes Classifiers.

Textbook 2: Ch. 6, Ch. 8

Module – 5	**08Hrs**

Artificial Neural Network: Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Learning in a Multi-Layer Perceptron, Radial Basis Function Neural Network, Self-Organizing Feature Map, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of Artificial Neural Networks.

Clustering Algorithms: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Gride-based Approach, Probability Module-based Methods, Cluster Evaluation Methods.

Textbook 2: Ch. 10, Ch. 13

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the foundational concepts of AI and implement blind search strategies (BFS, DFS) to design basic problem-solving agents.
CO2	Apply appropriate search and reasoning techniques to address various real-world problems.
CO3	Analyze data distributions using descriptive statistics and build predictive frameworks using similarity-based algorithms and regression models.
CO4	Construct and optimize Decision Trees and probabilistic Naïve Bayes Classifiers for continuous and discrete datasets.
CO5	Design neural network architectures for classification tasks and evaluate unsupervised clustering models using proximity and validation metrics.

Textbooks	
1	"Artificial Intelligence", Stuart J. Russell and Peter Norvig, 3rd Edition, Pearson,2015, ISBN: 978-9332543515
2	"Machine Learning". S. Sridhar, M Vijayalakshmi, Oxford ,2021, ISBN: 978-0199494545

Reference Books	
1	"Artificial Intelligence", Elaine Rich, Kevin K and S B Nair, 3rd Edition, McGraw Hill Education, 2017, ISBN-13: 978-1259004377

2	"The Elements of Statistical Learning", Trevor Hastie, Robert Tibshirani& Jerome Friedman. Springer Series in Statistics, 2nd Edition 2001, ISBN-13: 978-0387848570.
3	"Pattern Recognition and Machine Learning", Chrishtopher M.Bishop, Springer, 2006, ISBN-13: 978-0387310732.

Web links and Video Lectures (e – Resources)	
1	https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2	https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3	https://nptel.ac.in/courses/106/105/106105077/
4	https://www.javatpoint.com/history-of-artificial-intelligence
5	https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
6	https://techvidvan.com/tutorials/ai-heuristic-search/
7	https://www.analyticsvidhya.com/machine-learning/
8	https://www.javatpoint.com/decision-tree-induction
9	https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/mldecision-tree/tutorial/
10	https://www.javatpoint.com/unsupervised-artificial-neural-networks

CO – PO – PSO MAPPING

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

Semester: VI					
Compiler Design					
Course Code	**:**	BCS602	**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	Discrete Mathematics, Data Structures, Programming Languages, Design and Analysis of 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), LEX, YACC

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of language processors and the structure and phases of a compiler.
CLO2	Explain lexical analysis techniques and the role of tokens, patterns, and lexical analyzer generators.
CLO3	Analyze context-free grammars and apply top-down and bottom-up parsing techniques for syntax analysis.
CLO4	Construct LL(1) and SLR parsing tables and implement syntax-directed translation schemes.
CLO5	Generate intermediate code representations and understand the principles of target code generation in compilers.

Module – 1	**08Hrs**
Introduction: Language Processors, The structure of Compiler, The evolution of Programming Languages, The science of Building a Compiler, Applications of Compiler Technology, Programming Language Basics. **Textbook 1: Ch. 1:** 1.1,1.2,1.3,1.4,1.5,1.6	
Module – 2	**08Hrs**
Lexical Analysis: The Role of Lexical Analyzer, input buffering, Specification of Tokens, Recognition of Tokens, The lexical Analyzer Generator Lex, **Syntax Analysis**: Introduction, Context Free Grammars, Writing a Grammar. **Textbook 1: Ch. 3:** 3.1,3.2,3.3,3.4,3.5 **Ch. 4:** 4.1 4.2 4.3	
Module – 3	**08Hrs**
Top-Down Parsing: Recursive Descent Parsing, First and Follow, LL(1) Grammars **Bottom-Up Parsing**: Reductions, Handle Pruning, Shift Reduce Parsing. **Textbook 1: Ch. 4:** 4.4, 4.5	
Module – 4	**08Hrs**
Introduction to LR Parsing: Simple LR, LR Parsing Algorithm, Construction of SLR parsing Tables, Viable Prefixes. **Syntax Directed Translation:** Syntax Directed Definitions, Evaluation Orders for SDD.	

Textbook 1: Ch. 4: 4.6 **Ch. 5:** 5.1,5.2

Module – 5	**08Hrs**
Intermediate-Code Generation: Variants of Syntax Trees, Three Address Code, Types and Declarations. **Code generation:** Issues in the Design of a Code Generator, The target language. **Textbook 1: Ch. 6:** 6.1, 6.2, 6.3 **Ch. 8:** 8.1,8.2	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the working principle of different phases in compiler design.
CO2	Apply the concepts of Automata theory and regular expression to design a lexer.
CO3	Apply the concepts of CFG and different parsing techniques to design a parser.
CO4	Formulate syntax-directed translations, generate intermediate program representations, and evaluate target code generation strategies.
CO5	Apply compiler design concepts and tools to solve problems related to language processing, program analysis, and translation.

Textbook	
1	"Compilers- Principles, Techniques and Tools", Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman; 2nd Edition, 2023, Pearson Education, ISBN-10 -9357054111, ISBN-13 - 978-9357054119.

Reference Books	
1	"Compiler Design", Santanu Chattopadhyay, 1st Edition, 2011, PHI Learning, ISBN-978-81- 203-2725-2C
2	"Compiler Construction Principles, Practice", Kenneth C Louden; Cengage Learning, 1st Edition, 2009. ISBN – 0534939724

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=DFMf9oPbuRI&t=4s

PRACTICAL COMPONENT OF IPCC

Sl#	**Experiments**
1.	Write a LEX Program to find out total number of vowels and consonants from the given string.
2.	Write a LEX Program to convert the substring abc to ABC from the given input string.
3.	a. Lex program to recognize HTML/XML tags. b. Lex program to recognize IPv4 addresses.
4.	Write a YACC Program to Generate a YACC specification to recognize a valid arithmetic expression that uses operators +, – , *,/ and parenthesis.
5.	Write a YACC Program to Generate a YACC specification to recognize a valid identifier which starts with a letter followed by any number of letters or digits.
6.	Implement a parser for mathematical functions (sin, cos, log).
7.	Write program to find Simulate First and Follow of any given grammar.
8.	Construct a recursive descent parser for an expression.
9.	Construct a Shift Reduce Parser for a given language.
10.	Implement Intermediate code generation for simple expressions.

CO – PO – PSO MAPPING

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

Semester: VI					
Blockchain Technology					
Course Code	**:**	BCS623A	**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	Data Structures and Algorithms, Computer Networks, Cryptography Fundamentals
Knowledge on Fundamental Concepts	Distributed systems, cryptographic hashing, consensus mechanisms and peer-to-peer networks
Knowledge on Connected Tools (If any)	Hyperledger

Course Learning Objectives: This course will enable the students to	
CLO1	Understand Blockchain terminologies with its applications.
CLO2	Learn working principles of Blockchain and methodologies used in Bitcoin
CLO3	Build a strong foundation in Ethereum by studying its network, wallets, nodes, smart contracts, and DApps.
CLO4	Understand the design and implementation of blockchain applications with Hyperledger and the lifecycle of smart contracts.

Module – 1	**08Hrs**
Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.	
Textbook 1: Ch.1	
Module – 2	**08Hrs**
Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization.	
Textbook 1: Ch. 2, Ch. 3	
Module – 3	**08Hrs**
Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block, The structure of a block header, The bit coin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates.	
Textbook 1: Ch. 4, Ch. 6	
Module – 4	**08Hrs**
Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM).	
Textbook 1: Ch. 7	

Module – 5	08Hrs
Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda **Textbook 1: Ch. 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the Block chain terminologies with its applications.
CO2	Illustrate the working principles of Blockchain and the Smart Contract Lifecycle
CO3	Demonstrate the principles and methodologies used in Bitcoin
CO4	Develop Ethereum Network, Wallets, Nodes, Smart contract and DApps.
CO5	Analyze the use of Hyperledger in Blockchain.

Textbook	
1	"Mastering Blockchain", Imran Bashir Third Edition, Packt – 2020. ISBN: 978-1-83921-319-9

Reference Book	
1	"Mastering Bitcoin: Programming the Open Blockchain ", Andreas M., O'rielly – 2017. ISBN: 978-149-195438-6.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106104220
2	https://www.geeksforgeeks.org/blockchain/
3	https://www.tutorialspoint.com/blockchain/index.htm

CO – PO – PSO MAPPING

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

Semester: VI					
Computer Vision and Image Processing					
Course Code	**:**	BCS623B	**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, Probability a n d Statistics, Programming (Python/Matlab), Digital Image Processing
Knowledge on Fundamental Concepts	Understanding of image formation, filtering, feature extraction, and basic machine learning concepts
Knowledge on Connected Tools (If any)	OpenCV, MATLAB Image Processing Toolbox and deep learning frameworks like TensorFlow or PyTorch

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce the fundamental concepts of computer vision, digital image representation, and image processing systems.
CLO2	Provide knowledge of image enhancement and image restoration techniques for improving image quality and recovering degraded images.
CLO3	Familiarize students with color image processing methods and morphological operations used in image analysis.
CLO4	Impart knowledge of image segmentation and object recognition techniques for extracting meaningful information from images.
CLO5	Develop the ability to apply feature extraction, pattern classification, and object recognition techniques in computer vision applications.

Module – 1	**08Hrs**
Introduction: What is computer vision? A brief history. **Image Formation:** Photometric image formation, The digital camera. Image processing: Point operators, Linear filtering. **Textbook 1: Ch. 1:** 1.1, 1.2, **Ch. 2:** 2.2, 2.3, **Ch. 3:** 3.1, 3.2	
Module – 2	**08Hrs**
Introduction: What Is Digital Image Processing? The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. **Digital image fundamentals:** Elements of Visual Perception, Light and Electromagnetic spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations. **Textbook 2: Ch. 1, Ch. 2**	
Module – 3	**08Hrs**

Image Restoration and Reconstruction: A model of Image degradation/restoration process, restoration in the presence of noise only, periodic noise reduction by frequency domain filtering. **Image Segmentation:** Fundamentals, Point, Line and edge detection, thresholding (Foundation Basic global thresholding only), Segmentation by region growing region splitting merging. **Textbook 2: Ch. 5:** 5.1 to 5.4, **Ch. 10:** 10.1 to 10.3.2, 10.4
Module – 4 **08Hrs**
Image Restoration: Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering. **Colour Image processing:** Colour fundamentals, Colour models, Colour transformation, Smoothing and Sharpening, Colour segmentation. **Textbook 1: Ch. 5:** 5.1 to 5.7, **Ch. 6:** 6.1 to 6.7
Module – 5 **08Hrs**
Morphological Image Processing: Preliminaries, Erosion and Dilation, opening and closing, Hit-or-miss transform, some basic morphological algorithms. **Feature Extraction:** Background, Boundary preprocessing (Boundary following & Chain codes only). **Image pattern Classification:** Background, Patterns and classes, Pattern classification by prototype matching (Minimum distance classifier only). **Textbook 2: Ch. 9:** 9.1-9.5, **Ch. 11:** 11.1-11.2.2, **Ch. 12:** 12.1-12.3.1

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the fundamental concepts, principles, and applications of computer vision and digital image processing.
CO2	Apply image enhancement techniques, including smoothing and sharpening methods, to improve the quality of digital images.
CO3	Analyze and compare various image restoration and image segmentation techniques for different image processing applications.
CO4	Develop color image processing techniques, including smoothing and sharpening operations, for enhancing color images.
CO5	Evaluate morphological operations, feature extraction, and pattern classification techniques for object recognition in computer vision.

Textbooks	
1	"Computer Vision: Algorithms and Applications (Texts in Computer Science)", Szeliski, Richard, 2nd Edition, Springer, 2022. ISBN: 9783030343712.
2	"Digital Image Processing", Gonzalez, Rafael C., Woods, Richard E., and Eddins, Steven L, 4th Edition, Pearson Education, 2019. ISBN: 9781292223070
Reference Books	
1	"Computer Vision: A Modern Approach", Forsyth, David A., and Ponce, Jean., 2nd Edition, Pearson Education, 2015. ISBN: 9780134380513.
2	"Concise Computer Vision: An Introduction into Theory and Algorithms", Klette, Reinhard, 1st Edition, Springer, 2014. ISBN: 9781447163190.

Web links and Video Lectures (e – Resources)	
1	Virtual Labs: https://cse19-iiith.vlabs.ac.in/
2	https://onlinecourses.nptel.ac.in/noc21_ee78/preview
3	Introduction to Machine Vision: https://www.youtube.com/watch?v=tY2gczObpfU
4	https://coral.ise.lehigh.edu/optml/files/2019/10/OptML_CV_tutorial_1_compressed.pdf

CO – PO – PSO MAPPING

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

Semester: VI					
Data Mining and Data Warehousing					
Course Code	**:**	BCS623C	**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	Database Management Systems (DBMS), Data Structures, Computer Organization, Fundamentals of Statistics.
Knowledge on Fundamental Concepts	Relational Databases, SQL Queries, Data Modeling, Probability and Statistics, Basic Mathematics, Data Analysis Concepts.
Knowledge on Connected Tools (If any)	SQL, MySQL

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret data mining concepts, challenges, tasks, and preprocessing techniques.
CLO2	Apply association rule mining to discover frequent patterns and association rules.
CLO3	Analyze classification techniques such as Decision Trees, Rule-Based, Bayesian, and Nearest Neighbor classifiers.
CLO4	Evaluate clustering techniques including K-Means, Hierarchical Clustering, and DBSCAN.
CLO5	Asses data warehousing and data mining techniques in real-world analytics.

Module – 1	**08 Hrs**
Data Warehouse: Introduction to Data Ware House, Differences between operational database systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction Transformation-Loading, Logical (Multi-Dimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; Fact Less-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP. **Textbook 2: Ch.4:**4.1,4.2	
Module – 2	**08 Hrs**
Introduction to Data Mining: Introduction, what is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of similarity and Dissimilarity-Basics. **Textbook 1: Ch.1:**1.1,1.2,1.4**, Ch.1:**2.1, 2.4 **Textbook 2: Ch.4:**4.4	
Module – 3	**08 Hrs**
Association Analysis: Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns. **Textbook 1: Ch.6:**6.1,6.2,6.3, 6.5, 6.6, 6.7	
Module – 4	**08 Hrs**

Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers. **Textbook 1: Ch.4:**4.3,4.6,5.1,5.2,5.3	
Module – 5	**08 Hrs**
Clustering Analysis: Overview, K-Means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation, Density-Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithms. **Textbook 1: Ch.8:**8.1 to 8.5, 9.3 to 9.5	

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the fundamental concepts of data warehousing and data mining.
CO2	Apply data preprocessing and pattern discovery techniques to extract knowledge from data.
CO3	Analyze data using association, classification, and clustering techniques.
CO4	Evaluate the performance of data mining algorithms for knowledge discovery.
CO5	Examine data warehousing and data mining techniques for real-world data analytics applications.

Textbooks	
1	"Data Mining: Concepts and Techniques", Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 3rd Edition, 2011, ISBN: 9780123814791.
2	"Introduction to Data Mining", Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Pearson Education, 1st Edition, 2018, ISBN: 9780321321367.

Reference Books	
1	"Data Mining Techniques", Arun K. Pujari, Universities Press, 3rd Edition, ISBN: 9788173716065.
2	"Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals", Paulraj Ponniah, Wiley Student Edition, 2nd Edition, ISBN: 9788126506187.
3	"The Data Warehouse Lifecycle Toolkit", Ralph Kimball, Margy Ross, Wiley India, 2nd Edition, ISBN: 9788126521418.
4	"Data Mining", Vikram Pudi, P. Radha Krishna, Oxford University Press, 1st Edition, ISBN: 9780198066262

Web links and Video Lectures (e – Resources)	
1	https://www.oreilly.com/library/view/data-mining-concepts/9780123814791/?utm_source=chatgpt.com
2	https://openlibrary.org/books/OL50463837M/%E2%80%9CData_Mining_Concepts_Techniques%E2%80%9D?utm_source=chatgpt.com
3	https://onlinecourses-archive.nptel.ac.in/noc19_cs15/preview
4	https://nptel.ac.in/courses/106106853?utm_source=chatgpt.com

CO – PO – PSO MAPPING:

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

Semester: VI					
Introduction to Quantum Computing					
Course Code	**:**	BCS623D	**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	Probability and Statistics, Algorithms and Programming skills.
Knowledge on Fundamental Concepts	Basic understanding of probability and statistics, Fundamentals of linear algebra, Basic concepts of algorithms and programming, Knowledge of classical computing principles and Boolean logic.
Knowledge on Connected Tools (If any)	Basic knowledge of Python programming environment. NumPy, Qiskit, Cirq, QuTiP.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational principles and technological dimensions of quantum computing.
CLO2	Identify the difference of foundational concepts in classical and quantum computing.
CLO3	Explore the foundational workings of quantum computing models.
CLO4	Learn and interpret quantum operations.
CLO5	Apply quantum computing concepts and basic quantum algorithms using quantum programming tools.

Module – 1	**08Hrs**
Fundamental concepts: Introduction and overview, Global perspectives, Quantum bits, Quantum computation, Introduction to Superposition, What Is a Qubit? Mathematical Representation of Qubits, Matrix Representation, Bloch Sphere. **Textbook 1: Ch. 1, 2, Text Book 2: Ch.1, 2**	
Module – 2	**08Hrs**
Quantum algorithms: Classical computations on a quantum computer, Quantum parallelism, Deutsch's algorithm. **Textbook 1: Ch. 1**	
Module – 3	**08Hrs**
Quantum circuits design, Quantum gates: Single qubit operations, Controlled operations, Universal quantum gates, Entanglement, Entanglement Fundamentals, Hidden Variable Theory, Multi-Qubit States, Non-Entangled Systems. Entangled Systems. **Textbook 1: Ch. 3, Text Book 2: Ch.7**	
Module – 4	**08Hrs**
Introduction to quantum mechanics: Linear algebra, Bases and linear independence, Linear operators and matrices, The Pauli matrices, Inner products, Eigenvectors and eigenvalues, Adjoints and Hermitian operators, Tensor products, Operator functions, Probability, Scalars, Vectors and Matrices. **Textbook 1: Ch. 2, Textbook 2: Ch. 10**	

Module – 5	08Hrs
Quantum error-correction: Introduction, Theory of quantum error-correction, Constructing quantum codes, Entropy and information, Basic properties of entropy, VonNeumann entropy. **Textbook 1: Ch. 10,11**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret fundamental ideas and terms related to classical and quantum computing
CO2	Analyze quantum computing technology for real life applications.
CO3	Outline the principles and the technology involved in quantum computing.
CO4	Apply fundamental mathematical concepts and techniques in the context of quantum computation.
CO5	Evaluate the performance of quantum algorithms and quantum computing approaches for addressing complex computational problems.

Textbooks	
1	"Quantum Computation and Quantum Information", M. A. Nielsen and I. L. Chuang, 10th anniversary ed. Cambridge, U.K.: Cambridge University Press, 2010, ISBN: 978-1-107-00217-3.
2	"Quantum Computing for the Quantum Curious", C. Hughes, J. Isaacson, A. Perry, R. F. Sun, and J. Turner, Cham, Switzerland: Springer International Publishing, 2021, ISBN: 978-3-030-61600-7.

Reference Books	
1	"An Introduction to Quantum Computing", P. Kaye, R. Laflamme, and M. Mosca, Oxford, U.K.: Oxford University Press, 2007. ISBN: 978-0198570004.
2	"Fundamentals of Quantum Computing: Theory and Practice", V. Kasirajan, 1st Edition. Cham, Switzerland: Springer, 2021. ISBN: 978-3-030-63688-3.

Web links and Video Lectures (e – Resources)	
1	https://www.amazon.in/Quantum-Computing-Curious-Ciaran-ughes/dp/3030616002
2	https://www.amazon.in/Elements-Quantum-Computing-Engineering-Applications/dp/3319082833
3	https://www.amazon.in/Quantum-Computation-Information-10th-Anniversary/dp/1107002176
4	https://www.youtube.com/watch?v=h3w_B7BN_Qw
5	https://www.youtube.com/watch?v=zm64o27eHYw&list=PLxP0p--aBHmIe--9rczWe4AZmw03e2bz0

CO – PO – PSO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PS01**	**PSO2**
CO1	3	2	2									1	1
CO2	3	3	2	2								1	1
CO3	2	2	2	2								1	1
CO4	2	2	2	2	2	1						1	1
CO5	3	3	3	2	1	1						1	1

Semester: VI					
Cloud Computing					
Course Code	**:**	BCS624A	**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	Operating Systems, Computer Networks
Knowledge on Fundamental Concepts	Process, memory, and storage management VM lifecycle
Knowledge on Connected Tools (If any)	Google Cloud Console

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational concepts and motivations behind the evolution of cloud computing, including economic and technological business drivers.
CLO2	Analyze the various service and deployment models of cloud computing, along with associated benefits, limitations, and key technical challenges.
CLO3	Demonstrate the design of cloud native applications, the necessary tools and the design tradeoffs.
CLO4	Examine the role of virtualization, abstractions, enabling technologies, and security in cloud computing

Module – 1	**08Hrs**
Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency. **Textbook 1: Ch. 1**: 1.1 - 1.5	
Module – 2	**08Hrs**
Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation. **Textbook 1: Ch. 3:** 3.1 - 3.5	
Module – 3	**08Hrs**
Cloud Platform Architecture over Virtualized Datacenters: Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management. **Textbook 1: Ch. 4:** 4.1 - 4.4	
Module – 4	**08Hrs**
Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud **Security Cloud Security and Trust Management:** Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques,	

Reputation-Guided Protection of Data Centers. **Textbook 1: Ch. 4:** 4.6 **Textbook 2**: **Ch. 11:**11.1 - 11.3, 11.5 - 11.8, 11.10 -11.14

Module – 5	**08Hrs**
Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments. **Textbook 1**: **Ch. 6:**6.1 to 6.5	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe various cloud computing platforms and service providers.
CO2	Illustrate the significance of various types of virtualization.
CO3	Analyze the architecture, service delivery models, and industrial platforms used in cloud computing applications.
CO4	Describe the role of security aspects in cloud computing.
CO5	Demonstrate cloud applications in various fields using suitable cloud platforms.

Textbooks	
1	"Distributed and Cloud Computing", Morgan Kaufmann, Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Elsevier 2012 ISBN-13: 978-0123858801
2	"Cloud Computing Theory and Practice", Morgan Kaufmann, 2nd Edition, Elsevier 2018 ISBN-13: 978-0128128107

Reference Books	
1	"Mastering Cloud Computing", Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, McGrawHill Education, 1st Edition, 2017 ISBN-13: 9781259029950
2	"Cloud Computing: A Practical Approach", Toby Velte, Anthony Velte, McGraw-Hill Education, 2017, ISBN-13: 9780070683518
3	"Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", George Reese, O'Reilly Publication, 1st Edition, 2009 ISBN-13: 978-0596156367.

Web links and Video Lectures (e – Resources)	
1	https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
2	https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
3	https://www.geeksforgeeks.org/virtualization-cloud-computing-types/
4	https://www.javatpoint.com/cloud-service-provider-companies

CO – PO - PSO MAPPING

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

Semester: VI					
Advanced Computer Architecture					
Course Code	**:**	BCS624B	**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	Digital Design & Computer organization Microcontrollers
Knowledge of Fundamental Concepts	Understanding of instruction set architecture, pipelining, memory hierarchy, parallelism, and cache coherence
Knowledge of Connected Tools	Simulators Xilinx and Verilog, OpenMP Development Tools

Course Learning Objectives: This course will enable the students to	
CLO1	Understand parallel and high-performance computer architectures with examples.
CLO2	Measure and evaluate architecture performance using speedup and scalability metrics.
CLO3	Apply the principles of modern hardware technologies, including systems and organizations, pipelining techniques
CLO4	Compare parallel and scalable architectures using supporting software.
CLO5	Illustrate proficiency in using parallel models and compiler-based strategies to achieve instruction-level and system-level performance gains.

MODULE-1
Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multisector and SIMD Computers. **Program and Network Properties:** Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms. **Textbook 1: Ch. 1:** 1.1- 1.3 **Ch. 2:** 2.1 - 2.3
MODULE-2
Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or mechanism any one example is sufficient. **Hardware Technologies-1:** Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Virtual Memory Technology. **Textbook 1: Ch. 3:** 3.1 -3.3 **Ch. 4:** 4.1 - 4.4

MODULE-3
Hardware Technologies 2: Cache Memory Organizations, Shared Memory Organizations, Pipelining and Superscalar Techniques, Linear & Nonlinear Pipeline Processors. **Parallel and Scalable Architectures:** Multiprocessors and Multicomputer, Multiprocessor System Interconnects, Cache Coherence, Synchronization Mechanisms & Message-Passing Mechanisms. **Textbook 1: Ch. 5:**5.1 - 5.4 **Ch. 6:** 6.1 - 6.2
MODULE-4
Multi Vector and SIMD Computers: Vector Processing Principles, Multi vector Multiprocessors, Compound Vector Processing, Scalable. **Multithreaded and Dataflow Architectures:** Latency-Hiding Techniques, Principles of Multithreading, Fine- Grain Multicomputer. **Textbook 1: Ch. 8:** 8.1 - 8.3 **Ch. 9:** 9.1 - 9.3
MODULE-5
Software for parallel programming: Parallel Models, Languages, and Compilers, Parallel Programming Models, Parallel Languages and Compilers, Dependence Analysis of Data Arrays. **Instruction and System Level Parallelism**: Instruction Level Parallelism, Computer Architecture, Contents, Basic Design Issues, Problem Definition, Model of a Typical Processor, Compiler-detected Instruction Level Parallelism. **Textbook 1: Ch. 10:** 10.1 - 10.3 **Ch. 12:** 12.1 - 12.5

Course Outcomes: After completing the course, the students will be able to	
CO1	Classify parallel computer models and describe program partitioning, scheduling, and flow mechanisms.
CO2	Analyze processor performance using scalability metrics, speedup laws, and advanced architectures.
CO3	Evaluate pipeline processors, cache organizations, and synchronization in shared-memory architectures.
CO4	Apply vector processing, SIMD models, and latency-hiding techniques in multithreaded architectures.
CO5	Apply parallel programming models, compiler optimizations, and instruction-level parallelism to solve parallel computing problems.

Textbook	
1	"Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability", Kai Hwang and Naresh Jotwani, McGraw Hill Education 3rd edition. 2015, ISBN-10: 9339220927, ISBN-13: 9789339220921

Reference Book	
1	"Modern Processor Design", J.P. Shen and M.H. Lipasti, MC Graw Hill, Crowfordsville, 2005, ISBN-10: 0070570647, ISBN-13: 9780070570641.

Web links and Video Lectures (e – Resources)	
1	http://nptel.ac.in/courses/106102163/
2	https://onlinecourses.nptel.ac.in/noc23_cs07/preview/
3	https://archive.nptel.ac.in/courses/106/103/106103206/

CO – PO – PSO Mapping

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

Semester: VI					
NoSQL Database					
Course Code	**:**	BCS624C	**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	Database Management Systems, Data Structures
Knowledge on Fundamental Concepts	Database models, Data modeling techniques, Differences between SQL and NoSQL databases
Knowledge on Connected Tools (If any)	MongoDB Compass, Neo4j Browser, NoSQL Booster

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the fundamental concepts of NoSQL database.
CLO2	Outline the characteristics of different consistency models in distributed systems.
CLO3	Analyze where key-value databases work best and how partitioning and combining help Map- Reduce run better.
CLO4	Apply the concept of document databases to solve specific problems in real-world applications.
CLO5	Illustrate the use of nodes and edges in creating a simple graph model.

Module – 1	**08Hrs**
Why NoSQL? The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL. **Aggregate Data Models:** Aggregates, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases. **More Details on Data Models:** Relationships, Graph Databases, Schema less Databases, Materialized Views, Modeling for Data Access. **Textbook 1: Ch. 1, Ch. 2, Ch. 3**	
Module – 2	**08Hrs**
Distribution Models: Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication. **Consistency:** Update Consistency, Read Consistency, Relaxing Consistency, Relaxing Durability, Quorums. **Textbook 1: Ch. 4, Ch. 5**	
Module – 3	**08Hrs**

Map-Reduce: Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations **Key-Value Databases:** What Is a Key-Value Store, Key-Value Store Features, Suitable Use Cases, When Not to Use. **Textbook 1: Ch. 7, Ch. 8**

Module – 4	**08Hrs**
Document Databases: What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, ECommerce Applications, When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure. **Textbook 1: Ch. 9**	
Module – 5	**08Hrs**
Graph Databases: What Is a Graph Database? Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use. **Textbook 1: Ch. 11**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the fundamental concepts and data models of NoSQL databases.
CO2	Illustrate consistency concepts such as Update Consistency and Read Consistency in distributed models.
CO3	Design Map-Reduce workflows for big data processing and apply key-value database.
CO4	Analyze the effectiveness of document databases in managing complex transactions.
CO5	Explore graph database model to organize and represent real-world data relationships.

Textbook	
1	"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Sadalage, P. & Fowler, Pearson Addison Wesley, ISBN-13: 978-0-321-82662-6, 2012.

Reference Books	
1	"NoSQL For Mere Mortals", Dan Sullivan, 1st Edition, Pearson Education India, 2015, ISBN13: 978-9332557338.
2	"Making Sense of NoSQL: A guide for Managers and the Rest of us", Dan McCreary and Ann Kelly, 1st Edition, Manning Publication/Dream tech Press, 2013, ISBN-13: 978- 9351192022.
3	"Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", Kristina Chodorow, 2nd Edition, OReilly Publications, 2013, ISBN-13: 978-9351102694.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=xQnIN9bW0og
2	https://www.mongodb.com/resources/basics/databases/nosql-explained
3	https://www.mygreatlearning.com/no-sql/tutorials
4	https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/pages/lecture-notes/

CO – PO – PSO MAPPING

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

Semester: VI					
Internet of Things					
Course Code	**:**	BCS624D	**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	Digital Design & Computer Organization, Microcontrollers and Embedded Systems, Computer Networks, Introduction to Internet of Things (IOT), Problem Solving through Programming, Introduction to Python Programming.
Knowledge on Fundamental Concepts	IoT architecture, communication protocols, data analytics, and basic cloud computing.
Knowledge on Connected Tools (If any)	Arduino IDE, Raspberry Pi.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the genesis and impact of IoT applications, architectures in real world.
CLO2	Illustrate diverse methods of deploying smart objects and connect them to network.
CLO3	Compare different Application protocols for IoT.
CLO4	Infer the role of Data Analytics and Security in IoT.
CLO5	Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Module – 1	**08 Hrs**
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. **Textbook 1: Ch. 1, Ch. 2**	
Module – 2	**08 Hrs**
Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. **Textbook 1: Ch. 3, Ch. 4**	
Module – 3	**08 Hrs**
IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods. **Textbook 1: Ch. 5, Ch. 6**	
Module – 4	**08 Hrs**
Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics. Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary. Formal Risk Analysis Structures: OCTAVE and FAIR. **Textbook 1: Ch. 7, Ch. 8**	
Module – 5	**08 Hrs**

Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples. IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO learning board, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, RaspberryPi Operating Systems, Configuring RaspberryPi commands. **Textbook 1: Ch. 12** **Textbook 2: Ch. 7:** 7.1 to 7.4, **Ch. 8:** 8.1 to 8.5**.**

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the impact and challenges posed by IoT networks
CO2	Illustrate the deployment of smart objects and the technologies in IoT
CO3	Identify the role of IoT protocols for efficient network communication.
CO4	Analyze the need of Data Analytics and Security in IoT.
CO5	Assess different sensor technologies for sensing real world entities

Textbooks	
1	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, 1st Edition, Pearson Education (Cisco Press Indian Reprint) ISBN**:** 978-9386873743.
2	"Internet of Things", Srinivasa K G, CENGAGE Learning India, ISBN:978-9386858955,2017.

Reference Books	
1	"Internet of Things (A Hands-on-Approach)", Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, ISBN:978-8173719547, 2014.
2	"Internet of Things: Architecture and Design Principles", Raj Kamal, 1st Edition, McGraw Hill Education, ISBN:978-9352605224, 2017.

Web links and Video Lectures (e – Resources)	
1	https://docs.arduino.cc/
2	https://www.youtube.com/watch?v=xKX8N1VnXJU
3	Raspberry Pi Explained in 100 Seconds
4	https://www.youtube.com/watch?v=xKX8N1VnXJU&t=212s
5	https://www.google.com/search?q=data+analytics+for+IOT+videos&oq=data+analytics+for+IOT+videos&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIHCAEQIRigATIHCAIQIRigAdIBCTE3OTg3ajBqN6gCCLACAfEFeLeDY76oi8E&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:15d893b7,vid:MxgRipNuKW0,st:0

CO – PO – PSO MAPPING

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

Semester: VI					
Introduction to Data Structures					
Course Code	**:**	BCS645A	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Introduction to C Programming
Knowledge on Fundamental Concepts	Data types, Arrays, Structures, Functions, Recursion
Knowledge on Connected Tools (If any)	GCC, Code Blocks, Visual Studio

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of data structures.
CLO2	Analyze stack and queue data structures for problem-solving.
CLO3	Implement singly linked lists for basic operations and stack/queue structures.
CLO4	Analyze and construct expression trees for arithmetic expressions.
CLO5	Apply basic sorting and searching algorithms to organize and retrieve data efficiently.

Module – 1	**08Hrs**
Introduction: Data and Information, Data Structure, Classification of Data Structures, Operations on Data Structure. Pointers: Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions. **Arrays and Structures**: Arrays, One-Dimensional Arrays, Two-Dimensional Arrays, Initializing Two-Dimensional Arrays, Multidimensional arrays, Structures and Unions, Declaring Structures, Giving Values to Members, Structure Initialization. **Textbook 1: Ch. 1:** 1.2, **Ch. 2:** 2.1-2.5,2.6-2.9	
Module – 2	**08Hrs**
Stacks: Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks, Infix to postfix conversion, Postfix expression evaluation. **Queues:** Introduction, Queue Operations, Queue Implementation using Arrays, Applications of Queues. **Textbook 1**: **Ch. 3:**3.1-3.5, 3.6-3.8, **Ch. 4:**4.1-4.5	
Module – 3	**08Hrs**
Linked Lists: Introduction, Singly Linked List, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List. **Textbook 1**: **Ch. 5:**5.1-5.4,5.5-5.6	
Module – 4	**08Hrs**
Trees: Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search	

Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees. **Textbook 1**: **Ch. 6:**6.1-6.7,6.8-6.9,6.10

Module – 5	**08Hrs**
Sorting: Introduction, Bubble Sort, Selection Sort, and Insertion Sort. **Searching:** Introduction, Linear Search, Binary Search. **Textbook 1**: **Ch. 7:**7.1-7.4, **Ch. 8:**8.1-8.3	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the concept of linear and nonlinear data structures.
CO2	Implement stack and queue concepts effectively to solve problems.
CO3	Analyze the practical uses of linked lists in various computing applications.
CO4	Design binary search trees to efficiently perform insertion, searching, deletion, and traversal operations."
CO5	Apply basic sorting and searching techniques to organize and retrieve data efficiently.

Textbook	
1	"Data Structures: A Pseudo-code approach with C", Gilberg & Forouzan, Cengage Learning, 2nd edition, 2014, ISBN-10: 8131503143.

Reference Books	
1	"An Introduction to Data Structures with Applications", Jean-Paul Tremblay & Paul G. Sorenson, McGraw Hill, 2nd edition, 2013.
2	"Fundamentals of Data Structures in C", Ellis Horowitz and Sartaj Sahni, Universities Press, 2nd edition, ISBN-13: 978-8173714939, 2017.

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/106/102/106102064/
3	https://nptel.ac.in/courses/106/105/106105171/
4	http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
5	https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s

CO-PO-PSO MAPPING

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

Semester: VI					
Fundamentals of Operating Systems					
Course Code	**:**	BCS645B	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Computer Organization and Architecture, Programming in C.
Knowledge on Fundamental Concepts	Computer fundamentals, Arrays, Structures
Knowledge on Connected Tools (If any)	UNIX/Linux Environment

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the need of OS architecture and different types of OS.
CLO2	Illustrate the techniques for management of different system resources
CLO3	Analyze the different memory and file system management strategies.
CLO4	Demonstrate the virtual memory, paging and segmentation concepts.
CLO5	Analyze the importance of file system mechanisms.

Module – 1	**08Hrs**
Introduction: What operating systems do; Computer System organization; Computer System Organization, Computer System architecture; Operating System operations; Resource Management **Operating System Structures:** Operating System Services, User and Operating System interface; System calls, Application Program Interface, Types of system calls; **Textbook 1**: **Ch. 1**: 1.1, 1.2, 1.3,1.4, 1.5, **Ch. 2**: 2.1, 2.2 (2.2.1, 2.2.2), 2.3 (2.3.2, 2.3.3)	
Module – 2	**08Hrs**
Process Management: Process concept; Process scheduling; Operations on processes; Interprocess Communication. **Multi-threaded Programming:** Overview; Multithreading models, Thread Libraries. **Textbook 1**: **Ch. 3:**3.1-3.4, **Ch. 4:**4.1, 4.3 5, 4.4	
Module – 3	**08Hrs**
CPU Scheduling: Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling. **Process Synchronization:** Synchronization: The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization. **Textbook 1**: **Ch. 5:**5.1, 5.2,5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4 **Ch. 6:** 6.1, 6.2.,6.3, 6.6	
Module – 4	**08Hrs**
Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. **Memory Management:** Background; Contiguous memory allocation; Paging; Structure of page table. **Textbook 1: Ch. 8:** 8.1-8.8 **Ch. 9:** 9.1-9.4 (9.4.1, 9.4.2)	
Module – 5	**08Hrs**

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; **File System Interface:** File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations, **File System Internals**: File Systems, File System Mounting; Partition and Mounting, File sharing; **Textbook 1**: **Ch. 10:** 10.1-10.3, 10.4 (10.4.1, 10.4.2, 10.4.4.) **Ch. 13**: 13.1, 13.2, 13.3 (13.3.1, 13.3.2, 13.3.3), 13.4 (13.4.1, 13.4.2) **Ch. 15**: 15.1-15.4

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the structure and functionality of operating system
CO2	Illustrate the appropriate CPU scheduling algorithm for the given scenarios
CO3	Analyze the various techniques for process synchronization and deadlock handling
CO4	Apply the different techniques for memory management
CO5	Demonstrate the importance of File System Mounting and File Sharing

Textbook	
1	"Operating System Principles", Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 978–0–470–12872–5, 8th edition, Wiley-India, 2015.

Reference Books	
1	"Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Akshay Kulkarni, Adarsha Shivananda, Apress, 2019.
2	"Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", T V Geetha, Pearson, 2024.
3	"Information Storage and Retrieval systems", Gerald J. Kowalski and Mark.T. Maybury, Kluwer Academic Publishers.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=vBURTt97EkA
2	https://www.iemdaily.com/2020/05/operating-system-by-gate-smashers.html?utm

CO – PO – PSO MAPPING

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

Semester: VI					
Mobile Application Development					
Course Code	**:**	BIS645C	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming, Object-Oriented Programming
Knowledge on Fundamental Concepts	Understanding of core programming concepts (variables, loops, functions, OOP),Basic UI/UX principles, Database fundamentals
Knowledge on Connected Tools (If any)	SQL

Course Learning Objectives: This course will enable the students to	
CLO1	Learn to setup Android application development environment
CLO2	Illustrate user interfaces for interacting with apps and triggering actions
CLO3	Interpret tasks used in handling multiple activities.
CLO4	Identify options to save persistent application data
CLO5	Appraise the role of security and performance in Android applications

Module – 1	**08 Hrs**
Get started: Build your first app, Activities, Testing, debugging and using support libraries **Text Book1: Ch. 1: 1.1 - 1.4, Ch. 2: 2.1 - 2.3, Ch. 3:3.1-3.3.**	
Module – 2	**08 Hrs**
User experience: User Interaction, Delightful user experience, Testing your UI **Text Book1: Ch. 4: 4.1 - 4.4, Ch. 5: 5.1 – 5.3, Ch. 6:6.1.**	
Module – 3	**08 Hrs**
Working in the background: Background Tasks, Triggering, scheduling and optimizing background tasks **Text Book1: Ch. 7: 7.1 - 7.4, Ch. 8: 8.1 – 8.3.**	
Module – 4	**08 Hrs**
All about Data: Preferences and Settings, Storing data using SQLite, Sharing data with content providers, Loading data using Loaders **Text Book1: Ch. 9: 9.0 - 9.2, Ch. 10: 10.0 – 10.1, Ch. 11: 11.1, Ch. 12: 12.1.**	
Module – 5	**08 Hrs**
Permissions, Performance and Security, Firebase and AdMob, Publish **Text Book1: Ch. 13: 13.1, Ch. 14: 14.1, Ch. 15: 15.1.**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Develop Android applications using activities, support libraries, testing, and debugging techniques.
CO2	Design user interfaces by incorporating user interaction principles and user experience testing methods.
CO3	Implement background processing using task scheduling, triggering, and optimization techniques.
CO4	Apply application data using preferences, SQLite databases, content providers, and loaders.
CO5	Evaluate application security, permissions, performance optimization, and deployment using Firebase, AdMob, and publishing tools.

Text Books	
1	"Android Developer Fundamentals Course – Concept Reference", Google Developer Training, 2017, Google Developer Training Team.

Reference Books	
1	"Android Programming – Pushing the Limits", Erik Hellman, 1st Edition, , 2014,Wiley India Pvt Ltd. ISBN 978-1-118-71737-0
2	"Head First Android Development", Dawn Griffiths and David Griffiths, 1st Edition, 2015, O'Reilly SPD Publishers. ISBN-978-1-449-36218-8
3	"Beginning Android Programming with Android Studio", J F DiMarzio, 4th Edition, 2016,Wiley India Pvt Ltd,. ISBN-13: 978-8126565580

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.swayam2.ac.in/nou21_ge41/
2	https://nptel.ac.in/courses/106/106/106106156/

CO – PO MAPPING

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

Semester: VI					
Introduction to Artificial Intelligence					
Course Code	**:**	BCI645D	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	03 Hours

Prerequisites:	
Courses	Computer Program
Knowledge on Fundamental Concepts	Background in linear algebra, data structures and algorithms, and probability
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundations of Artificial Intelligence, intelligent agents, problem formulation, and the characteristics of intelligent environments.
CLO2	Apply uninformed and informed search techniques, game-playing algorithms, and heuristic methods to solve AI problems efficiently.
CLO3	Analyze various knowledge representation techniques and reasoning methods for intelligent decision-making under certainty and uncertainty.
CLO4	Examine first-order logic, inference mechanisms, machine learning approaches, and reinforcement learning techniques for solving AI problems.
CLO5	Illustrate the architecture, components, and real-world applications of expert systems and knowledge-based systems.

Module – 1	**08 Hrs.**
Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. **Textbook 1: Ch 1: 1.1–1.5, Ch 2: 2.1–2.4, Ch 3: 3.1–3.4**	
Module – 2	**08 Hrs.**
Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions **Textbook 1: Ch 3: 3.5–3.6, Ch 4: 4.1–4.7, Ch 5: 5.1–5.4, Ch 7: 7.1–7.5**	
Module – 3	**08 Hrs.**
Representation of Knowledge: Knowledge representation issues, predicate logic-logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and dempstershafer theory. **Textbook 1: Ch 8: 8.1–8.5, Ch 9: 9.1–9.6, Ch 10: 10.1–10.5**	
Module – 4	**08 Hrs.**
Logic concepts: First order logic. Inference in first order logic, propositional vs.	

first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning. **Textbook 2: Ch 1: 1.1–1.5, Ch 2: 2.2–2.7, Ch 3: 3.2, 3.3, 3.5, 3.6**
Module – 5 **08 Hrs.**
Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells. **Textbook 2: Ch7: 7.1–7.2, 7.4, Ch 8: 8.3–8.5, Ch 9: 9.4–9.6**

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the concepts of Artificial Intelligence, intelligent agents, and problem-solving methodologies
CO2	Apply search algorithms and game-playing techniques to solve complex AI problems.
CO3	Analyze knowledge representation and reasoning techniques for intelligent systems.
CO4	Apply logical inference, machine learning, and reinforcement learning concepts in AI applications.
CO5	Design and evaluate expert systems for real-world problem-solving.

Textbooks	
1	Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2022. ISBN: 9780134610993.
2	Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B. Nair, 3rd Edition (SIE), McGraw Hill Education. ISBN: 9781259029974.

Reference Books	
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F. Luger, 6th Edition, Pearson. ISBN: 9789332581982.
2	Artificial Intelligence: A New Synthesis, Nils J. Nilsson, Morgan Kaufmann. ISBN: 9781558604674.

Web links and Video Lectures (e – Resources)	
1	https://ai.google/
2	https://swayam.gov.in/nd1_noc19_me71/preview

CO – PO – PSO MAPPING

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

Semester: VI					
Major Project Phase – I					
Course Code	**:**	BCS636	**Credits**	**:**	2
Hours/Week(L:T:P)	**:**	0:0:4	**CIE**	**:**	100
Total Hours	**:**	12	**SEE**	**:**	--
Course Type	**:**	PROJ	**SEE Duration**	**:**	--

Prerequisites:	
Courses	Fundamental of Concepts Programming
Knowledge on Fundamental Concepts	Programming concepts on C, DSA, JAVA, DBMS, PYTHON
Knowledge on Connected Tools (If any)	Eclipse, Edit plus, GCC, Codeblocks, Visual Studio

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze a real-world problem to define a clear problem statement, project scope, and objectives.
CO2	Evaluate relevant literature, existing research, and technologies to identify suitable approaches for the proposed project.
CO3	Formulate an appropriate project proposal by integrating the problem statement, objectives, literature survey, and proposed methodology.
CO4	Prepare and deliver technical presentations and project documentation using appropriate engineering communication practices.
CO5	Demonstrate teamwork, professional ethics, and self-directed learning during project planning and proposal development.

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 instil 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.

CO – PO Mapping:

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

Semester: VI					
Machine Learning Lab					
Course Code	**:**	BCSL607	**Credit**	**:**	1
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	50 Marks
Total Hours	**:**	15Hrs	**SEE**	**:**	50 Marks
Course Type	**:**	PCCL	**SEE Duration**	**:**	03 Hours

Prerequisites:	
Courses	Introduction to Python Programming, Foundations of AI
Knowledge on Fundamental Concepts	Probability & Statistics
Knowledge on Connected Tools	Jupyter Notebook

Course Learning Objectives: This course will enable the students to	
CLO1	Become familiar with data characteristics and formats for effective analysis.
CLO2	Visualize univariate, bivariate, and multivariate data using appropriate statistical techniques.
CLO3	Apply dimensionality reduction methods to simplify complex datasets.
CLO4	Understand various machine learning algorithms such as similarity-based learning, regression, decision trees, and clustering.
CLO5	Familiarize with learning theories, probability-based models and developing the skills required for decision-making in dynamic environments.

Sl No.	**Experiments**
1	Develop a program to create histograms for all numerical features and analyze the distribution of each feature. Generate box plots for all numerical features and identify any outliers. Use California Housing dataset.
2	Develop a program to Compute the correlation matrix to understand the relationships between pairs of features. Visualize the correlation matrix using a heatmap to know which variables have strong positive/negative correlations. Create a pair plot to visualize pairwise relationships between features. Use California Housing dataset.
3	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2.
4	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
5	Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of [0,1]. Perform the following based on dataset generated. 1. Label the first 50 points {x1,……,x50} as follows: if (xi ≤ 0.5), then xi ∈ Class1, else xi ∈ Class1 2. Classify the remaining points, x51,……,x100 using KNN. Perform this for k=1,2,3,4,5,20,30
6	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
7	Develop a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression.

8	Develop a program to demonstrate the working of the decision tree algorithm. Use Breast Cancer Data set for building the decision tree and apply this knowledge to classify a new sample.
9	Develop a program to implement the Naive Bayesian classifier considering Olivetti Face Data set for training. Compute the accuracy of the classifier, considering a few test data sets.
10	Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamental principles of multivariate data analysis to interpret datasets using appropriate visualization techniques.
CO2	Demonstrate dimensionality reduction techniques such as PCA and t-SNE to simplify complex datasets while preserving essential patterns.
CO3	Apply similarity-based learning approaches, including k-NN, and perform regression analysis using appropriate evaluation metrics.
CO4	Construct decision trees for classification and regression tasks, and develop Bayesian models for probabilistic inference.
CO5	Develop clustering algorithms to group data effectively and optimize shared computing resources in distributed environments.

Web links and Video Lectures (e – Resources)	
1	https://www.drssridhar.com/?page_id=1053
2	https://www.universitiespress.com/resources?id=9789393330697
3	https://onlinecourses.nptel.ac.in/noc23_cs18/preview

CO – PO – PSO MAPPING

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

Semester: VI					
Competency Enhancement Course-4					
Course Code	**:**	BCE608	**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	Competency Enhancement Course 3, Fundamentals of Data Structures & Algorithms
Knowledge on Fundamental Concepts	Complexity analysis, competitive programming paradigms, and algorithmic problem solving
Knowledge on Connected Tools	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply fundamental data structures.
CLO2	Analyze and design algorithms using various paradigms.
CLO3	Evaluate the time and space complexity of algorithms using asymptotic notations.
CLO4	Develop problem-solving strategies for competitive programming.
CLO5	Apply algorithmic thinking in real-world applications through hands-on coding labs, group exercises, and simulations.

Module – 1	**8 Hrs**
Data Structures Overview of Data Structures, Searching and Sorting Algorithms, Stack, Queue, Linked, List, Trees, Graphs **Textbook-1: Ch1-15**	
Module – 2	**8 Hrs**
Algorithms Analysis of Algorithms, Pattern Matching, Bit Algorithms, Mathematical Algorithms, Randomized Algorithms, Dynamic Programming, Backtracking Algorithms, Greedy Algorithms, Sliding Window Approach **Textbook-2: Ch8-13**	
Module-3	**8 Hrs**
Time Complexity Big O Notation, Omega Notation, Theta Notation, Best, Worst, and Average Case Analysis, Asymptotic Analysis, Amortized Analysis, Time Complexity of Common Algorithms, Sorting (e.g., QuickSort, MergeSort), Searching (e.g., Binary Search), Graph Algorithms (e.g., BFS, DFS), Space Complexity Basics **Textbook-3: Ch1-6**	
Module-4	**8 Hrs**
Foundation of Competitive Coding Importance of Competitive Coding for interviews and placements, Problem decomposition & edge case identification, Basics of time and space complexity, Story-based introduction to problem-solving, Brainstorm real-world scenarios & translate to problems, Identify edge cases via mini-quizzes, Live walkthroughs (e.g., parking fee calculator), Coding warm-up challenge	

Textbook-3: Ch7-10	
Module-5	**8 Hrs**
Data Structures Simplified Arrays, Linked Lists, Stacks, Queues, Hashing, Trees, Graphs, Mapping DS to real-life systems (e.g., ticket booking, social feeds), Trade-offs in DS selection, Implement DS in hands-on coding labs, Real-life simulation: Airline or hospital queue system, Use case discussions, Group exercises with efficiency comparisons **Algorithmic Paradigms & Optimization** Greedy, Divide & Conquer, DP, Backtracking, Practical applications with real-world stories, Efficiency and trade-offs, Debugging complex logic, Group challenge: Route optimization using Dijkstra, Hands-on: Knapsack, Fibonacci DP, Game simulations, Compare multiple approaches for the same problem, Debugging hackathons **R-1: C1-10, 20,21&22**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply fundamental data structures such as arrays, stacks, queues, linked lists, trees and graphs to solve real-life computational problems.
CO2	Analyze and implement algorithmic strategies and backtracking for optimized problem-solving.
CO3	Evaluate the time and space complexity of algorithms using asymptotic notations to ensure computational efficiency.
CO4	Design and implement algorithms for searching, sorting and graph traversal with appropriate time complexity.
CO5	Demonstrate proficiency in competitive coding practices by identifying edge cases, decomposing problems and debugging logical errors.
CO6	Relate data structures and algorithmic techniques to real-world applications and industry use-cases such as routing, scheduling and transaction systems.

Textbooks	
1	**The C Programming Language,** Brian W. Kernighan and Dennis M. Ritchie 2nd Edition, Pearson Education India – 2015, (ISBN- 978-9332549449)
2	**Let Us C,** Yashavant Kanetkar, 15th Edition, BPB Publications- 2016, (ISBN- 978-8183331630)
3	**Object-Oriented Programming with C++**, E. Balagurusamy, 8th Edition, Tata McGraw-Hill – 2020, (ISBN- 978-9389949186)
4	Data Structures and Algorithms, Narasimha Karumanchi, 2023 Edition (latest available), paperback, CareerMonk Publications, (ISBN: 9788193245279)

Web links and Video Lectures (e – Resources)	
1	https://www.sanfoundry.com/best-reference-books-programming-language-c/?utm_source.com
2	https://studylib.net/doc/27609260/addison-wesley-c-primer-plus-6th-edition-2014?utm_source.com
3	https://books.dwf.dev/docs/c-programming-language/first-edition/types-operators-expressions?utm_source.com
4	https://www.geeksforgeeks.org/types-of-database-management-systems/?utm_source.com
5	https://faculty.kutztown.edu/shim/356CHAPTER%205.pdf?utm_source.com

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2								
CO2	3	3	2								
CO3	3	2		2							
CO4	3	2	3								
CO5		3			1						1
CO6	2		2			1					

Semester: VI					
Indian Knowledge System **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	BIK609	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	1:0:0	**CIE**	**:**	100 Marks
Total Hours	**:**	15 Hrs	**SEE**	**:**	--
Course Type	**:**	NCMC	**SEE Duration**	**:**	--

Prerequisites:	
Courses	Environmental Studies, Indian Philosophy or Ethics
Knowledge on Fundamental Concepts	Basic understanding of ancient Indian civilization, literature
Knowledge on Connected Tools (If any)	NA

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the foundational concepts of Indian Knowledge Systems (IKS)
CLO2	Explore the contributions of traditional Indian knowledge to various fields in the humanities and sciences
CLO3	Recognize the relevance and applications of traditional knowledge in professional domains
CLO4	Develop an appreciation for the interdisciplinary nature of IKS
CLO5	Analyze the integration of IKS with contemporary academic and professional practices

Module – 1	**08Hrs**
Introduction to Indian Knowledge Systems (IKS) Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge. **Textbook-1, Ch.1,2&3, Textbook-2: Ch. 2&3**	
Module – 2	**08Hrs**
Traditional Knowledge in Humanities and Sciences Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology. **Textbook-1, Ch. 4,5,6&7, Textbook-2: Ch. 3&4**	
Module – 3	**08Hrs**
Traditional Knowledge in Professional domain Town planning and architecture Construction, Health, wellness and Psychology- Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals. **Textbook-1, Ch.8,9,10,11&12, Textbook-2: Ch. 5,6&7**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Elucidate the scope, significance and philosophical foundations of Indian Knowledge Systems (IKS).

CO2	Compare traditional knowledge systems with indigenous and western knowledge frameworks.
CO3	Identify the applications of traditional Indian knowledge in humanities and scientific domains.
CO4	Demonstrate an understanding of traditional Indian contributions to professional domains.
CO5	Relate traditional knowledge systems to contemporary global frameworks such as Sustainable Development Goals (SDGs).

Textbooks	
1	"Introduction to Indian Knowledge System- concepts and applications", B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
2	"Traditional Knowledge System in India", Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230

Reference Book	
1	"Knowledge Traditions and Practices of India", Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=LZP1StpYEPM
2	http://nptel.ac.in/courses/121106003/
3	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7	https://unfoundation.org/whatwedo/issues/sustainabledevelopmentgoals/?gclid=EAIaIQobChMInpJtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

CO – PO MAPPING

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

Semester: VI					
National Service Scheme (NSS)					
Course Code	**:**	BNS610	**Credits**	**:**	0
Hours/Week(L:T:P)	**:**	0:0:2	**CIE**	**:**	100 Marks
Total Hours	**:**	24	**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	**08Hrs**
Plantation and adoption of plants. Know your plants.	
Activity – 2	**08 Hrs**
Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).	
Activity – 3	**08 Hrs**
Govt. school Rejuvenation and helping them to achieve good infrastructure.	

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	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.	Place 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	Organize National integration and social harmony events	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes	Place 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

	/workshops /seminars. (Minimum 02 programs).		officers/ campus etc.			
3	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.	Place 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 6th 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 6th 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 6th 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

	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: VI					
Physical Education (PE) (Sports & Athletics)					
Course Code	**:**	BPE610	**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 awareness about common postural deformities and equip students with techniques for stress management to enhance physical and mental well-being.
CLO2	Enable students to acquire the basic rules, techniques, and motor skills of selected games such as Throw Ball, Table Tennis, or Athletics, and to encourage regular participation in physical activities.
CLO3	Improve cardiovascular fitness, flexibility, and coordination through structured aerobic exercises.

Module – 1	**4 Hrs**
Orientation A. Postural deformities. B. Stress management	
Module – 2	**16 Hrs**
Specific games (Any one to be selected by the student) A. Throw ball B. Table Tennis C. Athletics (Field Events- Jumps) – Any event as per availability of Ground.	
Module-3	**4 Hours**
Aerobics	

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify common postural deformities and suggest corrective measures
CO2	Apply basic stress management techniques to enhance physical and mental well-being
CO3	Demonstrate fundamental skills, rules and techniques of a selected game (Throw Ball / Table Tennis / Athletics – Field Events)
CO4	Exhibit improved coordination, flexibility, endurance and cardiovascular fitness through aerobic exercises
CO5	Integrate principles of physical fitness, posture correction and stress management into daily routines for holistic health

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	2					2	3		2		
CO2	2					3	3	2	2		
CO3	2	1				2			3		
CO4	3					2			2		
CO5	3	2				3	3	2	3		

Semester: VI					
Yoga **Stream: CSE/ECE/ME/CV**					
Course Code	**:**	BYO610	**Credits**	**:**	00
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**
Higher Ashtanga Yoga: Ashtanga Yoga – last three limbs: Dharana (Concentration), Dhyana (Meditation), Samadhi (Absorption), Importance in spiritual and mental well-being	
Module - 2	**03 Hrs**
Sitting & Standing Asanas: Sitting Asanas: Bakasana, Hanumanasana, Ekapada Rajakapotasana, Yogamudra in Vajrasana, Standing Asanas: Vatayanasana, Garudasana, Technique, precautions & benefits	
Module - 3	**03 Hrs**
Balancing & Supine Asanas: Balancing Asanas: Veerabhadrasana, Sheershasana, Supine Asanas: Sarvangasana, Setubandha Sarvangasana, Shavasana (Relaxation), Asana meaning, method, safety tips & benefits	
Module - 4	**03 Hrs**
Pranayama & Kapalabhati: Pranayama: Bhastrika, Bhramari, Kapalabhati revision – 80 strokes/min, 3 rounds, Technique, precautions & benefits	
Module - 5	**03 Hrs**
Shatkriyas: Meaning, need & types of Shatkriyas, Techniques, safety & benefits of: Jalaneti & Sutraneti, Nouli (only for men), Sheetkarma Kapalabhati	

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.

Textbooks
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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