THE NATIONAL INSTITUTE OF ENGINEERING

MYSORE – 8

(Autonomous Institution under VTU)

B.E – CSE (AIML)

VII and VIII Semester

Department of Computer Science and Engineering

The National Institute of Engineering

Scheme of Teaching & Examination

Department: Computer Science and Engineering (Artificial Intelligence and Machine Learning)

B.E. 2022 Admitted Batch

VII SEMESTER

Sl. No	Type of Course	Course Code	Course Title	Teaching Department (TD)	Question Paper setting Board (PSB)	Teaching Hrs/Week				Examination				Credits
						L	T	P	S	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	BCI701	Natural Language Processing	CS	CS	3	2	0	0	03	50	50	100	4
2	IPCC	BCI702	Machine Learning - II	CS	CS	3	0	2	0	03	50	50	100	4
3	PEC	BCI713x	Professional Elective Course	CS	CS	3	0	0	0	03	50	50	100	3
4	OEC	BCI754x	Open Elective Course	CS	CS	3	0	0	0	01	50	50	100	3
5	PROJ	BCI785	Major Project	CS	CS	0	0	12	0	03	100	100	200	6
											300	**300**	**600**	**20**

Professional Elective Course

BCI713A	Scalable Data Systems	BCI713C	Data Engineering & MLOps
BCI713B	Parallel Computing	BCI713D	Big Data Analytics
BC1713E	Computer Vision		

Open Elective Course

BCI754A	Introduction to DBMS	BCI754C	Software Engineering
BCI754B	Introduction to Algorithms	BCI754D	Introduction to Machine Learning

Code: BCI701 **Course: Natural Language Processing**

Credits: 4 **L:T:P – 3:2:0**

SEE: 100 **CIE: 50**

SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	Programming Knowledge (Python), Data structures, Mathematics, Fundamentals of Automata Theory and AI& ML Basics .
Learning objectives	● Learn the importance of natural language modelling ● Understand the Applications of natural language processing ● Study spelling, error detection and correction methods and parsing techniques in NLP. ● Illustrate the information retrieval models in natural language processing

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Describe the origins, challenges, grammar structures, and applications of NLP, including Indian language processing and language models.	Understand
CO2	Apply regular expressions, FSA, and morphological parsing for word-level analysis to identify POS tags and apply context-free grammar concepts and parsing techniques for syntactic analysis	Apply
CO3	Apply Naive Bayes classifiers for text and sentiment classification and Analyze their effectiveness across different NLP tasks.	Analyze
CO5	Evaluate and compare different information retrieval models and utilize lexical resources for language processing tasks	Evaluate

Mapping with POs and PSOs:

COs	PO 1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO 9	PO10	PO1 1	PO12		PSO1	PSO2
CO1	3	2					1			2		2		3	
CO2	3	3	2	3	2					2		2		3	2
CO3	3	3	3	3	3	2	2			2				3	2
CO4	3	3	3	3	3	3	3	2	2	2				3	3

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

Course Structure

Sl. No.	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module 1				
1.1	**Overview and language modeling:** Origins and challenges of NLP-Language and Grammar.	2		
1.2	Processing Indian Languages- NLP Applications.	2		
1.3	**Language Modeling:** Statistical Language Model- N-gram model- (unigram, bigram).	2	2	
1.4	Paninion Framework, Karaka theory, Smoothing Technique.	2		
Module 2				
2.1	**Word Level Analysis**: Regular Expressions, Finite State Automata.	2		
2.2	Morphological Parsing, Spelling Error Detection and Correction.	3	2	
2.3	Words and Word Classes-Part-of Speech Tagging.	3		
Module 3				
3.1	**Syntactic Analysis:** Context-free Grammar.	2		
3.2	Constituency, top-down and bottom-up Parsing.	4	2	
3.3	CYK parsing.	2		
Module 4				
4.1	**Naive Bayes and Sentiment Classification:** Naive Bayes Classifiers, Training the Naive Bayes Classifier.	2		
4.2	Worked example, Optimizing for Sentiment Analysis.	3		
4.3	Naive Bayes for other text classification tasks, Naive Bayes as a Language Model.	3	2	
Module 5				
5.1	**Information Retrieval and Lexical Resources**: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical,	4	2	
5.2	Alternative Models of Information Retrieval- Custer model, Fuzzy model, LSTM model**,** Major Issues in Information Retrieval.	2		
5.3	**Lexical Resources**: World Net, Frame Net, Stemmers, POS Tagger- Research Corpora.	2		
	Total No. of Lecture Hours	**40**	**-**	-
	Total No. of Tutorial Hours		**10**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
2. Daniel Jurafsky, James H. Martin, “Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2023.

Reference Book:

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

Online Resources:

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw
4. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
5. https://archive.nptel.ac.in/courses/106/106/106106211/

Code: BCI702 **Course: Machine Learning-II**

Credits:4 **L:T:P-3:0:2**

SEE: 50Marks **CIE:50 Marks**

SEE Hours:03 Hours Theory/ 02 Hours LAB **Max.Marks:100**

Prerequisites if any	**Machine Learning-I**
Learning objectives	● To introduce well-posed learning problems, concept learning and Candidate-Elimination. ● To present rule-based learning methods, FOIL and explanation-based learning. ● To explain ensemble learning techniques and K-Means clustering with normalization. ● To describe vector quantization, SOM and MCMC sampling methods. ● To teach probabilistic graphical models, HMMs and filtering algorithms.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Apply foundational concept learning techniques, including Find-S and Candidate-Elimination algorithms, to identify hypotheses for well-posed machine learning problems.	Apply
CO2	Analyze rule-based and analytical learning methods to select appropriate techniques for knowledge representation and inference in machine learning.	Analyze
CO3	Apply ensemble and clustering algorithms to solve noisy data problems.	Apply
CO4	Apply Self-Organizing Maps and Markov Chain Monte Carlo methods for clustering and sampling.	Apply
CO5	Apply graphical models and inference algorithms for probabilistic reasoning and tracking	Apply

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	2	1	1	2	1	1	1	1	1	1		2	2
CO2	2	3	3	2	2	2	1	1	2	1	2	1		2	2
CO3	3	2	2	2	1	2	1	1	1	1	1	1		1	2
CO4	2	2	2	1	1	2	1	1	1	1	1	1		1	1
CO5	2	3	2	2	2	2	1	1	2	1	2	1		3	2

Mapping Strength: Strong– 3 Medium–2 Low –1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction: Well-Posed Learning Problems	1		
1.2	Designing a Learning System.	1		
1.3	Concept Learning and the General-to-Specific Ordering: A Concept Learning Task, Concept Learning as Search	2		
1.4	Find-S: Finding a Maximally Specific Hypothesis, Version Spaces	1		2
1.5	The Candidate-Elimination Algorithm	1		2
1.6	Candidate-Elimination, Inductive Bias.	2		
	Module – 2			
2.1	Learning Sets of Rules: Sequential Covering Algorithms	2		1
2.2	Learning Rule Sets: Example-Based Methods	1		1
2.3	Learning First-Order Rules	1		
2.4	FOIL: A First-Order Inductive Learner.	2		1
2.5	Analytical Learning: Perfect Domain Theories: Explanation-Based Learning	2		
	Module – 3			
3.1	Decision by Committee: Ensemble Learning: Boosting: Adaboost, Stumping	2		1
3.2	Bagging: Subagging	1		1
3.3	Random Forests	1		1
3.4	Comparison With Boosting, Different Ways To Combine Classifiers	1		
3.5	Unsupervised Learning: The K-MEANS algorithm: Dealing with Noise	1		2
3.6	The k-Means Neural Network	1		
3.7	Normalization	1		
	Module – 4			
4.1	Unsupervised Learning: Vector Quantisation, the self-organising feature map	2		1
4.2	The SOM Algorithm, Neighbourhood Connections, Self-Organisation	1		1
4.3	Markov Chain Monte Carlo (MCMC) Methods: Sampling: Random Numbers	2		
4.4	Gaussian Random Numbers	1		
4.5	The Proposal Distribution	1		
4.6	Markov Chain Monte Carlo.	1		
	Module – 5			
5.1	Graphical Models: Bayesian Networks : Approximate Inference	2		2
5.2	Markov Random Fields	1		
5.3	Hidden Markov Models (Hmms)	1		
5.4	The Forward Algorithm	1		
5.5	The Baum–Welch Or Forward–Backward Algorithm	1		
5.6	The Kalman Filter, The Particle Filter.	2		
	Total No. of Lecture Hours	**40**		
	Total No. of Tutorial Hours		**00**	
	Total No. of Practical Hours			**16**
	Total No. of Hours			**56**

Sl. No	Integrated LAB Experiments
1	Read a dataset from the user and i. Use the Find-S algorithm to find the most specific hypothesis that is consistent with the positive examples. Ii. What is the final hypothesis after processing all the positive examples?
2	Using the same dataset given in expt.no1, apply the Candidate Elimination algorithm. Determine the final version space after processing all examples (both positive and negative). What are the most specific and most general hypotheses in the version space?
3	Read a dataset and use an example-based method (such as RIPPER or CN2) to generate a set of classification rules. Apply the FOIL algorithm (First-Order Inductive Learner) to learn first-order rules for predicting.
4	Read a supervised dataset and use bagging and boosting technique to classify the dataset. Indicate the performance of the model.
5	Read an unsupervised dataset and group the dataset based on similarity based on k-means clustering.
6	Read a dataset and perform unsupervised learning using SOM algorithm.
7	Read a dataset and indicate the likelihood of an event occurring using Bayesian Networks.

Note: Each of the above experiment can be completed in 2 hours(Contact hours)

Text Books

1. Tom Mitchell ―Machine Learning, McGraw Hill, 3rd Edition, 1997.

2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Second Edition, CRC Press - Taylor and Francis Group, 2015.

Module 1: Text Book 1: Ch 1 & 2

Module 2: Text Book 1: Ch 10 & 11

Module 3: Text Book 2: Chap 13 and 14.1

Module 4: Text Book 2: Chap 14.2, 14.3, 15

Module 5: Text Book 2: Chap 16

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/106/106/106106139

https://www.youtube.com/watch?v=i_LwzRVP7bg

https://www.youtube.com/watch?v=NWONeJKn6kc

Code: BCI713A **Course: Scalable Data Systems**
Credits:3 **L:T:P-3:0:0**
SEE:50 Marks **CIE:50 Marks**
SEEHours:3 **Max.Marks:100**

Prerequisites if any	Database Management Systems, Computer Networks, Operating Systems
Learning objectives	• Understand the principles, architectures, and trade-offs in designing scalable, reliable, and maintainable data systems. • Apply distributed system concepts including replication, partitioning, and transactions to solve real-world scalability challenges. • Analyze and evaluate storage models, processing paradigms, and design strategies for batch and streaming data systems.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Explain core concepts, architectures, and trade-offs in scalable, reliable, and maintainable data systems.	Understand
CO2	Apply replication, partitioning, and transaction techniques to design distributed architectures.	Apply
CO3	Analyze storage engines, data models, and consistency mechanisms for performance and fault tolerance.	Analyze
CO4	Evaluate and recommend suitable architectures for batch and real-time data processing scenarios.	Evaluate

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	1	-	-	2		-	-
CO2	3	3	3	2	3	-	-	-	1	1	-	2		2	2
CO3	3	3	3	3	3	-	-	-	1	1	-	2		2	2
CO4	3	3	3	3	3	-	-	-	2	3	3	3		3	3

Mapping Strength: Strong–3 Medium–2 Low–1

Course Structure

Sl. No.	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module1			
1.1	Foundations of Data Systems: Data System Requirements	2	-	-
1.2	Reliability, Scalability, Maintainability	3	-	-
1.3	Data Models and Query Languages (Relational, Document, Graph)	3	-	-
	Module2			
2.1	Storage and Retrieval: Storage Engines (Log-structured, B-Trees)	2	-	-
2.2	SSTables and LSM Trees	3	-	-
2.3	File Formats and Data Encoding	3	-	-
	Module3			
3.1	Distributed Systems Basics: Replication: Leader-based, Multi-leader, Leaderless	4	-	-
3.2	Consistency and Consensus (Paxos, Raft)	4	-	-
	Module4			
4.1	Partitioning and Transactions: Partitioning Strategies and Rebalancing	2	-	-
4.2	Transactions and Isolation Levels	3	-	-
4.3	Distributed Transactions	3	-	-
	Module5			
5.1	Stream Processing and Final Design Principles: Batch vs Stream Processing	2	-	-
5.2	Event Sourcing and CQRS	3	-	-
5.3	Fault tolerance and architecture trade-offs	3	-	-
	Total No of Lecture Hours	**40**	**-**	-
	Total No. Of Tutorial Hours		**0**	-
	Total No. of Practical Hours			**0**

Textbook:

1.*Designing Data-Intensive Applications*, Martin Kleppmann, O'Reilly Media, 2017.

Reference Book:

1. *Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing*, Tyler Akidau, SlavaChernyak, Reuven Lax, O'Reilly Media, 2018.

Online Resources:

1. MITOpenCourseWare - https://ocw.mit.edu/courses/6-824-distributed-computer-systems-engineering-spring-2006/pages/lecture-notes/

Code: BCI713B **Course: Parallel Computing**

Credits: 4 **L:T:P - 3:0:0**

SEE: 100 Marks **CIE: 100 Marks**

SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Computer organization, C programming
Learning objectives	• To explore the need for parallel programming • To familiarize MIMD systems, parallelism in MPI library, OpenMP pragma and directives

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss basic concepts of Parallel Computing	Understand
CO2	Apply OpenMP and MPI concepts to write parallel programs	Apply
CO3	Analyze different parallel computing architectures parallel programming models to identify suitability for specific computational problems.	Analyze
CO4	Evaluate speedup, efficiency, and scalability trends of parallel programs by interpreting performance metrics.	Evaluate

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	1	-	-		-	-	2	-	-	-	3		-	-
CO2	3	3	3	2	2	-	2	-	2	2	2	3		3	2
CO3	3	3	2	3	2	-	1	-	2	2	2	3		2	2
CO4	3	3	2	3	2	-	1	2	2	2	2	3		2	2

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1: Introduction to parallel programming, Parallel hardware and parallel software				
1.1	Classifications of parallel computers, SIMD, MIMD	2		
1.2	Interconnection networks	2		
1.3	Cache coherence	2		
1.4	Coordinating the processes/threads,	1		
1.5	Shared-memory, Distributed-memory	1		
Module – 2: GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance				
2.1	Speedup and efficiency in MIMD systems	2		
2.2	Amdahl's law	2		
2.3	Scalability in MIMD systems	2		
2.4	Taking timings of MIMD programs	1		
2.5	GPU performance.	1		
Module – 3: Distributed memory programming with MPI				
3.1	MPI functions	2		
3.2	The trapezoidal rule in MPI	1		
3.3	Dealing with I/O, Collective communication	2		
3.4	MPI-derived datatypes, Performance evaluation of MPI programs	2		
3.5	A parallel sorting algorithm	1		
Module – 4: Shared-memory programming with OpenMP				
4.1	Openmp pragmas and directives	2		
4.2	The trapezoidal rule	1		
4.3	Scope of variables, The reduction clause	1		
4.4	Loop carried dependency, scheduling, producers and consumers	2		
4.5	Caches, cache coherence and false sharing in openmp, tasking, thread safety.	2		

Module – 5: GPU programming with CUDA				
5.1	GPUs and GPGPU, GPU architectures	2		
5.2	Heterogeneous computing, Threads, blocks, and grids	2		
5.3	Nvidia compute capabilities and device architectures, Vector addition	2		
5.4	Returning results from CUDA kernels, CUDA trapezoidal rule I,	1		
5.5	CUDA: trapezoidal rule II: improving performance, rule III: blocks with more than one warp	1		
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Peter S Pacheco, Matthew Malensek – An Introduction to Parallel Programming, second Edition, Elsevier Morgan Kauffman publictions

Reference Book:

1. Michael J Quinn – Parallel Programming in C with MPI and OpenMp, McGrawHill

Online Resources:

https://ocw.mit.edu/courses/18-337j-parallel-computing-fall-2011/

https://cc.iitm.ac.in/hpce/introductiontoparallelcomputing.html

Code: BCI713C **Course: Data Engineering and MLOps**

Credits:3 **L:T:P-3:0:0**

SEE:50 Marks **CIE:50 Marks**

SEE Hours:3 **Max.Marks:100**

Prerequisites if any	Python Programming, Database Management System, Foundations of Machine Learning
Learning objectives	• Understand the principles, architectures, and tools for designing and managing scalable data engineering workflows. • Apply ETL, orchestration, and automation techniques to build and maintain efficient data pipelines. • Evaluate and implement MLOps practices for reliable deployment, monitoring, and maintenance of machine learning models.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Explain architectures, components, and best practices in data engineering workflows.	Understand
CO2	Design and implement ETL/ELT pipelines using Python, databases, and modern data frameworks.	Apply
CO3	Apply workflow orchestration and automation techniques using tools such as Airflow and Prefect.	Apply
CO4	Evaluate and deploy MLOps pipelines for continuous integration, delivery, and monitoring of machine learning models.	Evaluate

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	1	-	-	2		-	-
CO2	3	3	3	2	3	-	-	-	1	1	-	2		2	2
CO3	3	3	3	3	3	-	-	-	1	1	-	2		3	3
CO4	3	3	3	3	3	-	-	-	2	3	3	3		3	3

Mapping Strength: Strong–3 Medium–2 Low–1

Course Structure

Sl. No.	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module1			
1.1	Introduction to Data Engineering: Data lifecycle	1	-	-
1.2	Role of data engineer	2	-	-
1.3	Architectures and infrastructure	3	-	-
1.4	Batch vs streaming	2	-	-
	Module2			
2.1	Data Modeling and Storage: Data types and formats	2	-	-
2.2	Database design	2	-	-
2.3	Normalization and data lakes	2	-	-
2.4	SQL and NoSQL systems	2	-	-
	Module3			
3.1	Building ETL and ELT Pipelines: ETL concepts	1	-	-
3.2	Python for data pipelines	2	-	-
3.3	Pandas, SQLAlchemy	3	-	-
3.4	Data validation	2	-	-
	Module4			
4.1	Workflow Orchestration and Automation: Airflow and Prefect	2	-	-
4.2	Scheduling and monitoring	2	-	-
4.3	Data pipeline failures	2	-	-
4.4	Logging and alerting	2	-	-
	Module5			
5.1	Introduction to MLOps: CI/CD for ML	1	-	-
5.2	Model packaging and deployment	3	-	-
5.3	Monitoring ML systems	2	-	-
5.4	Real-world examples	2	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**0**	-
	Total No. of Practical Hours			**0**

Textbook:

1. Data Engineering with Python, Paul Crickard, Packt Publishing, 2020.

ReferenceBook:

1. Machine Learning Engineering, AndriyBurkov, True Positive Inc., 2020.

Online Resources:

1. Coursera Course Link: https://www.coursera.org/specializations/mlops-machine-learning-duke

Code: BCI713D **Course: Big Data Analytics**

Credits: 3 **L: T: P-3:0:0**

SEE: 50 **CIE: 50**

SEE Hours: 03 **Max.Marks:100**

Prerequisites if any	Programming skills in languages commonly used in data analytics, such as Python, SQL, or Java, as well as familiarity with data manipulation libraries and frameworks.
Learning objectives	• To understand and apply the concepts of Big data analytics Hadoop eco-system • To enable students to develop applications using databases and built in Functions of Hive

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom's level**
CO1	Describe the fundamentals of Big Data and associated technologies for managing large-scale datasets, including the Hadoop ecosystem.	Understand
CO2	Analyze the architecture and components of the Hadoop ecosystem, including HDFS, MapReduce, and NoSQL systems like HBase.	Analyze
CO3	Apply MapReduce programming model and virtualization concepts to process large datasets effectively.	Apply
CO4	Analyze YARN and Hive architectures for managing resources and querying Big Data using distributed computing frameworks.	Analyze

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	-	-	-	-	-	1	-	2	2	3		2	-
CO2	3	2	1	1	3	-	-	1	-	3	2	3		2	1
CO3	3	2	1	3	3	-	-	1	-	2	2	3		2	1
CO4	3	2	1	3	3	-	-	1	-	3	2	3		2	1

Mapping Strength: Strong–3 Medium–2 Low –1

Course Structure

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module–1: Getting an Overview of Big Data:				
1.1	**Getting an Overview of Big Data**: What is Big Data, History of Data Management – Evolution of Big Data, Structuring Big Data, Types of Data,	2		
1.2	Elements of Big Data: Volume, Velocity, Variety, Veracity, Big Data Analytics, Advantages of Big Data Analytics	2		
1.3	**Exploring the concept of Big Data in Business context**: Use of Big Data in Social Networking, Use of Big Data in Preventing Fraudulent Activities,	2		
1.4	Use of Big Data in Retail Industry, Future of Big Data in Automation Industry	2		
Module–2: Introducing Technologies for Handling Big Data and Hadoop Ecosystem				
2.1	**Introducing Technologies for Handling Big Data and Hadoop Ecosystem**: Distributed and Parallel Computing for Big Data, Introducing Hadoop, How does Hadoop Function?	2		
2.2	Cloud Computing and Big Data, Features of Cloud Computing, Cloud Deployment Models, Cloud Delivery Models,	1		
2.3	Cloud Services for Big Data,Cloud Providers in Big Data Market, In-Memory Computing Technology for Big Data	1		
2.4	**Understanding Hadoop Ecosystem:** Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Features of HDFS	2		
2.5	MapReduce, Features of MapReduce, Hadoop YARN,	1		
2.6	Introduction to HBase, Hive Sqoop and Flume	1		
Module–3:Understanding MapReduce Fundamentals and HBase				
3.1	**Understanding MapReduce Fundamentals and HBase**: The MapReduce Framework	1		
3.2	Exploring the Features of MapReduce	1		
3.3	Working of MapReduce, Exploring Map and Reduce Functions	1		
3.4	Techniques to Optimize MapReduce Jobs, Hardware/Network Topology,	1		
3.5	Synchronization, File System, Uses of MapReduce,	1		
3.6	Role of HBase in Big Data Processing,	1		
3.7	Characteristics of HBase	1		
3.8	Installation of HBase	1		
Module–4:BigDataTechnology and Analytics , MapReduce and Hadoop YARN Architecture				
4.1	**Understanding Big Data Technology**: Exploring the Big Data Stack, Virtualization and Big Data,	1		

4.2	Virtualization Approaches.	1		
4.3	**Processing Your Data with Map Reduce:** Developing a Simple MapReduce Application	1		
4.4	Points to Consider while designing MapReduce	1		
4.5	**Understanding Hadoop YARN Architecture:** Background of YARN, YARN Architecture, Working of YARN	1		
4.6	YARN Schedulers, Backward Compatibility with YARN	1		
4.7	YARN Configurations, YARN Commands, Yarn Containers	1		
4.8	**Understanding Analytics and Big Data**: Comparing Reporting and Analysis ,Reporting Analysis	1		
4.9	The Analytic Process,	1		
4.10	Types of Analytics	1		
Module–5:Exploring Hive				
5.1	**Exploring Hive**: Introducing Hive,	1		
5.2	Hive Services	2		
5.3	Data Types in Hive	1		
5.4	Built-In Functions in Hive	1		
5.6	Hive DDL, Data Manipulation in Hive	1		
5.7	Data Retrieval in Hive, Using Joins in Hive	1		
5.8	Getting Started with Hive Installation	1		
	Total No .of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

1. Big Data: Black Book, DT Editorial Services, Wiley India Pvt Ltd,2015 Edition

ReferenceBook:

1. Big Data Analytics with R and Hadoop, Vignesh Prajapati, -PacktPublishing,2013
2. Michael Minelli, Michehe Chambers,—Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today_s Business‖, 1st Edition, Ambiga Dhiraj, Wiley CIO Series, 2013.
3. Bill Franks, —Taming theBig DataTidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, 1st Edition, Wiley and SAS Business Series, 2012.
4. TomWhite, —Hadoop:TheDefinitiveGuide‖,3rd Edition,O_reilly,2012.
5. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services, Wiley India Pvt Ltd, 2013

OnlineResources:

1.https://nptel.ac.in/courses/106104189

Code: BCI713E **Course: Computer Vision**

Credits:3 **L:T:P - 3:0:0**

SEE: 100 Marks **CIE: 100 Marks**

SEE Hours: 3 **Max. Marks:100**

Prerequisites if any	Deep learning
Learning objectives	Course objectives: 1) To introduce the fundamental concepts, theories, and applications of computer vision. 2) To develop an understanding of image formation, processing, and classical vision algorithms for analysis and feature extraction. 3) To provide knowledge of deep learning architectures and their application to computer vision problems. 4) To enable students to apply transfer learning techniques for building efficient and practical vision-based solutions.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Explain the principles of image formation, representation, and fundamental image processing operations in computer vision.	Understand
CO2	Apply classical image processing and segmentation techniques to extract features from digital images.	Apply
CO3	Analyse convolution neural networks and deep learning models to solve computer vision problems.	Analyze
CO4	Develop and evaluate computer vision-based applications using transfer learning approaches	Evaluate

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	2	1	2	-	-	-	-	-	-	-	2		2	1
CO2	3	3	2	2	2	-	-	-	2	2	2	3		3	2
CO3	3	3	3	2	3	-	-	-	2	3	3	3		3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3		3	3

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Sl. No.	Module Name	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	Introduction: What is computer vision?, Brief History	2		
1.2	Image Formation: Photometric image formation	2		
1.3	The digital camera	1		
1.4	Image processing: Point operators	1		
1.5	Linear filtering.	1		
	Module – 2			
2.1	Image processing: More neighborhood operators,	2		
2.2	Fourier transforms	2		
2.3	Pyramids and wavelets	2		
2.4	Geometric transformations	2		
	Module – 3			
3.1	Image Segmentation: Fundamentals	1		
3.2	Point, Line and edge detection,	2		
3.3	Thresholding (Foundation & Basic global thresholding only)	1		
3.4	Segmentation by region growing & region splitting & merging.	2		
3.5	Feature Extraction: Background	1		

	Boundary preprocessing (Boundary following & Chain codes only).	2		
Module – 4				
4.1	Deep Learning for Computer Vision : Deep neural networks,	2		
4.2	Convolutional Neural Network,	3		
4.3	More complex Models.	3		
Module – 5				
5.1	Transfer learning: Definition of Transfer learning	1		
5.2	Fundamental problems in Transfer learning, negative transfer learning,	2		
5.3	A complete transfer learning process.	1		
5.4	Pretraining and Fine-tuning. Transfer learning for computer vision.	2		
5.5	Recognition: Instance recognition, Image classification	2		
	Total No. of Lecture Hours	**40**	**-**	**-**
		Total No. of Tutorial Hours	**10**	**-**
			Total No. of Practical Hours	**00**

Textbook:

1. Richard Szeliski, Computer Vision: Algorithms and Applications (Texts in Computer Science), 2nd Edition, 2022, Springer.
2. Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Pearson, 4th edition, 2019.
3. Jindong Wang and Yiqiang Chen, Introduction to Transfer Learning: Algorithms and Practice, 2023, Springer.

Reference books

1. David Forsyth and Jean Ponce, Computer Vision: A Modern Approach, 2nd Edition, Pearson, 2015.
2. Reinhard Klette, Concise Computer Vision - An Introduction into Theory and Algorithms, Springer, 2014.

Code: BCI754A **Course: Introduction to DBMS**

Credits: 3 **L:T:P- 3:0:0**

SEE: 100 Marks **CIE:100 Marks**

SEE Hours: 3 **Max.Marks:100**

Prerequisites if any	NIL
Learning objectives	• Understand the fundamental concepts of databases, including database languages, architectures, and conceptual data modeling using entities and relationships. • Gain proficiency in relational database management systems, including the relational model, relational algebra, normalization, SQL, transaction processing.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	**Course Outcomes**	**Bloom'slevel**
CO1	Describe fundamental concepts of database management systems, including architecture, languages, and functionalities.	Understand
CO2	Design and implement database schemas using entities, relationships, and normalization techniques.	Apply
CO3	Demonstrate proficiency in SQL for data manipulation, retrieval, and management tasks.	Apply
CO4	Analyzeandcompareconcurrencycontrolmechanismsinrelationaldatabasesand NoSQL databases, understanding their respective advantages and limitations.	Analyze

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-		-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-		2	2
CO3	2	2	2	-	3	-	-	-	-	-	-	2		2	3
CO4	2	-	-	-	3	-	-	-	-	-	-	3		2	2

Mapping Strength: Strong–3 Medium–2 Low –1

Course Structure

Sl. No	Modules	No.of Lecture Hours	No.of Tutorial Hours	No.of Practical Hours
	Module–1:Introduction to Databases			
1.1	**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.	2	-	0
1.2	**Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence. Database languages, and interfaces, The Database System environment.	3	-	0
1.3	**Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams, Specialization and Generalization	3	-	1
	Module–2:Relational Databases			
2.1	**Relational Model:** Relational Model Concepts, Relational Model Constraints and Relational database schemas, Update operations, transactions, and dealing with constraint violations.	3	-	0
2.2	**Relational Algebra:** Unary and Binary relational operations, additional relational Operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.	3	-	0
2.3	**Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping	2	-	0
	Module–3: Normalization and SQL			
3.1	**Normalization:** Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.	5	-	1
3.2	**SQL:** SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL.	3	-	2
	Module–4:SQL and Transactions			
4.1	**SQL:** Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.	3	-	2
4.2	**Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions,	5	-	1

	Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.			
Module–5: Concurrency control and NoSQL Databases				
5.1	**Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multi version Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.	4	-	1
5.2	**NoSQL Databases and Big Data Storage Systems:** Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems.	4	-	2
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**10**

Textbook:

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B.Navathe, 7thEdition, 2017, Pearson.

Reference Book:

1. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

Online Resources:

1. MIT OpenCourseWare Course Link :

https://ocw.mit.edu/courses/6-830-database-systems-fall-2010/

2. IIT Kharagpur Course Link:

https://cse.iitkgp.ac.in/~pabitra/course/dbms/dbms_new.html

3. NPTEL Course Link:

https://onlinecourses.nptel.ac.in/noc22_cs91/preview

Code: BCI754B **Course: Introduction to Algorithms**

Credits: 3 **L:T:P-3:0:0**

SEE: 50Marks **CIE: 50Marks**

SEE Hours: 03 **Max.Marks:100**

Prerequisites if any	Recurrence Relations , Data Structures
Learning objectives	• To learn the methods for analyzing algorithms and evaluating their performance. • To demonstrate the efficiency of algorithms using asymptotic notations. • To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound. • To learn the concepts of P and NP complexity classes

Course Outcomes:*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom'slevel
CO1	Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.	Analyze
CO2	Demonstrate Brute force, divide & conquer approaches and decrease & conquer approaches to solve computational problems	Apply
CO3	Make use of transform &conquer, dynamic programming and greedy approaches to solve the given real world or complex computational problems.	Apply
CO4	Illustrate backtracking, branch & bound and P,NP and NP Complete problems	Apply

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1		3	2
CO2	3	2	3	-	-	-	-	-	-	-	-	1		3	2
CO3	2	2	3	-	-	-	-	-	-	-	-	1		3	2
CO4	2	2	3	-	-	-	-	-	-	-	-	1		3	2

Mapping Strength: Strong_3 Medium_2 Low_1

Sl. No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module - 1			
1	**INTRODUCTION:**			
1.1	What is an Algorithm?	1	-	-
1.2	Fundamentals of Algorithmic Problem Solving.	2	-	-
	FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY:			
1.3	Analysis Framework	1	-	-
1.4	Asymptotic Notations and Basic Efficiency Classes	1	-	-
1.5	Mathematical Analysis of Non recursive Algorithms	1	-	-
1.6	Mathematical Analysis of Recursive Algorithms.	1	-	-
	BRUTE FORCE APPROACHES:			
1.7	Selection Sort	1	-	-
1.8	Sequential Search	1	-	-
	Module_2			
	BRUTE FORCE APPROACHES(contd..):			
2.1	Brute Force String Matching	1	-	-
2.2	Exhaustive Search (Travelling Salesman problem)	1	-	-
2.3	Exhaustive Search (Knapsack Problem).	1	-	-
	DECREASE-AND-CONQUER:			
2.4	Topological Sorting.	1	-	-
	DIVIDE AND CONQUER:			
2.5	Merge Sort	1	-	-
2.6	Quick Sort	1	-	-
2.7	Strassen'sMatrix Multiplication.	2	-	-
	Module_3			
	TRANSFORM-AND-CONQUER:			
3.1	Balanced Search Trees	2	-	-
3.2	Heaps and Heapsort.	3	-	-
	SPACE-TIME TRADE OFFS:		-	-
3.3	Input Enhancement in String Matching: Horspool'sAlgorithm.	3	-	-
	Module_4:			
	DYNAMICPROGRAMMING:			
4.1	The Knapsack Problem and Memory Functions	2	-	-

4.2	Warshall'sand Floyd'sAlgorithms.	2	-	-
	THEGREEDYMETHOD:			
4.3	Prim's Algorithm	2	-	-
4.4	Kruskal's Algorithm	1	-	-
4.5	Dijkstra's Algorithm	1	-	-
	Module_5			
	LIMITATIONSOFALGORITHMICPOWER:			
5.1	Decision Trees	2	-	-
	COPINGWITHLIMITATIONSOFALGORITHMICPOWER:			
5.2	Backtracking (n-Queens problem)	2	-	-
5.3	Backtracking(Subset-sum problem)	2	-	-
5.4	Branch-and-Bound (Travelling Salesman Problem),	1	-	-
	Total No. of Lecture Hours	**40**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Course Structure

Textbook

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.

Reference books

1. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
3. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

Online Resources:

- Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/

Course Code: BCI754C **Course: Software Engineering**

Credits: 3 **L:T:P - 3:0:0**

SEE: 50% **CIE: 50%**

SEE Hours: 3 **Max. Marks: 100**

Prerequisites if any	NIL
Learning objectives	1. Learn the fundamentals of software engineering process and process models 2. Learn to use appropriate analysis and modeling techniques for building a software systems for real world problems 3. Learn to validate the software systems using testing strategies 4. Use suitable software project estimation model for developing software

Course Outcomes:

On successful completion of the course, the student will be able to:

COs	Course Outcomes	Bloom's level
CO1	Describe the fundamentals of Software Engineering Process and Process Models.	Understand
CO2	Discuss requirement engineering tasks.	Understand
CO3	Prepare quality software system using design principles.	Apply
CO4	Use software testing techniques to perform system validations.	Apply
CO5	Apply an effective software project estimation model for developing software product.	Apply

Mapping with POs and PSOs

COs	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	2	2	-	2		-	-
CO2	3	2	-	-	2	-	-	-	-	-	2	2		2	-
CO3	-	-	3	-	2	-	-	-	2	2	-	2		3	-
CO4	3	-	-	2	-	-	-	-	-	-	-	2		-	2
CO5	3	3	3	2	-	2	-	2	2	2	2	2		-	3

Mapping Strength: Strong-3 Medium-2 Low -1

Course Structure

Sl. No.	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module -1				
1.1	Introduction to Software engineering	2	-	-
1.2	The Software Process: Software Engineering, A Layered Technology, A Process Frame Work, Capability Maturity Model Integration	3	-	-
1.3	Process Models: Incremental Process Models, Evolutionary Process Models	3	-	-
Module – 2				
2.1	Agile View of Process: Agility, Agile Process, Agile Process Model	3	-	-
2.2	Requirement Engineering: Requirement Engineering Tasks, Initiating Requirement Engineering Process, Developing USE-CASE	4	-	-
Module – 3				
3.1	Building The Analysis Model: Requirement Analysis, Analysis Modeling Approach, Data Modeling concept, Scenario Based Modeling, Flow Based Modeling, and Behavioral Modeling	4	-	-
3.2	Design Engineering: Design Process and Design Quality, Design Concepts	4	-	-
3.3	Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns	3	-	-
	Module-4			
4.1	Testing Strategies: A Strategic Approach to Software Testing, Test Strategies for Conventional Software, validation testing	3	-	-
4.2	Testing Tactics: Software Testing Fundamentals, Black Box & White Box Testing, Basis Path Testing, Black Box Testing	4	-	-
Module – 5				
5.1	Project Management: Project Management Spectrum, People, Product, Process, Project	3	-	-
5.2	Software Project Estimation: Decomposition Techniques, Empirical Estimation Models	3	-	-
5.3	Report writing	1	-	
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**0**	**-**
	Total No. of Practical Hours			**-**

Text Books:

1. Software Engineering: A Practitioners Approach – Roger S. Pressman, 7th Edition, McGraw-Hill 2010

Reference Books:

1. Software Engineering: Ian Somerville, 10th Edition, Pearson Education, 2016.
2. Software Engineering Theory and Practice: Shari Lawrence Pfleeger, Joanne M. Atlee, 3rd Edition, Pearson Education, 2006.
3. Software Engineering Principles and Practice: Waman S Jawadekar, Tata McGraw Hill, 2004

Online Resources:

1. *https://www.digimat.in/nptel/courses/video/106101061/L01.html*
2. *https://www.digimat.in/nptel/courses/video/106105182/L01.html*
3. *https://www.coursera.org/learn/software-processes-and-agile-practices*

Course Code:BCI754D **Course: Introduction to Machine Learning**

Credits:3 **L:T:P-3:0:0**

SEE: 50Marks **CIE:50 Marks**

SEEHours:3 **Max.Marks:100**

Pre requisites if any	Programming Language, Mathematics foundations (Linear algebra, Probability, Statistics)
Learning objectives	• To introduce the fundamental concepts and techniques of machine learning. • To understand the various types of machine learning and the challenges faced in real-world applications. • To familiarize with machine learning algorithms such as regression, decision trees, Bayesian models, and clustering. • To explore advanced concept like reinforcement learning and enable students to model and evaluate machine learning solutions for different types of problems

Course Outcomes: *On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Describe the machine learning techniques, their types and Applications.	Understanding
CO2	Apply mathematical concepts for feature engineering and perform dimensionality reduction to enhance model performance.	Apply
CO3	Develop similarity-based learning models for solving classification and prediction tasks.	Apply
CO4	Develop regression models, decision tree models and Bayesian models for solving classification and prediction tasks.	Apply
CO5	Utilize clustering algorithms to identify patterns in data and implement reinforcement learning techniques	Apply

Mapping with Pos and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	1	2	1	2	1	1	1	1	1	1	2		1	1
CO2	3	2	2	3	3	1	1	1	1	1	1	2		1	1
CO3	3	3	3	2	2	1	1	1	1	1	1	2		2	2
CO4	3	3	3	2	2	1	1	1	1	1	1	2		2	2
CO5	3	2	2	2	3	1	1	1	1	1	1	2		2	2

Mapping Strength: Strong– 3 Medium–2 Low –1

Course Structure

Sl.No	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
	Module – 1			
1.1	**Introduction:** Need for Machine Learning, Machine Learning Explained	1	-	-
1.2	Machine Learning in Relation to other Fields	1	-	-
1.3	Types of Machine Learning	3	-	-
1.4	Challenges of Machine Learning, Machine Learning Process	1	-	-
1.5	Machine Learning Applications	1	-	-
	Module–2			
2.1	**Understanding Data:** Introduction	2	-	-
2.2	Big Data Analysis Framework	1	-	-
2.3	Descriptive Statistics	1	-	-
2.4	Bivariate Data and Multivariate Data	1	-	-
2.5	Multivariate Statistics	1	-	-
2.6	Essential Mathematics for Multivariate Data (Only Linear Systems and Gaussian Elimination for Multivariate Data, Matrix Decompositions	2	-	-
2.7	Feature Engineering and Dimensionality Reduction Techniques (only Introduction)	1	-	-
	Module–3			
3.1	**Basic Learning Theory:** Design of Learning System,	1	-	-
3.2	Introduction to Concept of Learning	1	-	-
3.3	Find-S Algorithm	1		
3.4	**Similarity-based Learning:** Nearest-Neighbor Learning	1	-	-
3.5	Weighted K-Nearest-Neighbor Algorithm	1	-	-
3.6	Nearest Centroid Classifier	1	-	-
	Module – 4			
4.1	**Regression Analysis:** Introduction to Regression, Introduction to Linear Regression	1	-	-
4.2	Multiple Linear Regression	1	-	-
4.3	Polynomial Regression	1	-	-
4.4	Logistic Regression	1	-	-
4.5	**Decision Tree Learning:** Introduction to Decision Tree Learning Model	1	-	-

4.6	Decision Tree Induction Algorithms **(**Only ID3 Tree construction)	2	-	-
4.7	**Bayesian Learning:** Introduction to Probability-based Learning, Fundamentals of Bayes Theorem	1	-	-
4.8	Classification Using Bayes Model (Only Naïve Bayes Algorithm)	2	-	-
	Module–5			
5.1	**Clustering Algorithms:** Introduction to Clustering Approaches	1	-	-
5.2	Hierarchical Clustering Algorithms (Only Single Linkage or MIN Algorithm and Complete Linkage or MAX or Clique)	2	-	-
5.3	Partitional Clustering Algorithm; K-Means Algorithm	2	-	-
5.4	**Reinforcement Learning:** Overview of Reinforcement Learning, Scope of Reinforcement Learning	1	-	-
5.5	Reinforcement Learning as Machine Learning, Components of Reinforcement Learning	1	-	-
5.6	Q-Learning	1	-	-
	Total No.of Lecture Hours	**40**	-	-
	Total No.of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Text Book

1. S Sridhar, M Vijayalakshmi, “Machine Learning”, OXFORD University Press 2021, First Edition.

Module 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7

Module 2: 2.1, 2.3, 2.4, 2.6, 2.7, 2.8.1, 2.8.2, 2.10(only introduction)

Module 3: 3.3, 3.4, 4.2, 4.3, 4.4

Module 4: 5.1, 5.3, 5.5, 5.6, 5.7, 6.1, 6.2.1, 8.1, 8.2, 8.3.1

Module 5: 13.1, 13.3.1, 13.3.2, 13.4, 14.1, 14.2, 14.3, 14.4, 14.9

Reference Books

1. Murty, M. N., and V. S. Ananthanarayana. Machine Learning: Theory and Practice, Universities Press,

2024.

2. T. M. Mitchell, “Machine Learning”, McGraw Hill, 1997.

3. Burkov, Andriy. The hundred-page machine learning book. Vol. 1. Quebec City, QC, Canada: Andriy

Burkov, 2019.

Web links and Video Lectures (e-Resources):

1. https://www.universitiespress.com/resources?id=9789393330697
2. https://www.drssridhar.com/?page_id=1053
3. Machine Learning Tutorials: https://www.geeksforgeeks.org/machine-learning/
4. Machine Learning Tutorials: https://www.tutorialspoint.com/machine_learning/index.htm
5. Python for Machine Learning: https://www.w3schools.com/python/python_ml_getting_started.asp
6. Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc22_cs29/preview

Course Code: BCI785 **Course: Major Project**

Credits: 6 **L:T:P-0:0:12**

SEE: 100 Marks **CIE: 100 Marks**

SEE Hours: 3 **Max.Marks: 200**

Prerequisites if any	Programming languages, data structures and algorithms, and core computer science concepts
Learning objectives	1.To effectively utilize oral, written and visual communication 2.To Demonstrate skill and knowledge of current tools and techniques specific to the professional field of study. 3.To creatively Identify, analyze and solve real world problems through critical investigation. 4.To foster a collaborative environment that enhances teamwork and collective success

Course Outcomes: *On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Understand research problems by conducting a comprehensive literature review and critically analyzing existing work to identify research gaps.	Understand
CO2	Apply theoretical knowledge to design and implement effective and innovative solutions for identified problems.	Apply
CO3	Analyze the implementation of proposed designs using appropriate methodologies and tools by testing for functionality, efficiency, accuracy, reliability, and performance.	Analyze
CO4	Evaluate and enhance technical writing skills by preparing a comprehensive project report and validating the work for possible publication in reputed journals or conferences.	Evaluate
CO5	Create and present original project outcomes by integrating research, design, implementation, and documentation to deliver innovative solutions for real-world problems.	Create

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	2	-	-	-	2	2	-	2	2	2
CO2	3	3	3	2	3	2	2	1	3	2	2	3	3	3
CO3	3	3	3	3	3	2	2	-	3	-	2	3	3	3
CO4	3	-	-	2	3	2	2	2	3	3	2	2	2	2
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	3

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**

The National Institute of Engineering														
Scheme of Teaching & Examination														
Department: Computer Science and Engineering (AIML)														
B.E. 2022 Admitted Batch														
VIII SEMESTER														
Sl.No	**Type of Course**	**Course Code**	**Course Title**	**Teaching Department (TD)**	**Question Paper setting Board (PSB)**	**Teaching Hrs/Week**				**Examination**				**Credits**
						L	**T**	**P**	**S**	**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
1	PEC	BCI801X	Professional Elective - Course Group IV (Online Course)	CS	CS	-	-	-		-	-	100	100	**3**
2	OEC	BCI802X	Open Elective Course Group III (Online Course)	CS	CS	-	-	-		-	-	100	100	**3**
3	INT	BCI803	Internship (Industry/ Research) (14-20 weeks)	CS	CS	0	0	20		3	100	100	200	**10**
Total											**100**	**300**	**400**	**16**

Professional Elective Courses Group IV (online)

SL No	Course / Title Name	URL iD	Credits
1	Advanced Computer Networks	https://online.vtu.ac.in/course-details/advanced-computer-networks	3
2	Circuit Complexity Theory	https://online.vtu.ac.in/course-details/circuit-complexity-theory	3
3	Computational Number Theory and Algebra	https://online.vtu.ac.in/course-details/computational-number-theory-and-algebra	3
4	Parallel Computer Architecture	https://online.vtu.ac.in/course-details/parallel-computer-architecture	3
5	Quantum Algorithms and Cryptography	https://online.vtu.ac.in/course-details/quantum-algorithms-and-cryptography	3
6	Switching Circuits and Logic Design	https://online.vtu.ac.in/course-details/switching-circuits-and-logic-design	3
7	Affective Computing	https://online.vtu.ac.in/course-details/Affective-Computing	3
8	Foundations of Cyber Physical Systems	https://online.vtu.ac.in/course-details/Foundations-of-Cyber-Physical-Systems	3
9	GPU Architectures and Programming	https://online.vtu.ac.in/course-details/GPU-Architectures-And-Programming	3
10	Reinforcement Learning	https://online.vtu.ac.in/course-details/Reinforcement-Learning	3
11	Secure Computation: Part I	https://online.vtu.ac.in/course-details/Secure-Computation-Part-I	3
12	Social Networks	https://online.vtu.ac.in/course-details/Social-Networks	3
13	Introduction To Industry 4.0 And Industrial Internet Of Things	https://online.vtu.ac.in/course-details/Introduction-To-Industry-40-And-Industrial-Internet-Of-Things	3
14	Reinforcement Learning	https://online.vtu.ac.in/coursedetails/Reinforcement-Learning	3
15	Parameterized Algorithms	https://online.vtu.ac.in/coursedetails/parameterized-algorithms	3
16	Accelerated Artificial Intelligence	https://online.vtu.ac.in/coursedetails/Applied-AcceleratedArtificial-Intelligence	3
17	Social Networks	https://online.vtu.ac.in/coursedetails/Social-Networks	3
18	Computational Complexity	https://online.vtu.ac.in/coursedetails/computational-complexity	3
19	Introduction To Game Theory And Mechanism Design	https://online.vtu.ac.in/coursedetails/Introduction-To-GameTheory-And- Mechanism-Design	3
20	Advanced Distributed Systems	https://online.vtu.ac.in/coursedetails/advanced-distributed-systems	3
21	Privacy And Security In Online Social Media	https://online.vtu.ac.in/coursedetails/Privacy-and-Security-inOnline-Social-Media	3
22	Ethical Hacking	https://online.vtu.ac.in/coursedetails/Ethical-Hacking	3
23	Introduction To Haskell Programming	https://online.vtu.ac.in/course-details/Intro duction-To-Haskell-Programming	2
24	Data Science For Engineers	https://online.vtu.ac.in/course-details/Data -Science-for-Engineers-815403	2
25	Google Cloud Computing Foundations	https://online.vtu.ac.in/course-details/Google-Cloud-Computing-Foundations	2
26	Edge Computing	https://online.vtu.ac.in/course-details/edge- computing	2

27	Embedded System Design with ARM	https://online.vtu.ac.in/course-details/embe dded-system-design-with-arm	2
28	Optimisation for Machine Learning: Theory and Implementation(Hindi)	https://online.vtu.ac.in/course-details/opti misation-for-machine-learning-theory-and-implementation-hindi	2
29	User-centric Computing For Human-Computer Interaction	https://online.vtu.ac.in/course-details/user- centric-computing-for-human-computer-inter action	2
30	AI: Constraint Satisfaction	https://online.vtu.ac.in/course-details/AI-C onstraint-Satisfaction-836131	2
31	Introduction To Soft Computing	https://online.vtu.ac.in/course-details/Intro duction-To-Soft-Computing	2
32	Foundation of Cloud IoT Edge ML	https://online.vtu.ac.in/course-details/Foun dation-of-Cloud-IOT-Edge-ML-487203	2
33	Hardware Modeling Using Verilog	https://online.vtu.ac.in/coursedetails/Hardware-Modeling-UsingVerilog	2
34	Machine Learning For Earth System Sciences	https://online.vtu.ac.in/coursedetails/Machine-Learning-For-EarthSystem- Sciences	2
35	Hardware Modeling Using Verilog	https://online.vtu.ac.in/coursedetails/Hardware-Modeling-UsingVerilog	2
36	Machine Learning For Earth System Sciences	https://online.vtu.ac.in/coursedetails/Machine-Learning-For-EarthSystem- Sciences	2
37	Software Testing (IITKGP)	https://online.vtu.ac.in/course-details/Soft ware-Testing-IITKGP	1
38	Systems and Usable Security	https://online.vtu.ac.in/course-details/syste ms-and-usable-security-979026	1

Design

SL No	**Course / Title Name**	**URL iD**	**Credits**
1	Understanding Incubation And Entrepreneurship	https://online.vtu.ac.in/coursedetails/Understanding-Incubation-andEntrepreneurship-839780	3
2	Fundamentals of Automotive Systems	https://online.vtu.ac.in/coursedetails/fundamentals-of-automotivesystems	3
3	Geographic Information System	https://online.vtu.ac.in/coursedetails/geographic-informationsystem	3
4	Manufacturing Strategy	https://online.vtu.ac.in/course-details/manufacturing-strategy	2
5	Intellectual Property Rights And Competition Law	https://online.vtu.ac.in/course-details/Intellectual-Property-Rights-and-Competition-Law	2
6	Financial Accounting	https://online.vtu.ac.in/course-details/Financial-Accounting	2
7	Organization Development And Change In 21st Century 8	https://online.vtu.ac.in/course-details/Organization-Development-And-Change-In-21st-Century	2
8	Strategic Management – The Competitive Edge	https://online.vtu.ac.in/course-details/strategic-management-the-competitive-edge	2
9	Patent Search For Engineers And Lawyers	https://online.vtu.ac.in/course-details/patent-search-for-engineers-and-lawyers	2

Skill

SL No	**Course / Title Name**	**URL iD**	**Credits**
1	Adobe Lightroom	https://online.vtu.ac.in/course-details/Credits-03-Adobe-Lightroom	3
2	Video Production	https://online.vtu.ac.in/course-details/Credits-03-Video-Production	3
3	Cloud Architecture	https://online.vtu.ac.in/course-details/Credits-03-Cloud-Architecture	3
4	Master Photoshop: A Comprehensive Course	https://online.vtu.ac.in/course-details/Credits-03-Master-Photoshop-A-Comprehensive-Course	3
5	Full Stack Web Development Bootcamp	https://online.vtu.ac.in/course-details/Credits-03-Full-Stack-Web-Development-Bootcamp	3
6	Master Computer Science Fundamentals	https://online.vtu.ac.in/course-details/Credits-03-Master-Computer-Science-Fundamentals	3
7	Master Coding and Emerging Technologies	https://online.vtu.ac.in/course-details/Credits-03-Master-Coding-and-Emerging-Technologies	3
8	Business Startup Essentials: From Idea to Launch	https://online.vtu.ac.in/course-details/Credits-03-Business-Startup-Essentials-From-Idea-to-Launch	3
9	Data Analytics Certification/Certified Data Analyst	https://online.vtu.ac.in/course-details/Credits-03-Data-Analytics-CertificationCertified-Data-Analyst	3
10	E-commerce Mastery	https://online.vtu.ac.in/course-details/Credits-03-E-commerce-Mastery	3
11	Project Management	https://online.vtu.ac.in/course-details/Credits-03-Project-Management	3
12	Master Excel Data Analysis and Visualization	https://online.vtu.ac.in/course-details/Credits-03-Master-Excel-Data-Analysis-and-Visualization	3
13	HR Employee Management	https://online.vtu.ac.in/course-details/Credits-02-HR-Employee-Management	3
14	Leadership & Management	https://online.vtu.ac.in/course-details/Credits-03-Leadership-Management	3
15	UX Design Certificate	https://online.vtu.ac.in/course-details/Credits-03-UX-Design-Certificate	3
16	Social Media Marketing	https://online.vtu.ac.in/course-details/Credits-03-Social-Media-Marketing	3
17	SEO & Digital Marketing	https://online.vtu.ac.in/course-details/Credits-03-SEO-Digital-Marketing	3
18	Budget Graphic Design	https://online.vtu.ac.in/course-details/Credits-03-Budget-Graphic-Design	3
19	Introduction to Digital Marketing	https://online.vtu.ac.in/course-details/Credits-03-Introduction-to-Digital-Marketing	3
20	Comprehensive Graphic Design	https://online.vtu.ac.in/course-details/Credits-03-Comprehensive-Graphic-Design	3
21	Object Oriented Programming using C++ - (Programming Skills)	https://online.vtu.ac.in/course-details/Credits-03-Object-Oriented-Programming-using-C-Programming-Skills	3

22	Python Essentials and Libraries for Data Science	https://online.vtu.ac.in/course-details/Credits-03-Python-Essentials-and-Libraries-for-Data-Science	3
23	Skill enhancement with Data structure algorithm - (C language)	https://online.vtu.ac.in/course-details/Credits-03-Skill-enhancement-with-Data-structure-algorithm-C-language	3
24	Employability skill course - (Corporate Skills)	https://online.vtu.ac.in/course-details/Credits-03-Employability-skill-course-Corporate-Skills	3
25	React Full stack (Web/App development Skills)	https://online.vtu.ac.in/course-details/Credits-03-React-Full-stack-WebApp-development-Skills	3
26	Android App Development with Kotlin Essentials - (App development Skills)	https://online.vtu.ac.in/course-details/Credits-03-Android-App-Development-with-Kotlin-Essentials-App-development-Skills	3
27	MS Excel Basic to Advance level	https://online.vtu.ac.in/course-details/Credits-03-MS-Excel-Basic-to-Advance-level	3
28	Interview preparation - (Corporate Skills)	https://online.vtu.ac.in/course-details/Credits-03-Interview-preparation-Corporate-Skills	3
29	Computer Programming Skill with C	https://online.vtu.ac.in/course-details/Credits-03-Computer-Programming-Skill-with-C	3

Open Elective Courses Group III(online)

SL No	**Course / Title Name**	**URL iD**	**Credits**
1	Machine Learning for Engineering and science applications	https://online.vtu.ac.in/course-details/machine-learning-for-engineering-and-science-applications	3
2	Data Analytics with Python	https://online.vtu.ac.in/course-details/Data-Analytics-with-Python	3
3	Discrete Mathematics - IITB	https://online.vtu.ac.in/course-details/Discrete-Mathematics-IIITB	3
4	Foundations of Cyber Physical Systems	https://online.vtu.ac.in/course-details/Foundations-of-Cyber-Physical-Systems	3
5	Introduction to Embedded System Design	https://online.vtu.ac.in/course-details/introduction-to-embedded-system-design	3
6	Introduction To Internet Of Things	https://online.vtu.ac.in/course-details/Introduction-To-Internet-Of-Things	3
7	Introduction To Industry 4.0 And Industrial Internet Of Things	https://online.vtu.ac.in/course-details/Introduction-To-Industry-40-And-Industrial-Internet-Of-Things	3
8	The Joy Of Computing Using Python	https://online.vtu.ac.in/course-details/The-Joy-of-Computing-using-Python	3
9	Introduction To Machine Learning	https://online.vtu.ac.in/course-details/Introduction-to-Machine-Learning	3
10	Getting Started With Competitive Programming	https://online.vtu.ac.in/course-details/Getting-Started-with-Competitive-Programming	3

Code: BCI803 **Course: Internship (Industry/ Research)**

Credits: 10 credits **L:T:P - 0:0:20**

SEE: 100 Marks **CIE: 100 Marks**

SEE Hours: 3 hours **Max. Marks:200**

Prerequisites if any	Strong understanding of relevant theoretical concepts and principles in field of computer science and Engineering.
Learning objectives	● Gain a comprehensive understanding of the industry-standard processes for software project development and management. ● Learn about the latest technologies and tools used in the industry and understand their relevance to specific projects. ● Develop problem-solving skills by tackling real-world challenges and finding innovative solutions. ● Understand and adhere to the industry's best practices, standards, and procedures.

Course Outcomes: *On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Describe the industry-standard process for software project development.	Understand
CO2	Gain insight into the technologies involved and their relevance to the projects undertaken during the internship.	Apply
CO3	Apply the technologies and processes appropriately to complete assigned tasks within the expected timeline.	Apply
CO4	Demonstrate the technical skills and process knowledge acquired during the internship and summarize the work done in detailed reports.	Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	-	-	-	3	2	2	-	2	-	-	-		2	2
CO2	3	2	1	-	3	2	2	-	2	1	1	-		2	2
CO3	3	3	3	-	3	2	2	3	2	1	1	1		2	2
CO4	3	1	3	2	3	-	-	-	2	2	3	2		2	2

Mapping Strength: **Strong– 3** **Medium – 2** **Low – 1**