SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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

SCHEME OF TEACHING AND EXAMINATION – B.E. –

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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

7th Semester

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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	BAD701	Deep Learning and Reinforcement Learning	IPCC		3	0	2	3	50	50	100	4
2	BIS702	Big data Analytics	IPCC		3	0	2	3	50	50	100	4
3	BCI703	GPU Architecture and Parallel Computing	PCC		4	0	0	3	50	50	100	4
4	BXX724x	Professional Elective Course – IV	PEC		3	0	0	3	50	50	100	3
5	Bxx745x	Open Elective Course – II	OEC		3	0	0	3	50	50	100	3
6	BCIP736	Major Project Phase – II	PROJ		0	0	12	3	100	100	200	6
7	BCR737	Career Readiness and Industry Integration	NCMC	CDCAC	0	2	0	-	100	-	100	0
									450	350	800	24

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 – IV			
Course Code	**Course Name**	**Course Code**	**Course Name**
BCI724A	Explainable AI and Responsible AI Systems	BCI724C	Cyber Physical and Federated AI
BCI724B	Human Computer Interaction	BCI724D	Blockchain Security
Open Elective Course – II			
Course Code	**Course Name**	**Course Code**	**Course Name**
BCS745A	Introduction to DBMS	BIS745C	Software Engineering
BCS745B	Introduction to Algorithms	BIS745D	Web Technology

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.

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 Work: The objective of the Project work is to:
i) Encourage independent learning and the innovative attitude of the students.
ii) Develop interactive attitude, communication skills, organization, time management, and presentation skills.
iii) Impart flexibility and adaptability.
iv) Inspire team working.
v) Expand intellectual capacity, credibility, judgment and intuition.
vi) Adhere to punctuality, setting and meeting deadlines.
vii) Install responsibilities to oneself and others.
viii) 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 the 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.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE 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.

Semester: VII					
Deep Learning and Reinforcement Learning					
Course Code	:	BAD701	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40L +12P	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Artificial Intelligence, ML
Knowledge on Fundamental Concepts	Basic Text Processing & Pattern Matching, Object-Oriented Programming (OOP) Principles
Knowledge on Connected Tools (If any)	Anaconda

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals of deep learning.
CLO2	Know the theory behind Convolutional Neural Networks, RNN.
CLO3	Illustrate the strength and weaknesses of many popular deep learning approaches.
CLO4	Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems
CLO5	Understand the fundamentals of reinforcement learning and apply deep learning models to develop intelligent decision-making systems.

Module – 1	**08 Hrs**
Introduction to Deep Learning Introduction, Shallow Learning, Deep Learning, Why to use Deep Learning, How Deep Learning Works,Deep Learning Challenges,. How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization. **Textbook 1: Ch 1.1 – 1.6, Textbook 2: 8.1,8.2**	
Module – 2	**08 Hrs**
Basics of Supervised Deep Learning Introduction, Convolution Neural Network, Evolution of Convolution Neural Network, Architecture of CNN, Convolution Operation **Textbook 1: Ch 2.1 – 2.5**	
Module – 3	**08 Hrs**
Training Supervised Deep Learning Networks Training Convolution Neural Networks, Gradient Descent-Based Optimization Techniques, Challenges in Training Deep Networks. **Supervised Deep Learning Architectures:** LetNet-5,AlexNet **Text Book - 1 : Ch 3.2,3.4,3.5, Ch 4.2,4.3**	
Module – 4	**08 Hrs**
Recurrent and Recursive Neural Networks Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory.Gated RNNs. **Text Book – 2: 10.1-10.3, 10.5, 10.6, 10.10**	
Module – 5	**08 Hrs**
Deep Reinforceme,nt Learning: Introduction, Stateless Algorithms: Multi-Armed Bandits, The Basic Framework of Reinforcement Learning, case studies. **Textbook – 3: Chapter 9: 9.1,9.2,9.3, 9.7**	

Practical Component

Sl.No	Experiments
1	Design and implement a neural based network for generating word embedding for words in a document corpus.
2	Write a program to demonstrate the working of a deep neural network for classification task.
3	Desing and implement a Convolutional Neural Network(CNN) for classification of image dataset.
4	Build and demonstrate an autoencoder network using neural layers for data compression on image dataset.
5	Desing and implement a deep learning network for classification of textual documents.
6	Design and implement a deep learning network for forecasting time series data.
7	Write a program to enable pre-train models to classify a given image dataset
8	Simple Grid World Problem: Design a custom 2D grid world where the agent navigates from a start position to a goal, avoiding obstacles. Environment: Custom grid (easily implemented in Python)

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate the implementation of deep learning techniques
CO2	Examine various deep learning techniques for solving the real-world problems
CO3	Design and implement research-oriented scenario using deep learning techniques in a team
CO4	Develop Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Long Short-Term Memory (LSTM) models for image and sequence learning tasks.
CO5	Apply reinforcement learning algorithms to solve sequential decision-making problems using deep learning approaches.

Text Books	
1	Advances in Deep Learning, M. Arif Wani Farooq Ahmad Bhat Saduf Afzal Asif Iqbal Khan, Springer, 2020
2	“Deep Learning”, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
3	“Neural Networks and Deep Learning”, Charu C. Aggarwal, Springer, 2018.
Reference Books	
1	"Learning deep architectures for AI." Foundations and trends in Machine Learning, Bengio, Yoshua.,2009
2	“Deep Learning Made Easy with R: A Gentle Introduction for Data Science”, N.D. Lewis, 2016
3	“Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms”, Nikhil Buduma, O’Reilly publications.

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2	https://archive.nptel.ac.in/courses/106/106/106106211/

CO – PO MAPPING

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

Semester: VII					
Big data Analytics					
Course Code	**:**	BIS702	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	3:0:2	**CIE**	**:**	50 Marks
Total Hours	**:**	40L +12P	**SEE**	**:**	50 Marks
Course Type	**:**	IPCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Database Management System, Operating System.
Knowledge on Fundamental Concepts	Basics of Networks and Machine Learning.
Knowledge on Connected Tools (If any)	Basic knowledge on AWS, Microsoft Azure, Google Cloud, Hadoop

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the concepts, characteristics, and evolution of Big Data.
CLO2	Apply Hadoop ecosystem components, including HDFS, YARN, and MapReduce.
CLO3	Implement MapReduce programs for processing big data.
CLO4	Realize storage and processing of big data using MongoDB, Pig, Hive and Spark.
CLO5	Analyze big data using machine learning techniques.

Module – 1	**08Hrs**
Introduction: Classification of data, Characteristics, Evolution and definition of Big data, What is Big data, Why Big data, Traditional Business Intelligence Vs Big Data,Typical data warehouse and Hadoop environment. **Big Data Analytics:** What is Big data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies used in Big data Environments, Few Top Analytical Tools , NoSQL, Hadoop. **Text Book 1: Ch 1: 1.1, Ch 2: 2.1-2.5,2.7,2.9-2.11, Ch 3: 3.2,3.5,3.8,3.12, Ch 4: 4.1,4.2**	
Module – 2	**08Hrs**
Introduction to Hadoop: Introducing hadoop, Why hadoop, Why not RDBMS, RDBMS Vs Hadoop, History of Hadoop, Hadoop overview, Use case of Hadoop, HDFS (Hadoop Distributed File System),Processing data with Hadoop, Managing resources and applications with Hadoop YARN(Yet Another Resource Negotiator). **Introduction to Map Reduce Programming:** Introduction, Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. **Text Book 1: Ch 5: 5.1-,5.8, 5.10-5.12, Ch 8: 8.1 - 8.8**	
Module – 3	**08Hrs**
Introduction to MongoDB: What is MongoDB, Why MongoDB, Terms used in RDBMS and MongoDB, Data Types in MongoDB, MongoDB Query Language. **Textbook 1: Ch 6: 6.1-6.5**	
Module – 4	**08Hrs**
Introduction to Hive: What is Hive, Hive Architecture, Hive data types, Hive file formats, Hive Query Language (HQL), RC File implementation, User Defined Function (UDF). **Introduction to Pig:** What is Pig, Anatomy of Pig, Pig on Hadoop, Pig Philosophy, Use case	

for Pig, Pig Latin Overview, Data types in Pig, Running Pig, Execution Modes of Pig, HDFS Commands, Relational Operators, Eval Function, Complex Data Types, Piggy Bank, User Defined Function, Pig Vs Hive.

Text Book 1: Ch 9: 9.1-9.6,9.8, Ch 10: 10.1 - 10.15, 10.22

Module – 5	**08Hrs**

Spark and Big Data Analytics: Spark, Introduction to Data Analysis with Spark.

Text, Web Content and Link Analytics: Introduction, Text Mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and Analyzing a Web Graph.

Text Book 2: Ch 5: 5.2,5.3, Ch 9: 9.1-9.4

PRACTICAL COMPONENT	
Sl. No.	**Experiments (Java/Python/R)**
1	Install Hadoop and Implement the following file management tasks in Hadoop: Adding files and directories Retrieving files Deleting files and directories. **Hint:** A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.
2	Develop a MapReduce program to implement Matrix Multiplication
3	Develop a Map Reduce program that mines weather data and displays appropriate messages indicating the weather conditions of the day.
4	Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data.
5	Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB
6	Write Pig Latin scripts to sort, group, join, project, and filter the data.
7	Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
8	Implement a word count program in Hadoop and Spark.
9	Use CDH (Cloudera Distribution for Hadoop) and HUE (Hadoop User Interface) to analyze data and generate reports for sample datasets

Textbooks	
1	Seema Acharya and Subhashini Chellappan “Big data and Analytics” Wiley India Publishers, 2nd Edition, 2019.ISBN 13 9788126554782
2	Rajkamal and Preeti Saxena, “Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning”, McGraw Hill Publication, 2019. ISBN 789353164973

Reference Books	
1	Adam Shook and Donald Mine, “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems” - O'Reilly 2012 ISBN: 978-1-449-32717-0
2	Tom White, “Hadoop: The Definitive Guide” 4th Edition, O’reilly Media, 2015. ISBN: ISBN: 9781491901687
3	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers & Techniques, Pearson India Education Service Pvt. Ltd., 1st Edition, 2016 ISBN-13: 978-0-13-429107-9 ISBN-10: 0-13-429107-7
4	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition ISBN: 0262537559, 9780262537551

Web links and Video Lectures (e – Resources)	
1	https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset
2	https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ
3	https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1m o37urJQOdCZ&in dex=4
4	https://www.youtube.com/watch?v=GG-VRm6XnNk https://www.youtube.com/watch?v=JglO2Nv_92A

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand Big Data concepts, characteristics, evolution, and analytics.
CO2	Interpret the Hadoop architecture, HDFS, YARN, and implement MapReduce programming.
CO3	Demonstrate MongoDB concepts and its applications.
CO4	Outline Hive and Pig architectures, query languages, and their differences.
CO5	Apply Spark for Big Data Analytics and perform text and web analytics.

CO – PO – PSO MAPPING

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

Semester: VII					
GPU Architecture and Parallel Computing					
Course Code	**:**	BCI703	**Credits**	**:**	4
Hours/Week(L:T:P)	**:**	4:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Computer Organization & Architecture, OS and programming Language.
Knowledge on Fundamental Concepts	CPU and memory hierarchy, Multicore processors / GPUs, Control structures, Pointers and memory management.
Knowledge on Connected Tools (If any)	OpenMP, Message Passing Interface, Compute Unified Device Architecture.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the principles, architectures, and memory models of parallel computing for AI and ML applications.
CLO2	Analyze the performance characteristics of multicore, many-core, and GPU-based computing systems.
CLO3	Identify the use of MPI to develop distributed-memory parallel programs for scalable AI applications.
CLO4	Demonstrate the use of OpenMP pragmas and directives to parallelize shared-memory programs
CLO5	Employ the design and execution of CUDA programs for GPU-based parallel computing.

Module – 1	**08Hrs**
Introduction to parallel programming, Parallel hardware and parallel software-Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory. **Textbook 1: Ch. 2:** 2.3 – 2.4	
Module – 2	**08Hrs**
GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance — Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, Parallel Computing for AI and Machine Learning: GPU Acceleration of Deep Learning and Matrix Operations (Case Study GPU performance). **Textbook 1: Ch. 2:** 2.5 – 2.6	
Module – 3	**08Hrs**
Distributed memory programming with MPI — MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm. **Textbook 1: Ch. 3:** 3.1 – 3.7	
Module – 4	**08Hrs**
Shared-memory programming with OpenMP — openmp pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in openmp, tasting, tasting, thread safety.	

Textbook 1: Ch. 5: 5.1 – 5.11	
Module – 5	**08Hrs**
GPU programming with CUDA - GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids NVIDIA compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, Case Study: CUDA-Based Acceleration of Deep Neural Network Training and Inference. **Textbook 1: Ch. 6:** 6.1 – 6.13	

Textbooks	
1	"An Introduction to Parallel Programming", Peter S Pacheco, Matthew Malensek —, second edition 2020, Morgan Kauffman ISBN: 978-0128046050.
2	"Parallel Programming in C with MPI and OpenMp", Michael J Quinn, McGrawHill. FIRST edition, 2017, ISBN: 978-0070582019.

Reference Books	
1	Calvin Lin, Lawrence Snyder – Principles of Parallel Programming, Pearson. 2008, ISBN: 978-0321487902.
2	Barbara Chapman – Using OpenMP: Portable Shared Memory Parallel Programming, Scientific and Engineering Computation. Scientific and Engin EDITION, 2007, ISBN: 978-0262533027.
3	William Gropp, Ewing Lusk – Using MPI:Portable Parallel Programing, Third edition, Scientific and Engineering Computation. Third edition2014, ISBN: 978-0262527392.

Web links and Video Lectures (e – Resources)	
1	Introduction to parallel programming: https://nptel.ac.in/courses/106102163
2	https://www.youtube.com/watch?v=pnGbjr0HM1k
3	https://www.youtube.com/watch?app=desktop&v=yi3zHpgGXpk&t=0s
4	https://www.youtube.com/watch?v=pn0EDrR3xtA

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the parallel computing architectures, memory models, and programming paradigms used in AI and ML.
CO2	Analyze the architecture and execution models of MIMD and GPU-based systems.
CO3	Apply MPI libraries to develop distributed memory parallel programs for solving computational problems.
CO4	Implement shared-memory parallel programs using OpenMP directives.
CO5	Design CUDA-based GPU programs to accelerate computationally intensive AI and machine learning applications.

CO – PO – PSO MAPPING

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

Semester: VII					
Explainable AI and Responsible AI Systems					
Course Code	:	BCI724A	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	PEC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Fundamentals of AI, Machine learning
Knowledge on Fundamental Concepts	Probability & Statistics, Data Analytics Fundamentals
Knowledge on Connected Tools (If any)	Jupyter Notebook

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of Explainable AI by emphasizing transparency, fairness, privacy and ethical governance in AI systems
CLO2	Illustrate the ethical, social and regulatory aspects of Explainable AI
CLO3	Evaluate the role of human-centered design, transparency and accountability in developing trustworthy and user-centric Explainable AI systems.
CLO4	Integrate fairness, non-discrimination and security principles in developing trustworthy and responsible Explainable AI systems.
CLO5	Examine the applications of Explainable AI across diverse sectors and interpret the future directions of ethical and socially responsible AI development.

Module – 1	**08 Hrs**
Introduction to Ethical and Socially Responsible Explainable AI: Introduction, The Need for Explainable AI, Challenges in Developing Ethical and Socially Responsible Explainable AI, The Role of Human-Centered Design in Developing Explainable AI, Transparency and Accountability in Explainable AI, Ensuring Fairness and Non-discrimination, Privacy and Security Considerations, The Importance of Ethical Governance, Applications of Socially Responsible Explainable AI. **Text Book 1: Ch 1: 1.1 to 1.9**	
Module – 2	**08 Hrs**
The Need for Explainable AI: Ethical and Social Implications: Introduction to the Need for Explainable AI, The Ethics of AI and Explainability, Social Implications of AI Explainability, AI Explainability and Regulatory Frameworks. **Challenges in Developing Ethical and Socially Responsible Explainable AI:** Introduction, Lack of Consenus on Ethical and Social Values, Limited Diversity in AI Development Teams, Bias in Training Data and Algorithmic Decision-Making, Difficulty in Interpreting Complex AI Models, Balancing Transparency and Confidentiality, Addressing the Trade-Offs Between Explainability and Performance, Ethical and Legal Implications of Explainable AI Systems. **Text Book 1: Ch 2: 2.1 to 2.4 & Ch 3: 3.1 to 3.8**	
Module – 3	**08 Hrs**

The Role of Human-Centered Design in Developing Explainable AI: Introduction, Importance of Human-Centered Design in Developing Explainable AI, Applications of Human-Centered Design in Explainable AI, Challenges in Implementing Human-Centered Design in Explainable AI.

Transparency and Accountability in Explainable AI: Best Practices: Introduction, Importance of Transparency and Accountability in AI, Best Practices for Transparency in AI, Best Practices for Accountability in AI, Conclusion.

Text Book 1: Ch 4: 4.1 to 4.4 & Ch 5: 5.1 to 5.5

Module – 4	**08 Hrs**

Ensuring Fairness and Non-discrimination in Explainable AI: Introduction, Challenges in Achieving Fairness and Non-discrimination in AI, Best Practices for Ensuring Fairness and Non-discrimination in AI, Case Studies of Fairness and Non-discrimination in AI.

Privacy and Security Considerations in Explainable AI: Introduction, Importance of Privacy and Security in AI, Challenges in Achieving Privacy and Security in AI, Best Practices for Ensuring Privacy and Security in AI, Case Studies of Privacy and Security in AI.

Text Book 1: Ch 6: 6.1 to 6.4 & Ch 7: 7.1 to 7.5

Module – 5	**08 Hrs**

Socially Responsible Applications of Explainable AI: Introduction, Healthcare, Education, Environmental Sustainability, Social Services, Business and Industry, Government and Public Services, Ethical Considerations for Socially Responsible Applications of AI.

Conclusion and Future Directions for Ethical and Socially Responsible Explainable AI: Summing Up Key Findings, Reiterating the Importance of Ethical and Social Responsibility in AI, Implications for Future AI Development, Global Perspectives on Ethical AI.

Text Book 1: Ch 9: 9.1 to 9.8 & Ch 10: 10.1 to 10.4

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the principles of Ethical and Socially Responsible AI and their role in developing trustworthy AI applications.
CO2	Analyze the ethical, social and legal aspects of Explainable AI and evaluate its key challenges and trade-offs.
CO3	Apply human-centered design principles and transparency practices to develop accountable and user-friendly Explainable AI solutions.
CO4	Implement fairness, privacy and security best practices to assess and improve the reliability of Explainable AI applications.
CO5	Demonstrate the ability to identify socially responsible Explainable AI applications and discuss their ethical impact and global significance in real-world domains.

Text Books	
1	Towards Ethical and Socially Responsible Explainable AI, Aboul Ella Hassanien, Nilanjan Dey, Vincenzo Piuri, 1st Edition, 2024, Springer Nature Switzerland AG, eBook ISBN: 978-3-031-66489-2.

Reference Books	
1	Explainable, Interpretable and Transparent AI Systems, Edited by Siddhartha Bhattacharyya, Aboul Ella Hassanien, 1st Edition, 2024, CRC Press (Taylor & Francis Group), ISBN-13: 978-1032528564**.**

2	Explainable AI: Foundations, Methodologies and Applications, Edited by Amit Kumar Tyagi, Siddhartha Bhattacharyya, Aboul Ella Hassanien, 1st Edition, 2023, Springer Nature Switzerland AG, eBook ISBN: 978-3-031-12807-3**.**

Web links and Video Lectures (e – Resources)	
1	Responsible & Safe AI Systems (NPTEL) https://onlinecourses.nptel.ac.in/noc25_cs118/preview
2	Explainable AI (XAI) Specialization – Duke University (Coursera) https://www.coursera.org/specializations/explainable-artificial-intelligence-xai

CO – PO MAPPING

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

Semester: VII					
HUMAN COMPUTER INTERACTION **Stream: CSE(AI&ML)**					
Course Code	**:**	BCI724B	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Programming Fundamentals, Data Structures, Introduction to Artificial Intelligence
Knowledge on Fundamental Concepts	Computer fundamentals, software development lifecycle, and basic user interface concepts
Knowledge on Connected Tools	

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the principles of human cognition, perception, and computer technologies that influence user interaction.
CLO2	Analyze interaction models, interface paradigms, and usability principles for designing effective user interfaces.
CLO3	Apply user-centered design methodologies, design rules, and usability engineering practices in interface development.
CLO4	Design and evaluate interactive systems using appropriate evaluation techniques, accessibility principles, and universal design approaches.
CLO5	Examine advanced HCI concepts, cognitive models, task analysis techniques, and emerging interaction paradigms.

Module – 1	**08 Hrs**
Foundations of Human Computer Interaction The Human: Input–Output Channels, Human Memory, Thinking: Reasoning and Problem Solving, Emotion and Human Error. The Computer: Text Entry and Pointing Devices, Display Devices, Devices for Virtual Reality and Interaction, Physical Controls, Sensors and Special Devices. **Textbook 1: Ch 1: 1.1 to 1.6, Ch 2: 2.1 to 2.6**	
Module – 2	**08 Hrs**
The Interaction, Paradigms and Interaction Design Basics Models of Interaction, Frameworks and Ergonomics, Interaction Styles, Interactivity, Paradigms for Interaction, The Design Process, User Focus, Scenarios, Navigation Design and Screen Design. **Textbook 1: Ch 3: 3.1 to 3.6, Ch 4: 4.1 to 4.2, Ch 5: 5.1 to 5.6**	
Module – 3	**08 Hrs**
HCI in the Software Process, Design Rules and Implementation Support Software Lifecycle, Usability Engineering, Iterative Design and Prototyping, Design Rationale, Principles to Support Usability, Standards, Guidelines and Heuristics, Windowing Systems, Interaction Toolkits and User Interface Management Systems. **Textbook 1: Ch 6: 6.1 to 6.5, Ch 7: 7.1 to 7.5, Ch 8: 8.1 to 8.4**	
Module – 4	**08 Hrs**
Evaluation Techniques, Universal Design and User Support: Goals of Evaluation, Evaluation Through Expert Analysis, Evaluation Through User Participation, Evaluation in Controlled Settings, Universal Design Principles, Designing for Diversity, User Support, Help and Documentation, Adaptive Help Systems. **Textbook 1: Ch 9: 9.1 to 9.5, Ch 10: 10.1 to 10.3, Ch 11: 11.1 to 11.4**	

Module – 5	08 Hrs
Cognitive Models, Socio-Organizational Issues and Task Analysis Cognitive Models, Hierarchical Models, Linguistic Models, Socio-Organizational Issues, Stakeholder Requirements, Task Analysis, Task Decomposition, Knowledge-Based Techniques and Entity-Relationship Based Techniques. **Textbook 1: Ch 12: 12.1 to 13.4, Ch 13: 13.1 to 13.3, Ch 15: 15.1 to 15.5,**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret human cognitive characteristics and computer technologies influencing human-computer interaction.
CO2	Analyze interaction models, interface paradigms, and user-centered design principles.
CO3	Apply usability engineering techniques, design standards, and implementation support tools for interface development.
CO4	Evaluate interactive systems using usability testing, heuristic evaluation, and accessibility guidelines.
CO5	Design human-centered solutions using cognitive models, task analysis methods, and emerging HCI concepts.

Text Books	
1	Human Computer Interaction, Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, 3rd Edition, Pearson Education, 2004, ISBN-13: 9780130461094

Reference Books	
1	*The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications,* Julie A. Jacko and Andrew SearsLawrence Erlbaum Associates, Inc., Publishers, First Edition (1st Ed.)**,** 2003**,** ISBN-13: 978-0805838389
2	Interaction Design: Beyond Human-Computer Interaction, Yvonne Rogers, Helen Sharp, Jenny Preece, John Wiley & Sons, Inc. 6th Edition, 2023. ISBN-13: 978-1119901097
3	Human-Computer Interaction: Developing Effective Organizational Information Systems, Dov Te'eni, Jane Carey, Ping Zhang, John Wiley & Sons, Inc. 1st Edition, 2007. ISBN-13: 978-0470082803

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106106177
2	https://nptel.ac.in/courses/106103115
3	https://freevideolectures.com/course/4491/nptel-introduction-humancomputer-interaction
4	https://www.iare.ac.in/sites/default/files/lecture_notes/HCI%20
5	https://mrcet.com/pdf/Lab%20Manuals/IT/R15A0562%20HCI.pdf

CO – PO MAPPING

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

Semester: VII					
Cyber-Physical and Federated AI					
Course Code	**:**	BCI724C	**Credits**	**:**	03
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	03 Hours

Prerequisites:	
Courses	Probability Statistics and Linear Algebra.
Knowledge on Fundamental Concepts	Python Programming, Data Structures & Algorithms
Knowledge on Connected Tools (If any)	Python Libraries (NumPy, SciPy, Matplotlib)

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamental concepts of Cyber-Physical Systems (CPS) and their integration with Artificial Intelligence (AI).
CLO2	Comprehend the principles and architectures of Federated Learning (FL) for distributed AI.
CLO3	Analyze security and privacy challenges in CPS and FL, and explore mitigation strategies.
CLO4	Design and implement AI models for CPS applications using federated learning approaches
CLO5	Evaluate the performance and ethical implications of Cyber-Physical AI and Federated AI systems.

Module – 1	**08 Hrs**
Introduction to Cyber-Physical Systems and AI: Definition and characteristics of CPS, components and architectures of CPS. Integration of AI with CPS, challenges and pportunities. Overview of AI paradigms for CPS: machine learning, deep learning, reinforcement learning. Case studies of AI in smart grids, smart manufacturing, and autonomous vehicles. **Text Book 1: Ch 1: 1.1-1.5, Ch 2: 2.1-2.4**	
Module – 2	**08 Hrs**
Fundamentals of Federated Learning: Introduction to Federated Learning (FL), motivations, and benefits (privacy, security, efficiency). Centralized vs. decentralized FL architectures. FL algorithms: FedAvg, FedProx, and their variants. Communication efficiency in FL. Data heterogeneity and model aggregation strategies **Text Book 2: Ch 1: 1.1-1.4, Ch 2: 2.1-2.5**	
Module – 3	**08 Hrs**
Security and Privacy in Cyber-Physical AI and Federated Learning: Threat models in CPS and FL: data poisoning, model inversion attacks, inference attacks. Privacy-preserving techniques: differential privacy, secure multi-party computation, homomorphic encryption. Robustness and Byzantine resilience in FL. Trust and accountability in distributed AI systems. **Text Book 1:Ch 5: 5.1-5.4 & Text Book 2: Ch 4: 4.1-4.6**	

Module – 4	08 Hrs
AI for Cyber-Physical System Applications: Real-time data processing and analytics in PS. Anomaly detection and fault diagnosis using AI. Predictive maintenance and intelligent control in CPS. Resource management and optimization in distributed CPS. Edge AI and TinyML for resource-constrained CPS devices. **Text Book 1: Ch 3: 3.1-3.5, Ch 4: 4.1-4.4**	
Module – 5	**08 Hrs**
Advanced Topics and Ethical Considerations: Human-in-the-loop CPS and FL. Explainable AI (XAI) for Cyber-Physical AI. Ethical implications of autonomous CPS and federated decision-making. Regulatory frameworks and societal impact. Future trends: quantum AI for CPS, blockchain-enabled FL. **Text Book 1:Ch 6: 6.1-6.3 & Text Book 2: Ch 5: 5.1-5.4**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the integration of Artificial Intelligence with Cyber-Physical Systems.
CO2	Apply federated learning algorithms to train distributed AI models.
CO3	Identify and address security and privacy issues in Cyber-Physical AI and FL.
CO4	Develop AI-driven solutions for various CPS applications.
CO5	Analyze the ethical and societal impact of Cyber-Physical AI and Federated AI.

Text Books	
1	Artificial Intelligence in Cyber-Physical Systems: Principles and Applications, Anil Kumar, et al., Taylor & Francis, 2023, ISBN: 9781003248750.
2	Federated Learning: Principles and Applications, Li, Qinbin, et al., Springer, 2021, ISBN: 9783030634471
Reference Books	
1	Cyber-Physical Systems: Foundations and Techniques, Houbing Song, et al., Wiley, 2017, ISBN: 9781119104070.
2	Intelligent Techniques for Cyber-Physical Systems, Valentina Emilia Balas, et al., CRC Press, 2023, ISBN: 9781032452869.

Web links and Video Lectures (e – Resources)	
1	TensorFlow Federated Tutorials: https://www.tensorflow.org/federated/tutorials
2	PySyft Documentation: https://pysyft.readthedocs.io/en/stable/
3	Coursera: Cyber Physical Systems Courses: https://www.coursera.org/courses?query=cyber%20physical%20systems

CO – PO MAPPING

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

Semester: VII					
Blockchain Security					
Course Code	:	BCI724D	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	PEC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Computer networks, Internet of things
Knowledge on Fundamental Concepts	AI&ML, Cryptography
Knowledge on Connected Tools (If any)	Eclipse IDE

Course Learning Objectives: This course will enable the students to	
CLO1	Interpret the fundamental concepts of Blockchain terminologies with its applications.
CLO2	Familiarize working principles of Blockchain and methodologies used in Bitcoin.
CLO3	Analyze the knowledge on Ethereum Network, Wallets, Nodes, Smart contract & DApps.
CLO4	Illustrate blockchain based application architecture using hyperledger and the smart contract lifecycle.
CLO5	Explore blockchain's role in healthcare and life sciences by analyzing finance sector implementations.

Module – 1	**08 Hrs**
Introduction: 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. **Text Book 1: Ch 1**	
Module – 2	**08 Hrs**
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. **Cryptographic primitives:** Symmetric cryptography, Asymmetric cryptography, Public and private keys, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA). **Text Book 1: Ch 2& Ch 3**	
Module – 3	**08 Hrs**
Similarity-Based Learning: 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 genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO. **Text Book 1: Ch 4 & Ch 6**	

Module – 4	08 Hrs
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), Accounts, Block, Ether, Messages, Mining, The Ethereum network. Hands-on: Clients and wallets –Geth. **Text Book 1: Ch 7**	
Module – 5	**08 Hrs**
Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media. **Hyperledger:** Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda. **Text Book 1: Ch 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the Blockchain terminologies with its applications and design.
CO2	Analyze 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	Interpret the use of Hyperledger in Blockchain Based Application Architecture.

Text Books	
1	Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities, to DeFi, NFTs and Web3, Imran Bashir, 4th Edition, 2023, Packt Publishing Ltd, ISBN-13: 978-1803241067

Reference Books	
1	Mastering Bitcoin: Programming the Open Blockchain, Andreas M. Antonopoulos, 2nd Edition, 2017, O'Reilly Media, Inc, ISBN-13: 978-1-491-95438-6
2	Bitcoin and Cryptocurrency Technologies,Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, 1st Edition, 2016, Princeton University, ISBN-13: 978-0-691-17169-2
3	Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, 1st Edition, 2017, Apress, ISBN-13: 978-1484226032

Web links and Video Lectures (e – Resources)	
1	Introduction to Blockchain Technology: https://nptel.ac.in/courses/106104220
2	Blockchain Tutorial: https://www.geeksforgeeks.org/blockchain/
3	Blockchain Simply easy Learning: https://www.tutorialspoint.com/blockchain/index.htm

CO – PO MAPPING

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

Semester: VII					
Introduction to Database Management System					
Course Code	**:**	BCS745A	**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	Programming in C/Python, Mathematics, Data Structures, Discrete Mathematics
Knowledge on Fundamental Concepts	Basic Programming Knowledge, Arrays, Set Operations, Access Methods.
Knowledge on Connected Tools (If any)	MySQL, PostgreSQL, SQLite, Microsoft SQL Server, Oracle Database

Course Learning Objectives: This course will enable the students to	
CLO1	Comprehend the basic concepts and definitions of databases and database users, including their roles in a database system.
CLO2	Construct ER diagrams using real-world scenarios to model data requirements.
CLO3	Develop and manipulate relational databases using SQL.
CLO4	Design efficient relational schemas using normalization and functional dependencies.
CLO5	Understand and apply transaction processing, concurrency control, and recovery mechanisms in databases.

Module – 1	**08Hrs**
Introduction to Databases and database users: Introduction to DBMS, Characteristics of the Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using the DBMS Approach Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment **Textbook 1:Ch. 1:** 1.1 – 1.6, **Ch. 2:** 2.1 to 2.4	
Module – 2	**08Hrs**
Data Modeling Using the Entity–Relationship (ER) Model : A Sample Database Application, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions **Relational Algebra:** Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. **Textbook 1: Ch. 3:** 3.1 to 3.7, **Ch. 8:** 8.1 to 8.5	
Module – 3	**08Hrs**
Basic Structured Query Language (SQL): SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Basic Queries in SQL; Insert, Delete and Update Statements in SQL; Schema Change Statements in SQL; Aggregate Functions and GROUP BY; Joins in SQL, Views (Virtual Tables) in SQL. **Textbook 1: Ch. 6:** 6.1 to 6.4, **Ch. 7:** 7.3 to 7.4	

Module – 4	08Hrs
Basics of Functional Dependencies and Normalization for Relational Databases: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form **Textbook 1: Ch. 14:** 14.1 to 14.7	
Module – 5	**08Hrs**
Introduction to Transaction Processing Concepts and Theory: Introduction to transaction processing; transaction and system concepts; desirable properties of transactions, transaction support in SQL **Concurrency Control & Database Recovery Techniques:** Two phase locking techniques, Concurrency control based on Timestamp ordering; Recovery concepts; NO-UNDO/REDO Recovery Based on Deferred Update **Textbook 1: Ch. 20:** 20.1 to 20.3,20.6 **Ch. 21:** 21.1 – 21.2, **Ch. 22:** 21.1 to 22.2	

Course Outcomes: After completing the course, the students will be able to	
CO1	Articulate the core concepts of DBMS including data models, architecture, and database languages.
CO2	Apply ER modeling and relational algebra to represent and manipulate real-world data.
CO3	Apply SQL to create schemas, manipulate data, enforce constraints, perform joins and aggregation, and implement views in relational databases.
CO4	Design efficient relational schemas by applying normalization techniques, functional dependencies, and decomposition principles to reduce redundancy and maintain data integrity.
CO5	Develop reliable databases by analyzing transaction management, concurrency control, and recovery techniques.

Textbook	
1	"Fundamentals of Database Systems", Elmasri and Navathe Pearson Education, 7th,Edition,2017, ISBN-13: 978-0-13-397077-7

Reference Books	
1	"Database System Concepts", Silberschatz, Korth and Sudharshan. McGraw-Hill 6th Edition,2016, ISBN 978-0-07-352332-3
2	"Database Management Systems", Raghu Ramakrishnan and Johannes Gehrke McGraw-Hill. 3rd Edition, 2003, ISBN-13: 9780072465631

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh
2	https://www.youtube.com/watch?v=sEaYXwmsLw0&list=PLyqSpQzTE6MxymXgqewlzcC3U4cdRoSu
3	https://www.w3schools.com/sql/default.asp

CO – PO – PSO MAPPING

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

Semester: VII					
Introduction to Algorithms					
Course Code	**:**	BCS745B	**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	Programming Fundamentals, Mathematics
Knowledge on Fundamental Concepts	Arrays, Strings, Structures, Pointers
Knowledge on Connected Tools (If any)	GCC, Code Blocks

Course Learning Objectives: This course will enable the students to	
CLO1	Understand algorithm design principles and analyze algorithm performance using asymptotic notations.
CLO2	Apply brute-force and divide-and-conquer techniques to solve sorting and searching problems.
CLO3	Utilize decrease-and-conquer, transform-and-conquer, and space-time tradeoff techniques for efficient problem solving.
CLO4	Apply dynamic programming and greedy methods to solve optimization and graph problems
CLO5	Explore computational complexity concepts and utilize backtracking and branch-and-bound methods for solving combinatorial problems.

Module – 1	**08Hrs**
Introduction: What is an Algorithm? Fundamentals of Algorithmic Problem Solving. **Fundamentals of the Analysis of Algorithm Efficiency:** Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Textbook 1: Ch 1:** 1.1-1.2**, Ch 2:** 2.1- 2.4	
Module – 2	**08Hrs**
Brute Force: Selection Sort, Bubble sort, Sequential Search and Brute-Force String Matching **Divide and Conquer:** Merge sort, Quick sort. **Textbook 1: Ch 3:** 3.1-3.2, **Ch 5:** 5.1,5.2,	
Module – 3	**08Hrs**
Decrease-and-Conquer: Insertion Sort, Topological Sorting. Decrease-by-a-Constant-Factor Algorithm: Binary Search. **Transform-and-Conquer:** Balanced Search Trees, Heaps and Heapsort. **Space-Time Tradeoffs:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm. **Textbook 1: Ch 4:** 4.1,4.2,4.4, **Ch 6:** 6.3,6.4**, Ch 7:** 7.1,7.2	
Module – 4	**08Hrs**
Dynamic Programming: Warshall's and Floyd's Algorithms, Knapsack Problem. **Greedy Technique:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes. **Textbook 1: Ch 8:** 8.2,8.4 **Ch 9:** 9.1-9.4	

Module – 5	08Hrs
Limitations of Algorithmic Power: Decision Trees: Comparison of three variables, Selection Sort, P, NP, and NP-Complete Problems. **Coping With Limitations of Algorithmic Power:** Backtracking: n-Queens problem, Subset-sum problem, Branch-and-Bound: Knapsack problem. **Textbook 1: Ch 11:** 11.2,11.3, **Ch 12:** 12.1,12.2	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret algorithmic problem-solving concepts and analyze algorithm performance using asymptotic analysis.
CO2	Apply brute-force and divide-and-conquer strategies to solve sorting and searching problems.
CO3	Utilize decrease-and-conquer, transform-and-conquer, and space-time tradeoff techniques in algorithm design.
CO4	Apply dynamic programming and greedy techniques to solve optimization problems.
CO5	Analyze computational complexity and apply backtracking and branch-and-bound methods to solve combinatorial problems.

Textbook	
1	"Introduction to the Design and Analysis of Algorithms", Anany Levitin, 3rd Edition (Indian), 2021, Pearson, ISBN-13: 978-0137541133.

Reference Books	
1	"Computer Algorithms/C++", Ellis Horowitz, Satraj Sahni and Rajasekaran, 2nd Edition, 2014, Universities Press, ISBN-13: 978-8173716119.
2	"Introduction to Algorithms", Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI 4th Edition 2022, ISBN 978-0-262-03384-8.
3	"Design and Analysis of Algorithms", S. Sridhar, Oxford (Higher Education), 2nd Edition, 2023, ISBN-13: 978-9354977886.

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_cs88/preview
2	https://www.geeksforgeeks.org/introduction-to-algorithms/
3	https://www.naukri.com/code360/library/types-of-algorithms-and-their-uses
4	https://topperworld.in/daa-tutorial-2/
5	https://www.youtube.com/watch?v=0IAPZzGSbME&list=PLDN4rrl48XKpZkf03iYFl-O29szjTrs_O

CO – PO – PSO MAPPING

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

Semester VII					
Software Engineering					
Course Code	**:**	BIS745C	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	OEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Programming Fundamentals, Database Structures, Object Oriented Programming with C++
Knowledge on Fundamental Concepts	Software Development Life Cycle (SDLC), Modularity and Reusability, Basic UML Diagrams
Knowledge on Connected Tools (If any)	IDS, GCC

Course Learning Objectives: This course will enable the students to	
CLO1	Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issue.
CLO2	Distinguish between various software process models and apply them to real-world scenarios.
CLO3	Infer the fundamentals of object-oriented concepts, differentiate system models, use UML diagrams
CLO4	Discuss various types of software testing practices and software evolution processes
CLO5	Recognize the importance of Project Management with its methods and methodologies

Module – 1	**08 Hrs**
Introduction: Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies. **Software Processes:** Models: Waterfall Model, Incremental Model and Spiral Model Process activities. **Requirements Engineering:** Requirements Engineering Processes, Requirements Elicitation and Analysis, Functional and non-functional requirements, The software Requirements Document, Requirements Specification Requirements validation, Requirements Management. **Textbook 1: Ch1, Ch 2, Ch 4**	
Module – 2	**08 Hrs**
Introduction, Modelling Concepts and Class Modelling: What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. **Modelling as a Design technique:** Modelling; Abstraction; The Three models. **Class Modelling:** Object and Class Concept; Link and associations concepts; Generalization and Inheritance; A sample class model; Navigation of class models. **Textbook 2: Ch 1 - 1.1-1.5, Ch 2 - 2.1-2.3 and Ch 3 - 3.1-3.5**	
Module – 3	**08 Hrs**
System Models: Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering, **Design and Implementation:** Object-oriented design using the UML, Design patterns, Implementation issues, Open source development **Textbook 1: Ch 5, Ch 7**	
Module – 4	**08 Hrs**

Software Testing: Development testing, Test-driven development, Release testing, User testing. **Software Evolution:** Evolution processes, Program evolution dynamics, Software maintenance, Legacy system management **Textbook 1 : Ch 8, Ch 9**

Module – 5	**08 Hrs**
Project Planning: Software pricing, Plan-driven development, Project scheduling, Agile Planning. Estimation techniques. **Quality management:** Software quality, Software standards, Reviews and inspections, Software measurement and metrics **Textbook 1: Ch 23, Ch 24**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Examine the importance of ethics and professionalism in software engineering
CO2	Utilize software engineering techniques to create software components that address specified requirements.
CO3	Evaluate the suitability of object-oriented models and UML diagrams for representing different software system requirements.
CO4	Analyze software testing strategies and software evolution processes to improve software reliability and performance.
CO5	Examine project planning, scheduling, and resource management techniques to support successful project execution.

Text Books	
1	Software Engineering, Ian Sommerville, 9th Edition, 2012, Pearson Education, ISBN-13: 978-0-13-703515-1 ISBN-10: 0-13-703515-2
2	Michael Blaha and James Rumbaugh, *Object-Oriented Modeling and Design with UML*, 2nd Edition, Pearson Education, 2012 (Updated Edition), ISBN-13: 978-0133002171

Reference Books	
1	Software Engineering-A Practitioners approach, Roger S. Pressman, 7th Edition, 2010, Global Publisher, ISBN 978-0-07-337597-7
2	An Integrated Approach to Software Engineering, Pankaj Jalote, 3rd Edition, 2005, Wiley India, ISBN-10: 0-387-28132-0 (eBook)

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/106/101/106101061/
2	https://archive.nptel.ac.in/courses/106/105/106105182/

CO – PO MAPPING

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

Semester: VII					
Web Technologies					
Course Code	:	BIS745D	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40L	**SEE**	:	50 Marks
Course Type	:	OEC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Introduction to Programming, Problem Solving and Algorithms
Knowledge on Fundamental Concepts	Computer Basics, Basic Logic Building, Text Editing Tools, Web and Internet Basics
Knowledge on Connected Tools (If any)	XAMPP/WAMP, Visual Studio Code, Notepad++

Course Level Objectives: Student able to	
CLO1	Understand web programming fundamentals, HTTP, security, and HTML structure.
CLO2	Illustrate HTML and XHTML syntax, structure, elements, and differences.
CLO3	Design web pages using CSS for styling, layout, and structure.
CLO4	Apply JavaScript and DOM techniques to manipulate web page elements and handle user interactions.
CLO5	Design server-side applications using PHP and web server functionalities.

Module 1	**8 Hrs**
Introduction to WEB Programming: Internet, WWW, Web Browsers, and Web Servers, URLs, MIME, HTTP, Security. Introduction to HTML, what is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements. **Textbook 1:** Ch 1 :1.1 to 1.8	
Module 2	**8 Hrs**
HTML and XHTML: Origins of HTML and XHTML, Basic syntax, Standard XHTML document structure, Basic text markup, Images, Hypertext Links, Lists, and Tables. Forms, Syntactic differences between HTML and XHTML. **Textbook 1:** Ch 2: 2.1 to 2.10	
Module 3	**8 Hrs**
CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The Box Model, Background images, tags. **Textbook 1:** Ch 3: 3.1 to 3.12	
Module 4	**8 Hrs**
What is JavaScript and What can it do? JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM),JavaScript Events. **Textbook 2:** Ch 6: 6.1 to 6.7	
Module 5	**8 Hrs**
Introduction to Server-Side Development with PHP: What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions, PHP Arrays and Super globals: Arrays, $_GET and $_POST Super global Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files. **Textbook 2:** Ch 8: 8.1 to 8.5, Ch 9: 9.1 to 9.5	

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

Text Books	
1	"Programming the World Wide Web", Robert W Sebesta, 6th Edition, Pearson Education, 2022. ISBN: 978-0137618149
2	"Fundamentals of Web Development", Randy Connolly and Ricardo Hoar, 3rd Edition, Pearson, 2022. ISBN: 978-0135863336

Reference Books	
1	"Internet & World Wide Web How to program", M.Deitel, P.J.Deitel, A.B.Goldberg, 3rd Edition, Pearson Education / PHI, 2004. ISBN: 978-0131450912
2	"Learning PHP, MySQL & JavaScript with jQuery, CSS and HTML5", Robin Nixon, 4th Edition, O"Reilly Publications, 2015. ISBN:978-9352130153
3	"PHP and MySQL Web Development", Luke Welling, Laura Thomson, 5th Edition, Pearson Education, 2016. ISBN:978-9332582736
4	"Professional JavaScript for Web Developers", Nicholas C Zakas, 3rd Edition, Wrox/Wiley India, 2012. ISBN:978-8126535088

Web links and Video Lectures (e – Resources)	
1	Fundamentals of WEB Programming: https://www.youtube.com/watch?v=DR9dr6gxhDM
2	HTML and XHTML: https://www.youtube.com/watch?v=A1XlIDDXgwg
3	CSS: https://www.youtube.com/watch?v=J35jug1uHzE
4	Java Script and HTML Documents: https://www.youtube.com/watch?v=Gd0RBdFRvF0
5	Dynamic Documents with JavaScript: https://www.youtube.com/watch?v=HTFSIJALNKc

CO – PO MAPPING

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

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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

SCHEME OF TEACHING AND EXAMINATION – B.E. –

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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

8th Semester

Computer Science and Engineering (Artificial Intelligence and Machine Learning)												
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	BCS821x	Professional Elective Course - V (Online Course) only through NPTEL / VTU MOOC / Centre Of Excellence of the concerned department	PEC		3	0	0	**3**	**50**	**50**	**100**	**3**
2	BCS842x	Open Elective Course - III (Online Course) only through NPTEL / VTU MOOC / Centre Of Excellence of the concerned department	OEC		3	0	0	**3**	**50**	**50**	**100**	**3**
3	BCS833	Internship (Industry / Research / Rural) (14 – 20 weeks)	INT		0	0	12	**3**	**100**	**100**	**200**	**8**
									200	**200**	**400**	**14**

PEC: Professional Elective Course, OEC: Open Elective Course, INT: Industry Internship / Research Internship, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Professional Elective Course – V (Online Course – only through NPTEL, suggested by BoS)

Course Code	Course Name	Course Code	Course Name
BXX821A	Programming with Generative AI (12)	BXX821C	Matlab for Numerical Computation (12)
BXX821B	Generative AI for Computer Vision (12)	BXX821D	Games and Information (12)

Open Elective Course – III (Online Course – only through NPTEL, suggested by BoS)

Course Code	Course Name	Course Code	Course Name
BXX842A	AI: Constraint Satisfaction (8)	BXX842C	Foundation of Cloud IOT Edge ML (8)

BXX842B	GPU Architectures & Programming (8)	BXX842D	User Centric Computing for Human Computer Interaction (8)

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.

Elucidation: At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship / Rural Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

Credit Definition

1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Skill Development Actives (SDA) per week = 1 Credit	04-Credits courses are to be designed for 50 hours of Teaching-Learning Session 04-Credits (IC) are to be designed for 40 hours' theory and 12-14 hours of practical sessions 03-Credits courses are to be designed for 40 hours of Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 12-15 hours of Teaching-Learning sessions