THE NATIONAL INSTITUTE OF ENGINEERING

MYSORE – 8

(Autonomous Institution under VTU)

B.E - CSE

VII and VIII Semester

Department of Computer Science and Engineering

The National Institute of Engineering

Scheme of Teaching & Examination

Department: Computer Science and Engineering (BE in CS&E)

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	BCS701	Cryptography & Network Security	CS	CS	4	0	0		03	50	50	100	**4**
2	IPCC	BCS702	Parallel Computing	CS	CS	3	0	2		03	50	50	100	**4**
3	PEC	BCS713x	Professional Elective Course (Group III)	CS	CS	3	0	0		03	50	50	100	**3**
4	OEC	BCS754x	Open Elective Course (Group II)	CS	CS	3	0	0		01	50	50	100	**3**
5	PROJ	BCS785	Major Project	CS	CS	0	0	12		03	100	100	200	**6**
											300	**300**	**600**	**20**

Professional Elective Course

BCS713A	Deep Learning	BCS713D	Big Data Analytics
BCS713B	Natural Language Processing	BCS713E	Quantum Computing
BCS713C	NoSQL	BCS713F	Digital Forensics

Open Elective Course

BCS754A	Introduction to DBMS	BCS754C	Software Engineering
BCS754B	Introduction to Algorithms	BCS754D	Introduction to Machine Learning

Code: BCS701 **Course: Cryptography & Network Security**

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

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

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

Prerequisites if any	
Learning objectives	1. To provide a strong foundation in cryptographic principles, algorithms, and network security mechanisms. 2. To enable students to apply cryptographic methods and analyze security protocols in real-world contexts. 3. To familiarize students with authentication, key management, and secure communication techniques for protecting data in networks.

Course Outcomes:

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

COs	Course outcomes	Bloom's level
CO1	Explain the fundamental concepts of cryptography, classical encryption techniques, and security principles	Understand
CO2	Apply symmetric and asymmetric cryptographic algorithms to solve security-related problems	Apply
CO3	Analyze key management, distribution schemes, and authentication protocols to evaluate their effectiveness	Analyze
CO4	Evaluate and recommend suitable mechanisms for E-mail security, transport layer security, and IP security in given scenarios.	Evaluate

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12		PSO1	PSO2
CO1	3	3	2	-	3	-	-	1	-	-	-	2		2	2
CO2	3	3	2	-	3	-	-	1	-	-	1	2		3	2
CO3	3	3	3	-	3	1	-	2	-	-	1	2		3	2
CO4	3	3	3	2	3	1	-	2	-	-	2-	2		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: Classical Encryption Techniques				
1.1	A model for Network Security	1	-	-
1.2	Classical encryption techniques: Symmetric cipher model	1	-	-
1.3	Substitution ciphers-Caesar Cipher	1	-	-
1.4	Mono alphabetic Cipher	1	-	-
1.5	Play fair Cipher	1	-	-
1.6	Hill Cipher	1	-	-
1.7	Polyalphabetic Ciphers.	1		
1.8	One time pad	1		
1.9	Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES)	2		
Module – 2: Public Key Cryptography and RSA				
2.1	Principles of public key cryptosystems-Public key cryptosystems	1	-	-
2.2	Applications for public key cryptosystems	1	-	-
2.3	Requirements for public key cryptography, Public key Cryptanalysis	1	-	-
2.4	The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA.	2	-	-
2.5	Diffie-Hellman key exchange: The Algorithm, Analog of Diffie-Hellman key Exchange, Key exchange Protocols	2	-	-
2.6	Elgamal Cryptographic system	1		
2.7	Elliptic Curve Cryptography: Elliptic Curve Encryption/Decryption .	2	-	-
Module – 3: Key Management and Distribution				
3.1	**Applications of Cryptographic Hash functions** Two simple Hash functions	2	-	-
3.2	**Key Management and Distribution**	1	-	-
3.3	**Symmetric key distribution using asymmetric encryption:** Simple Secret Key Distribution Secret Key Distribution with Confidentiality and Authentication A Hybrid Scheme	3		
3.4	**Distribution of public keys:** Public Announcement of Public Keys	2	-	-

	Publicly Available Directory Public-Key Authority Public-Key Certificates			
3.5	**X.509 Certificates:** Certificates X.509 Version 3	2	-	-
Module – 4: User Authentication				
4.1	Remote user-Authentication principles	1	-	-
4.2	Kerberos	2		
4.3	Remote user authentication using asymmetric encryption:	2		
4.3	Web security consideration:	2	-	-
4.4	Transport Layer Security	1		
4.6	Email Threats and comprehensive email security, S/MIME	1		
Module – 5: Internet Security and Electronic Mail Security				
5.1	Domain keys Identified Mail.	2	-	-
5.2	IP Security: IP Security overview	2	-	-
5.3	IP Security Policy	2	-	-
5.4	Encapsulating Security Payload	2	-	-
5.5	Combining security associations	2	-	-
	Total No. of Lecture Hours	**50**	-	-
	Total No. of Tutorial Hours		**00**	-
	Total No. of Practical Hours			**00**

Textbook:

William Stallings, “Cryptography and NetworkSecurity”, Pearson Publication, SeventhEdition.

Reference Book:

1. Keith M Martin, “Everyday Cryptography”, Oxford University Press
2. V.K Pachghare, “Cryptography and Network Security”, PHI, 2nd Edition

Online Resources:https://onlinecourses.nptel.ac.in/noc22_cs90/preview

Code: BCS702 **Course: Parallel Computing**

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

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

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

Prerequisites if any	Computer organization, C programming
Learning objectives	1. To explore the need for parallel programming 2. 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	Understanding
CO2	Apply OpenMP and MPI concepts to write parallel programs	Apply
CO3	Analyze different parallel computing architectures and 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 systems, MIMD systems	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		2
3.2	The trapezoidal rule in MPI	1		
3.3	Dealing with I/O, Collective communication	2		1
3.4	MPI-derived datatypes, Performance evaluation of MPI programs	2		1
3.5	A parallel sorting algorithm	1		1
Module – 4: Shared-memory programming with OpenMP				
4.1	Openmp pragmas and directives	2		2
4.2	The trapezoidalrule	1		
4.3	Scope of variables, The reduction clause	1		
4.4	Loop carried dependency, scheduling, producers andconsumers	2		2
4.5	Caches, cache coherence and false sharing in openmp, tasking, tasking, thread safety.	2		1
Module – 5: GPU programming with CUDA				
5.1	GPUs and GPGPU, GPU architectures	2		
5.2	Heterogeneouscomputing, 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,	2		
5.5	CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp			
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**10**

Practical Components	
Sl no	**Experiments**
1	Write a OpenMP program to sort an array on n elements using both sequential and parallel merge sort(using Section). Record the difference in execution time.
2	Write an OpenMP program that divides the Iterations into chunks containing 2 iterations, (OMP_SCHEDULE=static,2). Its input should be the number of iterations, and its output should be which iterations of a parallelized for loop are executed by which thread. For example, if there are two threads and four iterations, the output might be the following: a. `Thread 0 : Iterations 0 -- 1` b. `Thread 1 : Iterations 2 -- 3`
3	Write a OpenMP program to calculate n Fibonacci numbers using tasks.
4	Write a OpenMP program to find the prime numbers from 1 to n employing parallel for directive. Record both serial and parallel execution times
5	Write a MPI Program to demonstration of MPI_Send and MPI_Recv
6	Write a MPI program to demonstration of deadlock using point to point communication and avoidance of deadlock by altering the call sequence
7	Write a MPI Program to demonstration of Broadcast operation.
8	Write a MPI Program demonstration of MPI_Scatter and MPI_Gather
9	Write a MPI Program to demonstration of MPI_Reduce and MPI_Allreduce (MPI_MAX, MPI_MIN, MPI_SUM, MPI_PROD)

Textbook:

1. 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

Code: BCS713A **Course: Deep Learning**

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

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

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

Prerequisites if any	Linear Algebra, Probability and Statistics and Machine Learning Basics
Learning objectives	1. **Understand foundational machine learning concepts** such as types of learning, overfitting/underfitting, hyperparameters, and statistical learning techniques. 2. **Gain theoretical and practical knowledge of deep neural networks**, including feedforward architectures, backpropagation, and optimization methods. 3. **Explore specialized architectures** such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs) for handling image and sequential data. 4. **Apply deep learning methods to real-world tasks** like computer vision, speech recognition, and natural language processing. 5. **Develop skills in evaluating, tuning, and debugging deep learning models**, and understand practical considerations for deployment.

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

COs	Course Outcomes	Bloom's level
CO1	Explain the basic principles of machine learning and differentiate between various learning paradigms such as supervised and unsupervised learning.	Understand
CO2	Apply deep feed forward neural network concepts, including back propagation and regularization, to model complex learning problems.	Apply
CO3	Implement convolutional neural networks for image and pattern recognition tasks.	Apply
CO4	Analyze sequence modeling problems using recurrent architectures like RNNs, LSTMs, and encoder-decoder models.	Analyze
CO5	Analyze deep learning models for vision, speech, and NLP by examining performance metrics and identifying sources of errors using debugging techniques	Analyze

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		3		3	2
CO2	3	3	2	2	3				1			2		3	3
CO3	3	2	3	2	3				1			2		3	3
CO4	3	3	2	2	3				1			3		3	3
CO5	3	3	2	3	3			1	2	2	1	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
Module – 1 : Introduction to Machine Learning				
1.1	Machine Learning Basics	1	0	0
1.2	Types of Learning: Supervised vs. Unsupervised	2	0	0
1.3	Capacity, Overfitting and Underfitting .	1	0	0
1.4	Evaluation: Hyperparameters, Validation Sets, Estimator, Bias-Variance Trade-off	1	0	0
1.5	Maximum Likelihood Estimation, Bayesian Statistics, Challenges Motivating Deep Learning	2	0	0
Module – 2: Deep Feedforward Networks				
2.1	Gradient-Based Learning	2	0	0
2.2	Hidden Units, Architecture Design	2	0	0
2.3	Backpropagation	1	0	0
2.4	Optimization for Training Deep Models: How Learning Differs from Pure Optimization .	2	0	0
2.5	Challenges in Neural Network Optimization, Basic Algorithms	2	0	0
Module – 3: Convolutional Networks				
3.1	The Convolution Operation, Motivation	2	0	0
3.2	Convolution and Pooling	2	0	0
3.3	Variants of the Basic Convolution Function, Structured Outputs	2	0	0
3.4	Data Types, Efficient Convolution Algorithms	2	0	0
Module – 4: Sequence Modeling				
4.1	Unfolding Computational Graphs, Recurrent Neural Networks	2	0	0
4.2	Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures	3	0	0
4.3	The Challenge of Long-Term Dependencies, The Long Short-Term Memory.	3	0	0
Module – 5: Practical Methodology and Applications				
5.1	Performance Metrics, Default Baseline Models	2	0	0
5.2	Determining Whether to Gather More Data, Selecting Hyperparameters	2	0	0
5.3	Debugging Strategies	1	0	0
5.4	Simple Case Study: Multi-Digit Number Recognition	2	0	0
5.5	Computer Vision, Speech Recognition, Natural Language Processing(all 3 topics only introduction)	1	0	0
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. **Deep Learning**, Ian Goodfellow, YoshuaBengio, Aaron Courville, MIT Press, 2016.

Reference Books:

1. **Deep Learning with Python**, François Chollet, Manning Publications, 2nd Edition, 2021.
2. **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow**, AurélienGéron, O'Reilly Media, 3rd Edition, 2023.
3. **Neural Networks and Deep Learning: A Textbook**, Charu C. Aggarwal, Springer, 2018.
4. **Neural Networks and Deep Learning**, Michael Nielsen, 2015

Online Resources:

1. https://www.coursera.org/specializations/deep-learning
2. https://developers.google.com/machine-learning/crash-course
3. https://www.deeplearningbook.org

Code: BCS713B **Course: Natural Language Processing**

Credits: 4 **L:T:P – 3:2:0**

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

SEE Hours: 3hrs **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 and identify POS tags	Apply
CO3	Apply context-free grammar concepts and parsing techniques such as top-down, bottom-up, and CYK for syntactic analysis	Apply
CO4	Apply Naive Bayes classifiers for text and sentiment classification and analyze their effectiveness across different NLP tasks.	Analyze
CO5	Compare different information retrieval models and utilize lexical resources for language processing tasks	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				3	
CO2	3	3	2		3					2				3	2
CO3	3	3	3	2	3					2				3	2
CO4	3	3	2	2	3					2				3	3
CO5	3	3	2	2	3					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: BCS713C **Course: NoSQL**

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

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

Prerequisites if any	Basic Knowledge of Database, Distributed systems and Programming Knowledge(Python or Java).
Learning objectives	• Recognize and describe the four types of NoSQL Databases, the Document-oriented, Key Value Pairs, Column-oriented and Graph databases useful for diverse applications. • Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL Databases. • Differentiate the detailed architecture of column -oriented NoSQL database, Document database and Graph Database and relate usage of processor, memory, storage and file system commands. • Evaluate several applications for location-based service and recommendation services. Devise an application using the components of NoSQL.

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

COs	Course Outcomes	Bloom's level
CO1	Discuss the fundamental concepts of NoSQL databases, including their data models, distribution models, and consistency mechanisms.	Understand
CO2	Apply the principles of aggregate-oriented, key-value, document, and graph data models to design appropriate storage solutions for real-world applications..	Apply
CO3	Implement distribution techniques such as sharding, replication, and Map-Reduce operations to manage scalability and performance in NoSQL environments.	Apply
CO4	Analyze the suitability of different NoSQL databases for various use cases by evaluating their features, trade-offs, and limitations in terms of consistency scalability, and ransaction support.	Analyze
CO5	Evaluate NoSQL data models, distribution, and processing strategies to determine their effectiveness in a real-world prototype application.	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		3	-
CO2	3	3	2	2	3	-	-	-	-	2	-	1		3	2
CO3	3	3	3	2	3	-	-	-	-	2	-	1		3	3
CO4	3	3	3	2	3	-	-	1	1	2	-	1		3	2
CO5	3	3	3	2	3	-	-	2	3	2	1	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	Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters.	2		
1.2	The Emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation.	2		
1.3	Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate Oriented Databases.	2		
1.4	More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access,	2		
	Module 2			
2.1	Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication	3		
2.2	Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums.	3		
2.3	Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes	2		
	Module 3			
3.1	Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce.	3		
3.2	Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling.	3		
3.3	Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets .	2		
	Module 4			
4.1	Document Databases, What is a Document Database?	2		
4.2	Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management	4		

	Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications,			
4.3	When Not to Use, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure	2		
Module 5				
5.1	Graph Databases, What Is a Graph Database?	2		
5.2	Features, Consistency, Transactions, Availability, Query Features, Scaling	3		
5.3	Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.	3		
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012.

Reference Book:

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

Online Resources:

1. https://www.geeksforgeeks.org/introduction-to-nosql/ (and related links in the page)

2. https://www.youtube.com/watch?v=0buKQHokLK8 (How do NoSQL databases work? Simply explained)

3. https://www.techtarget.com/searchdatamanagement/definition/NoSQL-Not-Only-SQL (What isNoSQL and How do NoSQL databases work)

4. https://www.mongodb.com/nosql-explained (What is NoSQL)

5. https://onlinecourses.nptel.ac.in/noc20-cs92/preview (preview of Bigdata course contains NoSQL

Code: BCS713D **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	1	3	1	-	1	1	1	1	2		2	-
CO2	3	3	2	2	3	1	-	1	1	1	1	2		2	1
CO3	3	2	3	2	3	1	-	1	1	1	2	3		2	1
CO4	3	3	2	2	3	1	-	1	1	1	2	2		2	1

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:Gettingan 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:Big Data Technology 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

Reference Books:

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: BCS713E **Course: Quantum Computing**

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

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

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

Prerequisites if any	Nil
Learning objectives	1. To introduce the fundamentals of quantum computing 2. To inculcate the ability of problem-solving using quantum algorithms

Course Outcomes:

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

COs	Course Outcomes	Bloom's level
CO1	Explain the fundamental notions of quantum mechanics	Understanding
CO2	Make use of quantum bit gates to design quantum circuits	Apply
CO3	Use the architecture and algorithms to develop solutions	Apply
CO4	Differentiate between probabilistic and quantum computing	Analyze

Mapping with POs and PSOs:

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

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

Course Structure

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module – 1				
1.1	Introduction to quantum mechanics: Linear algebra	3	0	0
1.2	The postulates of quantum mechanics	3	0	0
1.3	Application: superdense coding	1	0	0
1.4	EPR and the Bell inequality	1	0	0
Module – 2				
2.1	Quantum bits, Single qubit gates, Multiple qubit gates	3	0	0
2.2	Quantum circuits	3	0	0
2.3	Example: Bell states	1	0	0
2.4	Example: quantum teleportation	1	0	0
Module – 3				
3.1	Classical computations on a quantum computer	2	0	0
3.2	Quantum parallelism	2	0	0
3.3	Deutsch's Algorithm	2	0	0
3.4	The Deutsch-Jozsa Algorithm	2	0	0
Module – 4				
4.1	The quantum Fourier transform, Phase estimation	2	0	0
4.2	Applications: order-finding and factoring	3	0	0
4.3	The quantum search algorithm	3	0	0
Module – 5				
5.1	Probabilistic and Quantum computations	2	0	0
5.2	Introduction to quantum cryptography and quantum information theory	2	0	0
5.3	Quantum programming languages	4	0	0
	Total No. of Lecture Hours	**40**	**-**	**-**
	Total No. of Tutorial Hours		**00**	**-**
	Total No. of Practical Hours			**00**

Textbook:

1. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University
Press 2010
2. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008

Reference Book:

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, 2008

Online Resources:

1. https://archive.nptel.ac.in/courses/106/106/106106232/
2. https://learn-xpro.mit.edu/quantum-computing

Code: BCS713F **Course: Digital Forensics**
Credits:3 **L:T:P-3:0:0**
SEE:50 Marks **CIE:50 Marks**
SEEHours:3 **Max.Marks:100**

Prerequisites if any	Computer Networks. Operating Systems, Fundamentals of Cyber Security
Learning objectives	• Understand the principles, processes, and legal considerations in digital forensics. • Apply forensic techniques to investigate, analyze, and interpret evidence from diverse digital environments. • Evaluate forensic findings and prepare professional investigation reports through experiential case studies.

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, processes, and legal frameworks of digital forensics.	Understand
CO2	Apply forensic tools and methodologies to acquire and preserve digital evidence.	Apply
CO3	Analyze file systems, network traces, and digital artifacts to identify potential security incidents.	Analyze
CO4	Evaluate forensic evidence and prepare structured investigation reports based on experiential case 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	2	1	1	1	-	-	2	-	-
CO2	3	3	2	2	3	-	-	-	1	1	-	2	2	1
CO3	3	3	3	3	3	-	-	-	1	1	-	2	-	-
CO4	3	3	3	3	3	1	1	1	2	3	3	3	2	2

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

Course Structure

No.	Modules	No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
Module 1				
1.1	Introduction to Digital Forensics: Overview and importance	2	-	-
1.2	Investigative process	2	-	-
1.3	Legal issues and ethics	2	-	-
1.4	Types of computer crimes	2	-	-
Module 2				
2.1	Data Acquisition & Storage Media: Forensic acquisition methods	2	-	-
2.2	Imaging tools	2	-	-
2.3	Chain of custody	2	-	-
2.4	Storage formats (FAT, NTFS)	2	-	-
Module 3				
3.1	Analysis of Operating Systems and File Systems: Windows / Mac / Linux analysis	2	-	-
3.2	File metadata	2	-	-
3.3	Recovering deleted files	2	-	-
3.4	Registry and log analysis	2	-	-
Module 4				
4.1	Network, Email, and Web Forensics: Logs, packet capture	3	-	-
4.2	Web browsers and history	2	-	-
4.3	Email headers and forensic tracking	3	-	-
Module 5				
5.1	Mobile and Cloud Forensics & Reporting: Mobile device acquisition	2	-	-
5.2	Forensics in cloud environments	3	-	-
5.3	Writing and presenting forensic reports	3	-	-
	Total No .of Lecture Hours	**40**	**-**	-
	Total No. of Tutorial Hours		**0**	-
	Total No. of Practica lHours			**0**

Textbook:

1. *Guide to Computer Forensics and Investigations*, Bill Nelson, Amelia Phillips, Christopher Steuart, 6th Edition, Cengage Learning, 2018.

Reference Book:

1. *Digital Forensics and Incident Response: Incident Detection and Investigation*, Gerard Johansen**,** Packt Publishing, 3rd Edition, 2022.

Online Resources:

1. NPTEL Course Link: https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
2. National Institute of Technology, Tiruchirappalli – Digital Forensics Course Page https://www.nitt.edu/home/academics/departments/cse/programmes/mtech/curriculum/semester_1/electives/digital_forensics/

Code: BCS754A **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	Analyze and compare concurrency control mechanisms in relational databases and 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, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.	5	-	1
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, 7th Edition, 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: BCS754B **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 algorithmsin terms of time complexity.	Analyze
CO2	Demonstrate Brute force, divide & conquer approaches and decrease & conquerapproaches to solve computational problems	Apply
CO3	Make use of transform &conquer, dynamic programming and greedy approachesto 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

MappingStrength: 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	**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**

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: BCS754C **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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	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: BCS754D **Course: Introduction to Machine Learning**

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

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

SEE Hours: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: BCS785 **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 (BE in CS&E)

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	BCS801X	Professional Elective - Course Group IV (Online Course)	CS	CS	-	-	-			-	100	100	**3**
2	OEC	BCS802X	Open Elective Course Group III (Online Course)	CS	CS	-	-	-			-	100	100	**3**
3	INT	BCS803	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: BCS803 **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**