Pimpri Chinchwad Education Trust's
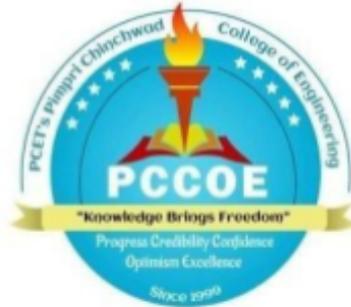
PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
(ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

Curriculum Structure and Syllabus

of

SY B Tech CSE (AI & ML)

(Course 2021)

Effective from Academic Year 2023-24

(Updated with Minor Changes)

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

- Serving the needs of the society at large through establishment of a state-of-art Engineering Institute
- Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education
- Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of-the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.

Department of Computer Science & Engineering (AI & ML)
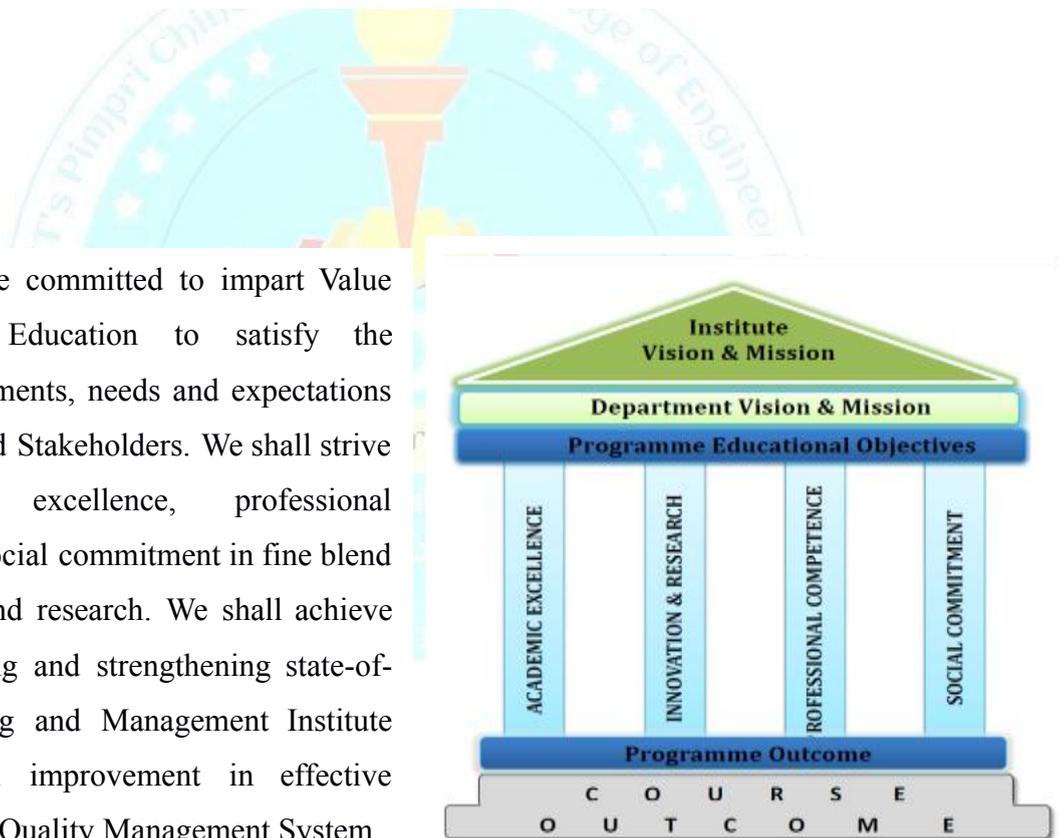
	Pimpri Chinchwad Education Trust's **Pimpri Chinchwad College of Engineering**	
	Course Approval Summary	

A) Board of study-Applied Sciences and Humanities

Sr. No.	Course Name	Course Code	Page Number	Signature and stamp of BoS
1.	Universal Human Values	BHM3101	28-29	
2.	Life Skills – III	BHM3939	30-31	
3.	Professional Skills for Engineers	BHM4101	51-52	
4.	Life Skills – IV	BHM4940	58-59	
5.	Constitution of India	BHM9962	60-61	

B) Board of Study- Computer Science & Engineering (Artificial Intelligence & Machine Learning)

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS
1.	Data Science	BCS3401	11-12	
2.	Discrete Mathematics	BCS3402	13-14	
3.	Computer Organization & Operating Systems	BCS3403	15-16	
4.	Data Structures	BCS3404	17-18	
5.	Object Oriented Programming	BCS3405	19-20	
6.	Data Science Lab	BCS3406	21-23	
7.	Data Structures Lab	BCS3407	24-25	
8.	Object Oriented Programming Lab	BCS3408	26-27	
9.	Machine Learning	BCS4409	33-34	
10.	Database Systems	BCS4410	35-36	
11.	Software Engineering	BCS4411	37-38	
12.	Artificial Intelligence	BCS4412	39-40	
13.	Machine Learning Lab	BCS4413	41-42	
14.	Database Systems Lab	BCS4414	43-44	
15.	Artificial Intelligence Lab	BCS4415	45-47	
16.	Project Development - I	BCS4701	48-50	
17.	Proficiency Course –I (R Programming)	BCS4911	53-55	
18.	Proficiency Course –I(Java Programming	BCS4912	56-57	

Department of Computer Science & Engineering (AI & ML)

Approved by Academic Council :

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

Approved by Board of Governors:

Chairman, Board of Governors
Pimpri Chinchwad College of Engineering

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LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sr. No.	Abbreviation	Type of Course
1.	BSC	Basic Science Course
2.	ECC	Engineering Core/ Science Course
3.	HSMC	Humanities, Social Sciences and Management Course
4.	PCC	Programme / Professional Core Course
5.	PEC	Programme / Professional Elective Course
6.	OEC	Open Elective Course
7.	PROJ	Project
8.	INTR	Internship
9.	AC	Audit Course
10.	MC	Mandatory Course
11.	LS	Life Skill
12.	PFC	Proficiency Course
13.	L	Lecture
14.	P	Practical
15.	T	Tutorial
16.	H	Hours
17.	CR	Credits
18.	IE	Internal Evaluation
19.	MTE	Mid Term Evaluation
20.	ETE	End Term Evaluation
21.	TW	Term Work
22.	OR	Oral
23.	PR	Practical

CURRICULUM FRAMEWORK

(2021-2022; 2022-2023; 2023-2024; 2024-2025)

The Course and Credit Distribution

Sr. No.	Type of Courses	No of Courses	Total Credits No
1.	Basic Science Course (BSC)	6	18
2	Engineering Core Course (ECC)	11	16
3.	Humanities, Social Sciences And Management Course (HSMC)	4	9
4.	Professional Core Course (PCC)	26	62
5.	Professional Elective Course (PEC)	8	16
6.	Open Elective Course (OEC)	2	6
7.	Project (PROJ)	6	31
8.	Internship (INTR)	1	3
9.	Audit Course (Audit)	3	-
10.	Mandatory Course (MC)	2	-
11.	Life Skill (LS)	4	-
12.	Proficiency Course (PFC)	2	-
	Total	**75**	**161**

	COURSE DISTRIBUTION : SEMESTER WISE									
Sr. No.	Type of Course	No of Courses / Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	3	3	-	-	-	-	-	-	6
2.	Engineering Core Course (ECC)	6	5	-	-	-	-	-	-	11
3.	Humanities, Social Sciences And Management Course (HSMC)	1	1	1	1	-	-	-	-	4
4.	Professional Core Course (PCC)	-	-	8	7	7	2	2	-	26
5.	Professional Elective Course (PEC)	-	-	-	-	-	4	4	-	8
6.	Open Elective Course (OEC)	-	-	-	-	-	1	1	-	2
7.	Project (PROJ)	-	1	-	1	1	1	1	1	6
8.	Internship (INTR)	-	-	-	-	-	-	-	1	1
9.	Audit Course (Audit)	-	-	-	1	1	1	-	-	3
10.	Mandatory Course (MC)	-	-	-	-	1	1	-	-	2
11.	Life Skill (LS)	1	1	1	1	-	-	-	-	4
12.	Proficiency Course (PFC)	-	-	-	1	-	1	-	-	2
	Total	11	11	10	12	10	11	8	2	75

CREDIT DISTRIBUTION : SEMESTER WISE										
1 Lecture hour = 1 Credit 2 Lab Hours = 1 Credit 1 Tutorial Hour = 1 Credit										
Sr. No.	Type of Courses	No of Credits /Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	9	9	-	-	-	-	-	-	18
2.	Engineering Core Course (ECC)	7	9	-	-	-	-	-	-	16
3.	Humanities, Social Sciences And Management Course (HSMC)	2	2	3	2	-	-	-	-	9
4.	Professional Core Course (PCC)	-	-	20	16	16	5	5	-	62
5.	Professional Elective Course (PEC)	-	-	-	-	-	8	8	-	16
6.	Open Elective Course (OEC)	-	-	-	-	-	3	3	-	6
7.	Project (PROJ)	2	-	-	3	4	4	4	14	31
8.	Internship (INTR)	-	-	-	-	-	-	-	3	3
9.	Audit Course (Audit)	-	-	-	-	-	-	-	-	-
10.	Mandatory Course (MC)	-	-	-	-	-	-	-	-	-
11.	Life Skill (LS)	-	-	-	-	-	-	-	-	-
12.	Proficiency Course (PFC)	-	-	-	-	-	-	-	-	-
	Total	20	20	23	21	20	20	20	17	161

Curriculum Structure
SY B Tech Computer Science & Engineering (AI & ML)

CURRICULUM STRUCTURE FOR SY B.Tech. COMPUTER SCIENCE & ENGINEERING- (AI & ML)

SEMESTER – III

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						Total
			L	P	T	Hrs		IE	MTE	ETE	TW	PR	OR	
BCS3401	PCC	Data Science	3	-	-	3	3	20	30	50	-	-	-	**100**
BCS3402	PCC	Discrete Mathematics	3	-	-	3	3	20	30	50	-	-	-	**100**
BCS3403	PCC	Computer Organization & Operating System	2	-	-	2	2	20	30	50	-	-	-	**100**
BCS3404	PCC	Data Structures	4	-	-	4	4	20	30	50	-	-	-	**100**
BCS3405	PCC	Object Oriented Programming	3	-	-	3	3	20	30	50	-	-	-	**100**
BCS3406	PCC	Data Science Lab	-	4	-	4	2	-	-	-	25	50	-	**75**
BCS3407	PCC	Data Structures Lab	-	4	-	4	2	-	-	-	25	50	-	**75**
BCS3408	PCC	Object Oriented Programming Lab	-	2	-	2	1	-	-	-	25	-	25	**50**
BHM3101	HSMC	HSMC-I: Universal Human Values	3	-	-	3	3	30	-	20	-	-	-	**50**
BHM3939	LS	Life Skills – III	-	2	-	2	-	-	-	-	-	-	-	**-**
Total			18	12	-	30	23							**750**

L-Lecture, **P**-Practical, **T**-Tutorial, **Hrs**-Hours, **CR**-Credits, **IE**- Internal Evaluation, **MTE**- Mid Term Evaluation, **ETE**-End Term Evaluation, **TW**- Term Work, **OR**- Oral, **PR**- Practical

Semester - III

List of courses – Life Skills – III

Course Code	Course Name	
BHM3939	1. Practicing Meditation 2. Sports	Choose any one
	Performing Arts: Music, Singing, Poetry, Indian Conventional Dancing, Photography, Short Movie Making, Painting/ Sketching/ Drawing, Theatre Arts, Anchoring, Calligraphy etc.	Choose any one performing arts

Department of Computer Science & Engineering (AI & ML)

CURRICULUM STRUCTURE FOR SY B.Tech.
COMPUTER SCIENCE & ENGINEERING (AI & ML)

SEMESTER –IV

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						
			L	P	T	Hrs		IE	MTE	ETE	TW	PR	OR	Total
BCS4409	PCC	Machine Learning	3	-	-	3	3	20	30	50	-	-	-	100
BCS4410	PCC	Database Systems	3	-	-	3	3	20	30	50	-	-	-	100
BCS4411	PCC	Software Engineering	2	-	-	2	2	20	30	50	-	-	-	100
BCS4412	PCC	Artificial Intelligence	3	-	-	3	3	20	30	50	-	-	-	100
BCS4413	PCC	Machine Learning Lab	-	2	-	2	1	-	-	-	25	-	25	50
BCS4414	PCC	Database Systems Lab	-	4	-	4	2	-	-	-	25	50	-	75
BCS4415	PCC	Artificial Intelligence Lab	-	4	-	4	2	-	-	-	25	50	-	75
BCS4701	PROJ	Project Development - I	-	6	-	6	3	-	-	-	50	-	50	100
BHM4101	HSMC	HSMC-II: Professional Skills for Engineers	1	2	-	3	2	30	-	20	-	-	-	50
BCS4911–912	PFC	Proficiency Course – I	-	2	-	2	-	-	-	-	-	-	-	-
BHM4940	LS	Life Skills – IV	-	2	-	2	-	-	-	-	-	-	-	-
BHM9962	AC	Audit Course – I Constitution of India	1	-	-	1	-	-	-	-	-	-	-	-
Total			**14**	**20**	**-**	**34**	**21**							**750**

L-Lecture, **P**-Practical, **T**-Tutorial, **Hrs**-Hours, **CR**-Credits, **IE**- Internal Evaluation, **MTE**- Mid Term Evaluation, **ETE**-End Term Evaluation, **TW**- Term Work, **OR**- Oral, **PR**- Practical

Semester - IV

List of courses – Proficiency Course – I

Course Code	Course Name	
BCS4911	R Programming	Choose any One
BCS4912	Java Programming	

List of courses – Life Skills – IV

Course Code	Course Name	
BHM4940	1. Social welfare and Cultural Awareness 2. Transactional Analysis	Choose any one
	Caring and service Hospital Caring, Personal Safety, First Aid, Disaster Management Gardening, Organic farming, Cooking etc.	Choose any one

List of courses – Audit Course – I

Course Code	Course Name
BHM9962	Constitution of India

Course Syllabus
SY B Tech CSE (AI & ML)
Semester-III

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :		III	
Course :	**Data Science**			**Code :**		**BCS3401**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-	03	03	20	30	50	100

Prior knowledge of Mathematics is essential.

Course Objectives:
1. To solve numerical problems using the concepts of linear algebra and matrices.
2. To demonstrate the use of mathematical techniques in the field of data science.
3. To explain the theory of statistics for its use in statistical inference.
4. To perform the data preprocessing operations.
5. To demonstrate the use of data visualization and data analytics techniques.

Course Outcomes:
After learning the course, students will be able to:
1. Analyze the need of data preprocessing/visualizations operations and apply those to prepare the data
2. Use linear algebra and matrices for problem-solving.
3. Perform statistical analysis to understand the data representation by computing various statistical measures.
4. Apply various hypothesis tests on sample data and provide inferences.
5. Analyze and solve the regression and classification problem for data analysis.
6. Apply the model evaluation techniques using different performance measures.

Detailed Syllabus:		
Unit	**Description**	**Duration (Hours)**
I	**Introduction to Data Science:** Data Science Life Cycle, Data Analytics and Types, Key performance indicators of data science projects. Data Preprocessing: Need, preprocessing techniques for: handling redundant data, data transformation, replacing or handling missing data, and handling data inconsistency. Data Visualization: Introduction, need, Data visualization techniques: line plot, scatter plot, histogram, density plot, box plot, bar plot, pie chart, heatmap, etc.	08
II	**Mathematics for data science: Linear Algebra -** Introduction to Linear algebra, Matrices and vectors in data science. Vector – vector space, Column vectors, row vectors, working with vectors. Matrices: types of matrices, Addition of Matrices and their properties, Matrix multiplication and their properties. Linear combination as a matrix-vector product.	08
III	**Mathematics for data science: Matrices -** Transpose of Matrices, properties of Transpose. Determinants; Determinants and their properties, Cramer's Rule, Inverses. Introduction Minors and Cofactors in a Determinant, Properties of Determinants, Differentiation of a Determinant, Rank of a Matrix, Systems of linear equations, Row reduction, Echelon form and its Properties, Eigenvalues and Eigenvectors.	**07**
IV	**Statistics and Inference** – Measures of central tendency, Measures of variability: standard deviation, variance, quartiles, Interquartile range. Skewness and Kurtosis. **Sampling & Inference** - Sampling: Introduction, types of sampling. Hypothesis testing, types of errors, level of significance, test of	**08**

	hypothesis: t-test, z-test, chi-square, ANOVA. Correlation analysis: Pearson's correlation coefficient.	
V	**Regression** - Understanding Linear regression. Lines of regression – numerical problems. Performing a linear Regression: Linear function, Fitting the line, residual errors, coefficient of determination. Multiple linear regression. Understanding Logistic regression. Performing a logistic Regression: Logistic function, fitting the curve, understanding the log-odds, R-Squared. Multivariate logistic Regression.	**07**
VI	**Data Analytics and Model Evaluation -** Introduction to classification, Naive Bayes classifier. Model Evaluation and Selection: holdout method, random sub-sampling, cross-validation. Model's parameter tuning and optimization. Performance metrics for evaluation of model, confusion matrix, AUC-ROC analysis. Model building and validations for Naïve Bayes classifier and for logistic regression.	**07**
	Total	**45**

Text Books:
1. Thomas Nield, "Essential Math for Data Science", O'Reilly Media Inc., October 2022, ISBN: 9781098102869.
2. Data Science and Big Data Analytics, EMC education services, Wiley publication, 2015, ISBN: 9781118876138.

Reference Books:
1. Peter Bruce, Andrew Bruce, Peter Gedeck , "Practical Statistics for Data Scientists", O'Reilly Media, 2nd edition, May 2020, ISBN: 9781492072942.
2. Norman Matloff ,"Probability and Statistics for Data Science", CRC Press, 2019, ISBN:9780429687112.

Web references:
1. NPTEL Course on "Python for Data Science" : https://onlinecourses.nptel.ac.in/noc22_cs74/preview
2. NPTEL Course on "Data Science for Engineers" : https://onlinecourses.nptel.ac.in/noc22_cs72/preview

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)				Semester:		III	
Course:	Discrete Mathematics				Code:		BCS3402	
Teaching Scheme					Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE		Total
03	-	03	03	20	30	50		100

Prior Knowledge of : Linear Algebra and Univariate Calculus is essential.

Course Objectives:
1. To learn the mathematical formulation of problems by using set, function and relations.
2. To learn logic and proof techniques to reason the solutions mathematically.
3. To interpret set theory, graph theory, and algebraic structures.
4. To learn the formal proof techniques in the formulation of problems.
5. To learn probability theory and various distributions.

Course Outcomes:
After learning the course, students will be able to:
1. Use fundamental discrete structures and perform various set operations.
2. Solve the problems logically using discrete objects like functions and relations.
3. Use propositional logic to formulate the problems mathematically.
4. Use graph and Tree techniques in problem-solving.
5. Identify and apply the basic techniques in counting.
6. Apply probability theory and by analyzing the various types of probability distribution.

	Detailed Syllabus:	

Unit	Description	Duration (Hours)
I	**Mathematical Reasoning and Set theory** **Fundamentals of logic:** Propositions, Truth Tables, Logical Connectivity, Propositional logic and its applications **Set Theory:** Introduction, Set Representation, Types of Sets, Set Operations, Laws of set theory, Introduction to Structured sets: group, rings. **Mathematical Induction:** Introduction, proof technique, Case Study on Verification for the correctness of computer program using principle of mathematical induction	08
II	**Relations and Functions:** **Relation:** Relation Definition, Properties of Binary Relations, Closure of Relations, Warshall's Algorithm, Equivalence Relations and Equivalence Classes, Partitions, Partial Ordering Relations, Hasse Diagrams and Lattices, Chains and Anti-chains. **Function:** Function Definition, Composition of Functions, Injective, Surjective and Bijective Function, Inverse of a Function	07
III	**Graphs and Trees:** **Graph theory:** Basic Terminology, Types of Graphs, Paths and Circuits, Hamiltonian and Euler Paths and Circuits, Isomorphic Graphs, Planar Graph, Dijkstra's Shortest Path Algorithm. **Trees**: Trees, Rooted Trees, Prefix Codes, Huffman Algorithm for Optimal Tree, Spanning Trees, Minimum Spanning Trees, Kruskal's and Prim's Algorithm.	08

IV	**Counting:** Introduction, Basic counting principles, principle of inclusion and exclusion, pigeonhole principle, permutations, combinations, permutations and combinations with repetitions, binomial theorem.	**07**
V	**Probability:** The axioms of probability, discrete probability, Random variables, discrete random variable, conditional probability, independent events, Bayes' rule, Bernoulli trials, probability mass function, continuous random variable, probability density function.	**07**
VI	**Probability Distribution** - Cumulative distribution function, properties of cumulative distribution function. Two-dimensional random variables and their distribution functions, Marginal probability function, Independent random variables. Probability distributions: Gaussian distribution, Binomial Distribution, Poisson Distribution.	**08**
	Total	**45**

Textbooks:
1. C. L. Liu, "Elements of Discrete Mathematics", Tata McGraw-Hill, 4th Edition, 2017, ISBN 978- 1259006395.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw-Hill, 8th Edition, 2018, ISBN 978- 1259676512

Reference Books:
1. Dr. K. D. Joshi, "Foundations of Discrete Mathematics", New Age International Limited Publishers, 2nd Edition, January 2014, ISBN-13: 978-8122435986
2. Nicholas N.N., Nsowah-Nuamah, "Introduction to Probability Theory" Universal Book Stall.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :			III
Course :	Computer Organization and Operating Systems			Code :			BCS3403

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
02	–	02	02	20	30	50	100

Prior knowledge of Basic Electrical and Electronics Engineering is essential.

Course Objectives:

1. To get acquainted with the basic concept of computer organization & operating systems.
2. To learn and understand data structures used in the design of operating systems.
3. To understand the functions of operating systems.
4. To learn process management and inter-process communication
5. To learn memory management and I/O management

Course Outcomes:
After learning the course, students will be able to:
1. Use the basic concepts of Computer Organization.
2. Comprehend the internal components of operating systems
3. Analyze the solutions of process synchronization
4. Compare various process scheduling and memory management algorithms
5. Simulate various components of OS for hypothetical OS
6. Analyze the design requirements for I/O management

Detailed Syllabus:		
Unit	**Description**	**Duration (Hours)**
I	**Computer Organization:** Introduction: Function and structure of a computer, Functional components, Interconnection of components, Processing Unit: Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Input/Output Subsystem: Access of I/O devices, I/O ports, I/O interfaces - Serial port, Parallel port, PCI bus. I/O peripherals - Input devices, Output devices, Secondary storage devices. Memory Subsystem: Memory cells - SRAM and DRAM.	08
II	**Introduction to OS.** Operating system functions, Different types of O.S, **Process Management:** Process Management: Process Concept- Process states, Process control block, Threads, system calls. Process Scheduling: Basic Concepts, Scheduling Algorithms. **Case Study:** Process model and Process management system calls in xv6. **Process Synchronization:** Introduction, Critical-Section Problem, Semaphores, **Deadlocks:** Introduction, Methods for Handling Deadlocks, Bankers algorithm. **Case Study:** Kernel level synchronization (spinlocks) in xv6.	08
III	**Memory Management:**Memory management: Introduction, Contiguous and non-contiguous, Swapping, Memory Allocation Strategies, Paging, Segmentation. Virtual Memory: Background, Demand paging, Page Replacement Policies, Thrashing.	07

	Case Study: Memory management in xv6	
IV	**I/O Management:** File Management: File-System Structure, File-System Operations, Directory Implementation, Allocation Methods, Free-Space Management. I/O Devices, Organization of I/O function, I/O Buffering, Disk Scheduling-Disk Scheduling policies like FIFO, SSTF, SCAN, C-SCAN. **Case Study:** File system design and related systems calls in xv6	**07**
	Total	**30**

Text Books:
1. W. Stallings , "Computer Organization & Architecture: Designing for performance", 10th Edition, 2016, Pearson Education/ Prentice Hall of India, ISBN-10: 0-13-410161-8 | ISBN-13: 978-0-13-410161-3
2. Silberschatz A., Galvin P., Gagne G.; "Operating System Concepts", 9th Edition, John Wiley and Sons.
3. xv6 book rev 11 (MIT**).**

Reference Books:
1. Achyut S. Godbole , Atul Kahate; "Operating Systems", 3rd Edition, McGraw Hill
2. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 -07 - 463579 – 4
3. Stallings W., "Operating Systems", 6th Edition, Prentice Hall, ISBN-978-81-317-2528-3.
4. Andrew S. Tanenbaum; Modern Operating Systems; Prentice Hall of India Publication; 3rd Edition. ISBN: 978-81-203-3904-0

Web references:
1. https://pdos.csail.mit.edu/6.828/2018/xv6/book-rev11.pdf

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :			III
Course :	Data Structures			Code :			BCS3404
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
04	-	04	04	20	30	50	100

Prior Knowledge of : Computer Programming and Problem Solving is essential.

Course Objectives:
1. To understand the standard and abstract data representation methods.
2. To perform operations on the various structured data.
3. To use appropriate data structure for logic building in computational solutions.
4. To understand various data searching and sorting methods with pros and cons.
5. To develop a logic for graphical modeling of real life problems.

Course Outcomes :
After learning the course, students will be able to:
1. Apply the different linear data structures like array,stack and queue to various computing problems.
2. Apply Dynamic memory management strategy to represent data structures
3. Evaluate algorithms and data structures in terms of time and memory complexity using asymptotic notations.
4. Apply nonlinear data structures such as trees and graphs to solve various computing problems
5. Analyze and apply various sorting, searching techniques to solve computing problems.
6. Use collision resolution hashing techniques for efficient data retrieval.

	Detailed Syllabus:	
Unit	**Description**	**Duration (Hours)**
I	**Introduction to Data structures and Array:** Types of Data Structure - Linear & Nonlinear, Static & Dynamic **Algorithms:** Characteristics of algorithms, Analysis of algorithms – Frequency Count, Time & Space complexity, Array: Memory representation, Array as an abstract data type (ADT), Types One Dimensional Array & 2 Dimensional Array, Address Calculation, Operations on Array.Applications: Polynomial representation using array & array of structure.	10
II	**Linked List:** Dynamic Memory Management, Basics of Linked List, Comparison of sequential and linked organizations, Types of linked list, Singly linked list, Doubly linked list, Circular linked list. Operations on Linked list	10
III	**Stack & Queue:** Fundamentals of stack, Stack representation using array and linked List, Operations on stack.**Applications**: Recursion, Validity of parentheses, Expression Evaluation and Conversion. Fundamentals of queue, Queue representation using array and Linked List, Types of queue – Linear Queue, Circular Queue, Dequeue, Priority Queue	10

IV	**Tree:** Basic terminology, representation using array and linked list, Recursive And Non recursive Tree Traversals, Operations on binary tree, Construction of binary tree from traversals, Binary Search tree (BST): Insertion, deletion of a node from BST. Threaded Binary tree (TBT): Creation and traversals on TBT. Height Balanced Tree- AVL tree.	**10**
V	**Graph:** Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first search, Applications Minimum spanning Tree using Prim's and Kruskal's Algorithm	**10**
VI	**Searching , Sorting Techniques and Hashing:** Search Techniques - Sequential search, Binary search.Sorting - Types of sorting- Internal and external sorting, Sorting methods- Bubble sort, Insertion sort, Selection sort. Quick sort and Merge Sort. Hashing: Concepts - Hash table, issues in hashing, hash functions- properties of good hash function, Collision resolution strategies- open addressing and chaining,	**10**
Total		**60**

Text Books:
1. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, Fundamentals of Data structures in C++, 2nd Edition, University Press (India) Pvt.Ltd. 2008

Reference Books:
1. G.A.V. PAI, Data Structures and Algorithms, Concepts, Techniques and Applications, Volume1,1st Edition , Tata McGraw-Hill,2008.
2. Richard F. Gilberg& Behrouz A. Forouzan, Data Structures, Pseudocode Approach with C, 2nd Edition, Cengage Learning India Edition,2007.
3. Langsam, M. J. Augenstein, A. M. Tanenbaum, Data structures using C and C++, 2nd Edition, PHI Education,2008.
4. Sartaj Sahni, Ellis Horowitz, Fundamentals of Data Structures in C, 2nd Edition, Orientblackswan,2010.

Web Reference:
1. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester:			III
Course:	Object Oriented Programming			Code:			BCS3405
Teaching Scheme:				Evaluation Scheme:			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior Knowledge of: Computer programming and problem solving is essential.

Course Objectives:
1. To demonstrate the principles of Object-Oriented Programming (OOP).
2. To use the object-oriented paradigm in program design.
3. To provide a foundation for advanced programming using OOP constructs.
4. To solve complex problems using OOP concepts.

Course Outcomes:
After learning the course, students will be able to:
1. Demonstrate the fundamentals of Object Oriented Programming.
2. Apply Inheritance constructs to design various software scenarios
3. Identify and handle the Exceptions.
4. Perform file handling operations using Object Oriented Programming.
5. Select and Apply the concepts of polymorphism to construct and design various software scenarios.
6. Use components of Standard Template Library to design computer programs

	Detailed Syllabus	
Unit	Description	Duration (Hours)
I	**Introduction to Object Oriented Programming:** Introduction to various programming paradigms: Procedural, object-oriented, logical and functional, Features of OOP. **Data Types**: variables and constants, Class – Data members, Member Functions, and class as abstract data type, Object Visibility Modes, Constructor & Types of Constructors, Destructor, Binding – static & dynamic, Inline Function, Static Members, Static Function, Friend Function, Friend Class, Array of Objects.	07
II	**Inheritance:** Derived class & base class Public, Protected and Private Inheritance, Types of inheritance, Ambiguity in multiple inheritance & multipath inheritance, Constructor & Destructor in Inheritance, Order of Constructor and Destructor Call.	08
III	**Polymorphism:** Introduction: Function overloading & Operator overloading: Overloading unary & binary operators, Data conversion, Pointers to Objects, this pointer,Virtual function, Pure virtual function, Abstract class.	08

IV	**Generic Programming & Exception Handling:** Generic Programming - Function Template Class templates Template with multiple parameters Exception Handling - Exception Handling: Fundamentals multiple catching nested try statements uncaught exceptions throw and rethrow Stack unwinding.	**07**
V	**File Handling:** Classes for file stream operation, Opening and closing a file - File mode, Error Handling functions in file, File Operations on Characters, File Operations on Binary Files – Variables, Class Objects, Sequential File Organization, Direct Access Files, Indexed sequential File organization, Linked Organization.	**08**
VI	**Standard Template Library:** Standard Template Library (STL), components of STL: Containers, algorithms and iterators, Containers- Sequence container, associative containers, container adapters, Iterators- input, output, forward, bidirectional and random access, Algorithms- basic searching and sorting algorithms, set operations.	**07**
Total		**45**

Textbooks:
1. E. Balagurusamy, "Object -Oriented Programming with C++", McGraw Hill Education, Eighth Edition, Sept. 2020, ISBN-13 : 978-9389949186.
2. Ivor Horton, Peter Van Weert, "Beginning C++20" , Novice Professional, Sixth Edition, 2020, ISBN-13: 978- 1484258835 (ISBN-10: 1484258835)
3. Robert Lafore, "OOP in C++", Pearson Publishing, 4th Edition, 2001, ISBN:0672323087 (ISBN 13: 9780672323089).

Reference Books:
1. Bjarne Stroustrup, The C++ Programming language, Third edition, 2008, Pearson Education. ISBN 9780201889543.
2. Deitel, C++ How to Program, 4 th Edition, Pearson Education,2002, ISBN:81-297-0276-2.
3. Herbert Schildt, C++ The complete reference, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :		III	
Course :	Data Science Lab			Code :		BCS3406	
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	25	50	-	75

Prior Knowledge of Computer Programming & Problem Solving is essential.

Course Objectives:
1. To write software programs using linear algebra, matrices and using data structures in Python.
2. To apply mathematical techniques in the field of data science for analysis of data.
3. To use the theory of statistics for data analysis.
4. To learn the data preprocessing and data visualization techniques.
5. To perform regression analysis and classification tasks for various applications.

Course Outcomes:
After learning the course, students will be able to:
1. Implement data preprocessing techniques to prepare the data for analysis.
2. Implement data visualization techniques to analyze data graphically.
3. Perform statistical analysis to understand the data representation by computing statistical measures.
4. Write a software program to perform hypothesis tests on sample data.
5. Implement the regression techniques for data analysis.
6. Develop a classification model and evaluate its performance.

Guidelines: The suggested list of assignments is given below. Instructors can frame suitable assignments based on scenarios. Students should perform all assignments compulsorily using Python. As per assignment requirement, an open-source data can be downloaded from the web (Kaggle, github, UCI ML repository, OpenML, Datahub, Data.gov, etc).

Assignment No.	Suggested List of Assignment
1.	Write programs using Python language constructs. Suitable 2 assignments will be framed based on topics such as: Data types and data structures in Python– lists, array, dictionary, tuple, etc. Reading data from files. Different types of language constructs: operators, control structures, functions. Python libraries like pandas, NumPy, etc. Suggested list is as follows: a) Write a python program to create a list of random numbers in normal distribution and display the frequency of each value b) Write a python program to print the odd and even numbers from a given range taken as per user's input and display the prime numbers from the first 20 odd numbers. c) Write a python program to read any .csv file as per user-provided input and display its content.

2.	Write programs using Python language constructs. Suitable 2 assignments will be framed based on topics such as: Data types and data structures in Python– lists, array, dictionary, tuple, etc. Reading data from files. Different types of language constructs: operators, control structures, functions. Python libraries like pandas, NumPy, etc. Suggested list is as follows: a) To reverse the tuple or unpack the tuple into multiple variables or access a specific value from tuple b) To merge two dictionaries or create a dictionary by extracting only key values from any given dictionary
3.	Write programs using Python language constructs and Python libraries like NumPy to perform linear algebra operations. Suitable any 2 assignments can be framed. Suggested list is as follows: a) To perform addition and subtraction of matrices b) To perform multiplication and division of matrices
4.	Write programs using Python language constructs and Python libraries like NumPy to perform linear algebra operations. Suitable any 2 assignments can be framed. Suggested list is as follows: a) To find the transpose of a matrix b) To solve linear systems of equations by implementing matrices and vectors
5.	Perform the following data preprocessing operations using Python and pandas on any open-source dataset. a) Data Preprocessing operations: check for missing values, noisy data, null values, etc. and handle those. b) Data Integration and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions. Perform data transformations suitably like normalization, standardization, etc. Turn categorical variables into quantitative variables
6.	Create an "Academic performance" dataset of students and perform the following operations using Python. a) Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. b) Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them.
7.	Create an "Academic performance" dataset of students and perform the following operations using Python. a) Apply data transformations on suitable variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution.
8.	Write a program for Data Visualization using IRIS flower dataset or any other suitable public dataset a) Create a histogram for each feature in the dataset to illustrate the feature distributions. Plot each histogram. b) Create a boxplot for each feature in the dataset. All of the boxplots should be combined into a single plot. Compare distributions and identify outliers.

9.	Write a program for Data Visualization to create any 6 types of graphs. Select the right chart for data visualization as per requirements like visualization required for comparisons, identification of relationships, identification of trends over time, part of a whole, understanding the distribution of data values, etc. Create graphs among types such as Line plot, Scatter plot, bar plot, Density plot, pie chart, bubble plot, heat maps, tree map, correlation matrices, dendrograms, etc. Use Pima Indians Diabetes dataset or time series data or any other suitable public dataset.
10.	Write a python program to perform descriptive statistics to compute various statistical measures by using Pandas library. Use IRIS flower dataset or any other suitable public dataset.
11.	Write a program to perform hypothesis testing for a suitable dataset. Select appropriate hypothesis testing strategies such as the student's t-test, z test, chi-square test, ANOVA test, etc.
12.	Write a program to implement linear or logistics regression using any suitable public dataset OR the following scenario of Bigmart Sales Analysis may be considered: Perform prediction for the sales of a store using linear or logistics regression. Sample test data set is available here https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/
13.	Write a program to perform classification using Naïve Bayes classifier. Calculate the probabilities by implementing the Bayes theorem using Pima Indians Diabetes dataset or any other suitable public dataset. Measure the performance of the classifier for separate test and training data using various metrics.

Text Books:
1. Thomas Nield ," Essential Math for Data Science" - ,Released October 2022   Publisher(s): O'Reilly Media, Inc. ISBN: 9781098102869

Reference Books:
1. Peter Bruce, Andrew Bruce, Peter Gedeck**,** "Practical Statistics for Data Scientists"- · 2020 , ISBN:9781492072898, 1492072893 ,Published:10 April 2020 , Publisher:O'Reilly Media.
2. Norman Matloff, "Probability and Statistics for Data Science" **-** Norman Matloff · 2019, ISBN:9780429687112, 0429687117 , CRC Press, Published:21 June 2019
3. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press,(2020), ISBN : ISBN 978-1-108-47244-9.
4. Wes McKinney, "Python for Data Analysis", O' Reilly media, ISBN : 978-1-449-31979-3.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester:			III
Course:	Data Structures Lab			Code:			BCS3407
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	25	50	-	75

Prior Knowledge of : Computer Programming and Problem Solving is essential.

Course Objectives:
1. To implement linear data structures using C++.
2. To implement nonlinear data structures using C++.
3. To apply various sorting and searching techniques.
4. To build an efficient program using online platforms/judges.

Course Outcomes:
After learning the course, students will be able to:
1. Develop logic building skills to solve computing problems.
2. Select appropriate data structure and demonstrate a working solution for a given problem.
3. Implement linear data structures to solve various computing problems.
4. Implement hashing and sorting techniques to solve real life problems.
5. Develop an application using nonlinear data structures such as trees and graphs.
6. Analyze different possible solutions to a program and select the most efficient one.

Guidelines for Laboratory Conduction:
The instructor is expected to frame the set of suggested assignment lists provided. Each student must perform all assignments. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. Instructors may also set one assignment or mini-project that is suitable to the respective branch beyond the scope of syllabus. Assignments should be implemented in C++ language. Operating System recommended: - 64-bit Open source Linux or its derivative.
Programming tools recommended: - G++/GCC, Eclipse.

Assignment No.	Suggested List of Assignments (All assignments are compulsory)
1.	Write a C++ program to implement a two dimensional array and perform the operations such as insert, display, search, and find minimum and maximum elements from it.
2.	Write a C++ program to implement a singly link list and perform operations such as insert, delete, display, search element from it, reverse the list. (Implement using Online judge Codechef / Hackerrank platform)
3.	Write a C++ program to implement a doubly linked list and perform operations such as insert, delete, display, search element from it.
4.	Write a C++ program to implement a circular linked list and perform operations such as insert, delete, display, search element from it.
5.	Write a C++ program to implement Stack & Queue using Linked list.
6.	Write a C++ perform to implement a doubly ended queue.

7.	Write a C++ program to perform infix to postfix conversion using a stack.
8.	Write a C++ program to construct a binary search tree and perform insertion, deletion, searching of a node and its traversal. ((Implement using Online judge Codechef / Hackerrank platform)
9.	Write a C++ program to implement a threaded binary tree and its traversal.
10.	Write a C++ program to perform the following operations on a height balanced tree: i) Insert a node ii) Search a node iii) Display it in ascending order.
11.	Write a C++ program for the implementation of bfs and dfs for a given graph.
12.	Write a C++ program to find the minimum spanning tree of a given undirected graph.
13.	Write a C++ program to search the contact number of a particular student using the following search algorithms: i) Linear Search ii) Binary Search.
14.	Write a C++ program to store the monthly salary of an employee in an array. Sort array of numbers in ascending order using i) Bubble sort ii) Quick sort, iii) Insertion sort . and Display details of the top five employees with the highest salary.
15.	Consider the employee database of N employees. Make use of a hash table implementation to quickly look up the employee's id number.

Text Books:
1. Horowitz and Sahani, "Fundamentals of Data Structures in C++", University Press, ISBN 10:0716782928 /ISBN 13: 9780716782926.
2. Brassard & Bratley, "Fundamentals of Algorithms", Prentice Hall India/Pearson Education, ISBN 13-9788120311312.

Reference Books:
1. Horowitz, Sahani and Rajshekaran, "Fundamentals of Computer Algorithms", University Press, ISBN 13: 9788175152571.
2. Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, "Data Structures using C and C++", Pearson Education, ISBN 81-317-0328-2.

Program:	B. Tech. CSE (AI & ML)			Semester:		III	
Course:	Object Oriented Programming Lab			Code:		BCS3408	
Teaching Scheme:				Evaluation Scheme:			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	-	25	50

Prior Knowledge of : Computer Programming and Problem Solving is essential.

Course Objectives:
1. To develop solutions by using various OOP concepts.
2. To strengthen problem solving ability by using the characteristics of an object-oriented approach.
3. To apply appropriate Object-Oriented features for various applications.
4. To handle Exceptions in programs.

Course Outcomes:
After learning the course, students will be able to:
1. Apply various object-oriented features for problem solving.
2. Develop the solutions using features of C++ supporting object oriented programming
3. Implement object oriented programs using encapsulation.
4. Write Object oriented programs using inheritance and polymorphism.
5. Develop the solutions using advanced features of C++ such as stream I/O, templates and operator overloading.
6. Write programs to perform file handling operations.

Guidelines for Students:
- Each student must perform at least 10 assignments.
- Assignments should be implemented in C++ language.
- Operating System recommended: - 64-bit Open source Linux or its derivative.
- Programming tools recommended: - G++/GCC, Eclipse.

Assignment No. Suggested List of Assignments	
1.	Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.
2.	Write a program to illustrate default constructor, parameterized constructor and copy constructors. Program should illustrate the order of execution of constructors and destructors when a new class is derived from more than one base class.
3.	Implement a class Complex which represents the Complex Number data type. Implement the following operations: a Constructor (including a default constructor which creates the complex number 0+0i). b Overloaded operator + to add two complex numbers. c. Overloaded operator * to multiply two complex numbers. d. Overloaded << and >> to print and read Complex Numbers.
4.	Write C++ programs that illustrate how the following forms of inheritance are supported: a)Single inheritance b)Multiple inheritance c)Multilevel inheritance d)Hierarchical inheritance.

5.	Write a C++ program using the following concepts.
	    a. Friend Function
	    b. Friend Class
	    c. Static data Member
	    d. Static Function
	    e. Inline Function

6.	Write a C++ program to implement the matrix ADT using a class. The operations supported by this ADT are: a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices. e) Multiplication of matrices
7.	Write a class template to represent a generic vector. Include member functions to perform the following tasks: To create the vector. b To modify the value of a given element. c To multiply the vector by a scalar value. d To display the vector in the form (10, 20, 30)
8.	Write a program to maintain an employee database in a binary file with employee information such as empId, name, age, department, post and salary. Write function for adding new records, displaying all records, searching for a particular employee, updating employee salary and post.
9.	Write C++ program using STL to add binary numbers (assume one bit as one number); use STL stack. Write C++ program using STL map for managing Person Records (Name, birth date, telephone no). Perform operations – add, display, search, delete, and update.
10.	Write a C++ program using STL to perform various stack and queue operations.
11.	Write a C++ to handle the exception if account balance is less than minimum balance.
12.	Write a C++ Program to Check Characters are Uppercase, Lowercase, Digit or SpecialCharacter.

Text Books:
1. Richard F. Gilberg& Behrouz A. Forouzan, "Data Structures, Pseudo code Approach with C", Cengage Learning India Edition, 2nd Edition, 2007, ISBN 10: 8131503143 / ISBN 13: 9788131503140.
2. Herbert Schildt, "C++: The Complete Reference", McGraw Hill Education, 4th Edition, July 2017, ISBN-10 : 007053246X (ISBN-13 : 978-0070532465).

Reference Books:
1. Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C", Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1.
2. Bjarne Stroustrup, "The C++ Programming language" , Pearson Education , Third edition, 2008, ISBN 9780201889543.

Program:	B. Tech. CSE(AI&ML)		Semester :		III	
Course :	Universal Human Values (HSMC-I)		Code:		BHM3101	
Teaching Scheme				**Evaluation Scheme**		
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-	03	03	30	-	20	50

Prior knowledge: Nil

Course Objectives:
1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Course Outcomes:
After learning the course, students will be able to:
1. Understand the relevance of Universal Human Values.
2. Interpret the concept of 'Self' & 'Body'.
3. Develop harmony in the family based on nine Universal Human Values.
4. Apply the sense of Harmony in society.
5. Take part in maintaining coexistence with Nature.
6. Integrate Universal HumanValues in personal and professional life.

	Detailed Syllabus:	
Unit	**Description**	**Duration (Hours)**
I	**Introduction to Value Education:** Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Right Understanding, Relationship and Physical Facility, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations	**06**
	Practice Session: Sharing about Oneself, Exploring Human Consciousness, Exploring Natural Acceptance	**03**
II	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.	**06**
	Practice Session: Exploring the Difference of Needs of Self and Body, Exploring Sources of Imagination in the Self, Exploring Harmony of Self with the Body .	**03**
III	**Harmony in the Family:** Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, Nine universal values in relationships viz. Trust, Respect, Affection, Care, Guidance, Reverence, Glory, Gratitude, Love	**04**

		Practice Session: Exploring the Feeling of Trust, Exploring the Feeling of Respect	**03**
IV		**Harmony in Society:** Understanding Harmony in the Society, Vision for the Universal Human Order, Human Order Five Dimensions	**03**
		Practice Session: Exploring Systems to fulfill Human Goals	**02**
V		**Harmony in Nature/Existence:** Understanding Harmony in Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Coexistence at All Levels, The Holistic Perception of Harmony in Existence	**03**
		Practice Session: Exploring the Four Orders of Nature, Exploring Co-existence in Existence	**02**
VI		**Implications of the Holistic Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	**04**
		Practice Session: Exploring Ethical Human Conduct, Exploring Humanistic Models inEducation, Exploring Steps of Transition towards Universal Human Order	**06**
		Total	**45**

Text Books
1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics,, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books
1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
4. On Education - J Krishnamurthy
5. Rediscovering India - by Dharampal
6. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

Web references:
1. http://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
3. https://youtu.be/OgdNx0X923I

Program:	B. Tech. CSE(AI&ML)		Semester	III
Course :	Life Skills-III		Code :	BHM3939

Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	TW	PR	OR	Total
-	02	-	-	-	-	-	-

Prior knowledge: Nil

Course Objectives:
1. To attain mental, emotional balance and spiritually to achieve self-realization and enlightenment to help better understand the inner personality & its establishment of harmony with the external demands.
2. To learn to build team spirit and adapt to the various skills required in various sports activities.
3. To provide a platform to express their mind, body, and emotions through performing arts.

Course Outcomes:
After learning the course, students will be able to:
1. Achieve a balanced state of mind and enjoy improved mental, physical, emotional, and spiritual wellbeing.
2. Apply sportsmanship skills in the context of leadership, sports management etc.
3. Demonstrate the ability to think critically about a variety of visual and performing arts.

Detailed Syllabus:		

Unit	Description	Duration (Hours)
I	**Practicing Meditation** Pranayama and Breathing exercises, Meditation Technique, Thoughtless Awareness : Through Patanjali /Sahaja Yoga/Vipassana /Madhyasth Darshan/ Art of Living etc., **OR** **Sports:** Indoor Games / Outdoor Games	12
II	**Performing arts** Music, Singing, Poetry, Indian Conventional Dancing, Photography, Short Movie Making, Painting/ Sketching/ Drawing, Theater Arts, Anchoring, Calligraphy etc.	12
Total		24

Reference Books:

1. Vishnu Devananda, "Meditation and Mantras" ,1978.
2. Swami Vivekananda, "Patanjali"s Yoga Sutras", 1 Jan 2012.
3. Shri Mataji Nirmala Devi, "Sahajayoga an Introduction"
4. William Hart , S. N. Goenka, "The Art of Living", 4 August 2009.
5. Dennis Hill, "Meditation Deep Peace", Trafford Publishing, 7 August 2014.
6. Boria Majumdar, Sachin Tendulakar, "Sachin Tendulkar – Playing It My Way", Hodder & Stoughton, Hachette Livre publishing, 6 November 2014.
7. Milkha Singh, "The Race of My Life", 2013.
8. Sfurti Sahare, "Think and Win like Dhoni", 3 July 2016.
9. Dina Serto and Mary Kom, "Unbreakable", 19 November 2013.
10. Ronojoy Sen, "Nation at Play: A History of Sport in India", 2015.
11. Andre Agassi, "Open", 2009.

12. Dr. Monica Hiten Shah, "Sangeet Aradhana", Aradhana Sangeet Academy Ahmedabad, Edition 2018.
13. Kishori Amonkar , "Recreating A Dream", Standard Edition .
14. Veejay Sai & foreward by Girish Karnad, "Drama Queens – Women who created history on Stage", Roli Books publication.
15. Jiwan Pani, "Back to the roots – Essays on Performing Arts of India", 1 January 2004.

Course Syllabus
SY B Tech CSE (AI & ML)
Semester-IV

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :		IV	
Course :	Machine Learning			Code :		BCS4409	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-	03	03	20	30	50	100

Prior knowledge of **Linear Algebra** is essential.

Course Objectives:
1. To understand the basics of Machine Learning.
2. To apply different machine learning models to various datasets.
3. To design and implement various machine learning algorithms in a range of real-world applications.
4. To interpret the model results and analyze the accuracy of the model.

Course Outcomes:
After learning the course, students will be able to:
1. Distinguish basic applications and issues of Machine Learning.
2. Use different data preprocessing techniques to prepare training and testing data set.
3. Solve various problems using regression algorithms and improve the model performance.
4. Analyze various Machine Learning techniques and algorithms.
5. Evaluate the performance of the model using different performance metrics.
6. Interpret and Analyze results with reasoning using different ML techniques.

	Detailed Syllabus:	
Unit	**Description**	**Duration (Hours)**
I	**Basics of machine learning:** Introduction to Machine Learning, Applications, Introduction to Machine Learning Techniques: Supervised Learning, Unsupervised Learning and Reinforcement Learning, Data formats, Underfitting and Overfitting, Creating training and testing datasets, Feature Selection and Filtering, Principal Component Analysis (PCA)	**08**
II	**Regression techniques:** Linear Regression and higher dimensionality, Ridge regression, Lasso and ElasticNet regression, polynomial regression, Robust regression with random sample consensus, Stochastic gradient descendent algorithms, Finding the optimal hyper-parameters through grid search.	**07**
III	**Supervised learning:** Classification: K-Nearest Neighbor, Decision Tree Classification, Random Forest, Support Vector Machine (SVM), Evaluation Measures: SSE, MME, R2, confusion matrix, precision, recall, F-Score, ROC-Curve, cross-validation.	**07**

IV	**Unsupervised learning:** Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitional Clustering - K-means clustering, Finding optimal number of clusters using Elbow method. Association Rule Learning	**08**
V	**Artificial Neural Network:** Introduction to ANN, Perceptron, Cost Function, Gradient Checking, multilayer perceptron and backpropagation algorithm that is used to help learn parameters for a neural network, Random Initialization	**07**
VI	**Reinforcement Learning & Ensemble Method:** Reinforcement learning through feedback network, function approximation. Ensemble Method**:** Bagging, boosting, stacking and learning with ensembles. Random Forest.	**08**
Total		**45**

Text Books:
1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Ltd., ISBN 978-1-78588-962-2
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O"REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.
3. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807

Reference Books:
1. EthemAlpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, *ISBN*-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN : 0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O"REILLY publication, second edition 2017, ISBN: 1491925612

Web references:
1. http://scikit-learn.org/stable/datasets/
2. https://scikit-learn.org/stable/modules/model_evaluation.html
3. https://www.kaggle.com/dataset

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)				Semester:		IV	
Course:	**Database Systems**				**Code:**		**BCS4410**	
Teaching Scheme:					**Evaluation Scheme:**			
Lecture	**Tutorial**		**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-		03	03	20	30	50	100

Prior Knowledge of: 1. Discrete Mathematics 2. Data Structures are essential.

Course Objectives:
1. To understand the fundamental concepts of database systems.
2. To learn Database query language.
3. To understand the basic issues of transaction processing and concurrency control.
4. To learn unstructured data management.

Course Outcomes:
After learning the course, students will be able to:
1. Classify and compare Database Management Systems.
2. Write queries and PL/SQL Code blocks.
3. Design schema in appropriate normal form considering actual requirements.
4. Demonstrate use of ACID properties for transaction management.
5. Use advanced database Programming concepts like mongoDB.
6. Apply Vector Space Model on unstructured database

Detailed Syllabus:

Unit	Description	Duration (Hours)
I	**Introduction:** Characteristics and fundamental concepts of Databases, Types of Data Models and Data Modeling, Elements of Database Systems, Classification and comparison of Database Management Systems (Regular and NoSQL Page), E-R and EER diagram, bIntroduction to Data Mining & Data Warehousing.	**08**
II	**SQL and PL/SQL:** Introduction to **SQL:** Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Updating, SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL, Views: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, SQL Functions, Nested Queries, **PL/SQL:** Stored Procedures & Functions, Cursors, Triggers, Assertions, Roles and Privileges	**07**
III	**Structured and Semi-Structured Data Management:** Structured data, relational databases, Relational model, Functional Dependencies, Normal Forms, algorithms for query optimization, Semi-structured data, document-databases, semi-structured data abstraction, representation, and search.	**08**

IV	**Transaction Management:** Transaction concept, transaction state, ACID properties, serializability, Recoverability: Shadow-Paging and Log-Based Recovery, Checkpoints. Implementation of Isolation, Testing for serializability, Concurrency control, Lock based concurrency control, Time stamping methods.	07
V	**NoSQL Databases**: Introduction to Distributed Database System- Advantages, disadvantages, CAP Theorem. NoSQL Database: Introduction, need, Features, Types of NoSQL Database, BASE Properties, MongoDB (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.	08
VI	**Unstructured Data Management**: Unstructured text, Information retrieval systems, document retrieval and ranking. Case Study 1-Use of NoSQL databases for processing unstructured data from social media Case Study 1-Use of Vector Space Model for Document database	07
	Total	45

Textbooks:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020 ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.
4. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN 10: 0321826620, 2013, ISBN 13: 978-0321826626.
5. Serge Abiteboul, Peter Buneman, Dan Suciu, Data on the Web: From Relations to Semistructured Data and XML / / 1st Edition / ISBN-13: 978-155860622/ ISBN-10: 155860622X
6. Prabhakar Raghavan, Hinrich Schütze , Introduction to Information Retrieval / Christopher Manning,/ book and slides available online

Reference Books:

1. C. J. Date, "An Introduction to Database Systems", Addison-Wesley, 8th Edition, 2004, ISBN 0321189566.
2. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009,ISBN 9788177585674.
3. Kristina Chodorow, Michael Dierolf, "MongoDB: The Definitive Guide", O'Reilly Publications, 3rd Edition, 2019 ISBN 9781491954461.
4. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereo Pty Limited, 2011,ISBN 1743045743, 9781743045749.
5. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education 2013
6. Ramakrishnan and Gehrke, Database Management Systems,, McGrawHill 2003
7. R.P. Mahapatra, Database Management Systems,, Khanna Book Publishing 2016.
8. J. D. Ullman, "Principles of Database Systems", 2nd Ed., Galgotia Publications

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester:		IV	
Course:	Software Engineering			Code:		BCS4411	
Teaching Scheme:				Evaluation Scheme:			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
02	-	02	02	20	30	50	100

Prior Knowledge of Computer Programming and Problem Solving **is essential.**

Course Objectives:
1. To learn the principles of Software Engineering
2. To learn process models for software project development
3. To learn the methods of capturing, specifying, and analyzing software requirements.
4. To learn design principles to software project development

Course Outcomes:
After learning the course, students will be able to:
1. Comprehend the principles of Software Engineering.
2. Apply appropriate process models for specific software project development.
3. Analyze software requirements
4. Apply Design principles to software project development.
5. Design the system using UML diagrams.
6. Analyze the agile software development process Model

	Detailed Syllabus:	
Unit	Description	Duration (Hours)
I	**Introduction and Software Process Models :** Software Engineering, Myths, Software Process, Software development life cycle, Work Products, Importance of Software Engineering, Standard for Software Process, Waterfall Model, Prototyping Model, Iterative Enhancement Model, Spiral Model, RAD model, 4th Generation models, Formal Methods, Agile DevelopmentCase Study: Introduction to Safe Home.	08
II	**Software Requirement Specification, Design and Coding:** Requirements Engineering- Problem analysis, Establishing the Groundwork-Eliciting Requirements, Requirements Analysis-Requirements Modeling Strategies.Design Concepts, Modularity, Architectural design, Coupling and Cohesion, Top-down and bottom-up design,Software Design Document, Coding styles and documentation	07

III	**Agile development:** Agile Process- Extreme Programming in agile development, Pair Programming in agile development, Agile software development process Models: SCRUM, Sprint Cycle, Sprint Cycle Stages, SCRUM master, Kanban Boards and Methodology, Comparison of Agile with Conventional process models.	**08**
IV	**Computer Aided Software Engineering and Advanced Topics:** Computer Aided Software Engineering (CASE) and its Scope, CASE support in Software Life Cycle, Architecture of CASE Environment, Upper CASE and Lower CASE, Exposure to CASE tools. Software Process Improvement, Component Based Software Engineering, Web Engineering, Reverse Engineering, Software Engineering challenges of Big Data, Mobile Applications	**07**
	Total	**30**

Textbooks:
1. Roger S Pressman, "Software Engineering – A Practitioner's Approach", Pearson Education, 7th Edition, 2010.
2. Ian Sommerville, "Software Engineering", 9 th edition, 2010.
3. N.S. Gill, Software Engineering,, Khanna Publishing Co., Delhi 2018.
4. Software Engineering (3rd ed.), By K.K Aggarwal & Yogesh Singh, New Age International Publishers, 2007.

Reference Books:
1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 10: 0133056996, 2002.
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 13: 978-8120348981, 2014.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715, 2010.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester :		IV	
Course :	Artificial Intelligence			Code :		BCS4412	
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior Knowledge of Data Structures and Algorithms is essential

Course Objectives:
1. To impart artificial intelligence principles, techniques and its history
2. To understand the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods.
3. To apply multi-agents in competitive environment
4. To learn intelligent systems by assembling solutions to concrete computational problems

Course Outcomes:

After learning the course, student will be able to:

1. Select and Apply intelligent agents for various AI applications.
2. Apply various search strategies and algorithms to solve real life problems
3. Apply basic principles of AI for problem solving using inference, perception, knowledge representation and learning.
4. Demonstrate knowledge representation and reasoning for solving real world problems
5. Design an Expert System by performing problem decomposition and Planning.
6. Perform knowledge reasoning in uncertainty conditions.

	Detailed Syllabus:	

Unit	Description	Duration (Hours)
I	**Introduction :** Introduction to Artificial Intelligence, Applications of AI , Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Concept of Rationality, Nature of Environments, Structure of Agents**.** **Case Study:** AI In Automotive: A New Edge Of the Automotive Industry	08
II	**Problem-solving:** Problem-Solving Agents, Searching for solution, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problem-Gradient Descent**.** **Case Study:** The AI Revolution Is Happening Now	07
III	**Adversarial Search**: Games, Optimal Decisions in Games, Alpha–Beta Tree Search, Stochastic Games, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Crypt-arithmetic problem. **Case Study:** The Unseen Revolution: Video Game AI	08

IV	**Knowledge Representation and Reasoning:** Knowledge Based Agents, Logic, Propositional Logic and theorem proving, First Order Logic- Syntax and semantics, Knowledge engineering in FOL,Second Order Logic, Inference in FOL-Unification and Lifting, Forward Chaining, Backward Chaining, Resolution. **Case Study:** Beyond Siri: The AI revolution coming from the web	07
V	**Problem Decomposition and Planning:** Goal Trees, Rule Based Systems, Rule Based Expert Systems. Planning: STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning **Case Study:** The coming AI revolution in retail and consumer products - IBM	08
VI	**Reasoning with Uncertainty**: Handling uncertain knowledge, axioms of probability, inference using full joint distributions, independence, Baye's Rule , Bayesian network -Semantics, Exact and Approximate inference in Bayesian Networks **Case Study:** How AI handles uncertainty	07
	Total	45

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson, 4th edition, 2020, ISBN-13 : 978-0134610993
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07- 008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, "Artificial Intelligence, As per AICTE: Making a System Intelligent",Wiley publication, ISBN: 9788126579945.

Web References:

1. https://futureoflife.org/2018/03/15/how-ai-handles-uncertainty-brian-ziebart/#:~:text=Cautious%20and%20 uncertain%2C%20AI%20 systems,to%20ask%20 humans%20for%20 help.

Program:	B. Tech. CSE (AI & ML)			Semester:		IV	
Course:	Machine Learning Lab			Code:		BCS4413	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	-	25	50

Prior Knowledge of : Data Science is essential.

Course Objectives:

1. To develop skills for preparing training and testing data set
2. To solve regression problems using regression techniques.
3. To develop skills to identify nature of the problem and apply machine learning algorithm
4. To develop classifier model using classification algorithms
5. To interpret the model results and analyze the accuracy of the model

Course Outcomes:

After learning the course students will be able to:
1. Use different feature selection techniques to prepare training and testing dataset.
2. Apply regression algorithms to solve real world problems and improve the model performance
3. Compare different regularization techniques for linear regression problems
4. Apply classification algorithms to solve real world problems.
5. Evaluate the performance of the model using different performance metrics.
6. Develop a Machine Learning application to provide optimal solution to the selected problem statement

Guidelines for Students:
1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:

1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness

Note: The suggested list of assignments is given below. Instructors can frame suitable assignments.

Department of Computer Science & Engineering (AI & ML)

Assignment No.	Suggested List of Assignments
1.	Select any data set with high dimensions (such as the Boston dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Write a program to Reduce dimensions using SelectKBest method on the selected dataset and display the result.
2.	Select any data set with high dimensions (such as the Boston dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Write a program to Reduce dimensions using SelectPercentile method on the selected dataset and display the result.
3.	Select any data set with high dimensions (such as the Boston dataset, breast cancer dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Write a program to perform dimensionality reduction using PCA on the selected dataset and display the result.
4.	Select any data set with high dimensions (such as Diabetes dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Implement Linear Regression. Evaluate and compare the performance of the model.
5.	Select any data set with high dimensions (such as Diabetes dataset) from any repository of data such as SK-Learn, UCI library, Kaggle dataset library etc. Implement Ridge, Lasso and ElasticNet models. Evaluate and compare the performance of these models.
6.	Select any suitable dataset (such as Diabetes dataset, Bostan dataset, breast cancer dataset) perform classification using Support vector machine algorithm.
7.	Select any suitable dataset (such as Diabetes dataset, Bostan dataset, breast cancer dataset) perform classification using K-nearest neighbor algorithm for different k values.
8.	Select any suitable dataset (such as Diabetes dataset, Bostan dataset, breast cancer dataset) perform classification using K- Means clustering Technique.
9.	Implementation of following machine learning algorithms using Python: Artificial Neural Network (with back-propagation).
10.	Implementation of following machine learning algorithms using Python: Logistic Regression
11.	Implementation of following machine learning algorithms using Python: Decision Trees.
12.	Implementation of following machine learning algorithms using Python: Random Forest.

Reference Books:
1. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, *ISBN*-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN : 0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O"REILLY publication, second edition 2017, ISBN: 1491925612

Web references:
1. http://scikit-learn.org/stable/datasets/
2. https://scikit-learn.org/stable/modules/model_evaluation.html
3. https://www.kaggle.com/dataset

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester:		IV	
Course:	Database Systems Lab			Code:		BCS4414	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	0 4	25	50	-	75

Prior Knowledge of : Data Structures is essential.

Course Objectives:
1. To develop Database programming skills
2. To develop basic Database administration skills
3. To develop skills to handle NoSQL database
4. To learn different types of database systems and their applications in different scenarios.

Course Outcomes:
 After learning the course, students will be able to:
1. Implement SQL queries for given requirements.
2. Implement PL/SQL Code block for given requirements
3. Implement NoSQL queries using MongoDB
4. Implement document retrieval and ranking using any algorithm.
5. Apply practical principles involved in the design and use of database systems.
6. Design and implement databases for various scenarios.

Guidelines for Students:

Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of students.

Guidelines for Laboratory Conduction:
The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and is inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to each branch beyond the scope of the syllabus. Operating System recommended :- 64-bit Open source Linux or its derivative Programming tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

Assignment No.	Suggested List of Assignments
1.	Design at least 10 queries to perform SQL DDL and DML operations.
2.	Design at least 10 queries to perform DML operations , use appropriate constraints (Primary key, foreign key, default, check etc.)
3.	Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym

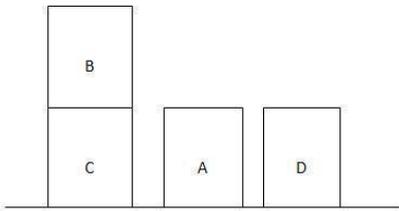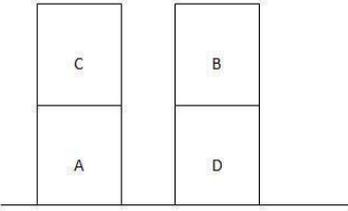|	
4.	Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, Delete with operators, functions, and set operators.
5.	Design at least 10 SQL queries for suitable database application using SQL DML statements: all types of Join, Sub-Queries.
6.	Write a PL/SQL block of code. Instructor can frame 5 problem statements for writing PL/SQL block
7.	Write a PL/SQL block of code to implement all types of cursors.
8.	Write a PL/SQL Stored Procedure and functions. Instructor can frame 5 problem statements.
9.	Write a database trigger on the Employee table. Instructors can frame the problem statements for writing Database Triggers of all types.
10.	Large Scale Databases: a. Design and Develop MongoDB Queries using CRUD operations. b. Implement aggregation and indexing with suitable examples using MongoDB. c. Implement Map reduce operations with suitable examples using MongoDB. d. Create simple objects and array objects using JSON. Encode and Decode JSON Objects using Java/Perl/PHP/Python/Ruby
11.	Implement document retrieval and ranking using any algorithm.
12.	Mini Project: a. Write a program to implement MongoDB database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit etc.) using ODBC/JDBC. b. Implement MYSQL/Oracle database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC. c. Students in the group are expected to design and develop a database application with following details: - Design Entity Relationship Model, Relational Model, Database Normalization - Front End: Java/Perl/PHP/Python/Ruby/.net - Backend: MongoDB/MYSQL/Oracle - Database Connectivity: ODBC/JDBC - Project Report preparation

Reference Books:
1. Ivan Bayross, "SQL, PL/SQL: The Programming Language of Oracle", BPB Publication, ISBN10: 8176560723; ISBN-13: 78-8176560726
2. Kristina Chodorow, Michael Dirolf, "MangoDB: The Definitive Guide", O'Reilly Publications, ISBN: 9781449381561
3. Import, Tidy, Transform," R for Data Science", O'REILLY, ISBN: 13:978-93-5213-497-7
4. http://www.tutorialspoint.com/json/ & http://docs.mongodb.org/manual/

Program:	B. Tech. CSE (AI & ML)			Semester :		IV	
Course :	Artificial Intelligence Lab			Code :		BCS4415	
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	25	50	-	75

Prior Knowledge of Python and Java is essential

Course Objectives:
1. Identify the type of search strategy that is more appropriate to address a particular problem and implement the selected strategy
2. To develop intelligent systems by assembling solutions to concrete computational problems
3. To analyze the type of problem and apply the appropriate strategy to solve it
4. To perform uncertain knowledge and reasoning for any real time problem

Course Outcomes:
After learning the course, students will be able to:

1. Develop a solution to complex problems by applying a search strategy.
2. Formulate and implement constraints in search problems
3. Design and implement planning strategy for an agent considering suitable environment.
4. Develop an application to analyze uncertain knowledge for deriving conclusions and quantification of the uncertainty.
5. Develop an expert system by applying AI principles.
6. Design and implement an interactive application using AI principles.

Guidelines for Students:

1. The laboratory assignments are to be submitted by students in the form of a journal.
2. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, data description, conclusion, and assessor's signature.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory/Term Work Assessment:
1. Continuous assessment of laboratory work is done based on the overall performance and laboratory performance of the students.
2. Each laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.
3. Suggested parameters for overall assessment as well as each laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction
1. Recommended Tools for the implementation of above assignments: Python, Java.
2. For a mini project, select a real world application in the group of 3-4 students and formulate a problem statement for the application to be developed.
3. Student groups are required to continue the same problem statement throughout all the assignments in order to design and develop an application as a part of a mini project. Further assignments will be useful for students to develop an application.

Note: The suggested list of assignments is given below. Instructors can frame suitable assignments. Students should perform all assignments. Mini-project is compulsory

Detailed Practical Syllabus:

Assignment No.	Suggested List of Assignment
1.	Write a program to implement depth Limited search algorithm and Breadth First Search algorithm, Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.
2.	Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).
3	Solve 8-puzzle problem using A* algorithm. Assume any initial configuration and define goal configuration clearly.
4.	Constraint Satisfaction Problem: Write a program to implement a crypt-arithmetic problem or n-queens or graph coloring problem (Branch and Bound and Backtracking).
5.	Write a program to implement Local search Hill climbing algorithm for blocks world problem.
6.	Write a program to implement alpha-beta pruning graphically with proper examples and justify the pruning.
7.	Write a program to implement 3 missionaries and 3 cannibal problems depicting appropriate graphs. Use A* algorithm.
8.	Write a program to implement goal stack planning for the following configurations from the blocks world, Initial State ON(B,C) ∧ ONTABLE(C) ∧ ONTABLE(A) ∧ ONTABLE(D) CLEAR(B) ∧ CLEAR(A) ∧ CLEAR(D) Goal State ON(C,A) ∧ ON(B,D) ∧ ONTABLE(A) ∧ ONTABLE(D) ∧ CLEAR(C) ∧ CLEAR(B)
9.	Write a program to build a Bayesian Network that will model the performance of a student in an exam

10.	**Mini-Project**
	a. Implement any one of the following Expert System I. Information management II. Hospitals and medical facilities III. Help desks management IV. Employee performance evaluation V. Stock market trading VI. Airline scheduling and cargo schedules or b. Implement AI Chatbot to Support any customer or business application c. Implement Technical ability Prediction System via CV Analysis of student d. Implement AI-assisted Sudoku Solver.

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN:10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07- 008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, "Artificial Intelligence, As per AICTE: Making a System Intelligent",Wiley publication, ISBN: 9788126579945

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)		Semester :	IV	
Course :	Project Development -I		Code :	BCS4701	

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
06	-	03	06	50	-	50	100

Course Objectives:

1. To understand the Project Development Process.
2. To develop problem solving ability by following Software Development Life Cycle meticulously.
3. To review literature for project work from appropriate sources such as books, manuals, research journals and from other sources, and in turn increase analytical skills.
4. To design and implement real world applications using available platforms.
5. To validate and evaluate the work undertaken.
6. To work in a team and demonstrate the knowledge, skills and attitudes of a professional engineer.
7. To prepare good quality technical reports based on the selected project statement

Course Outcomes:
After learning the course, students will be able to
1. Select process model for a given problem.
2. Prepare Software Requirement Specification for a given project.
3. Plan and design software projects.
4. Develop and validate software projects.
5. Use project management tools for estimation and scheduling of projects.
6. Work in a team and demonstrate the knowledge, skills and attitudes of a professional engineer.

General Guidelines for Project development -I Work:
● Project Development-I is one of the significant contributory work that has to be completed based on the required number of credits as per academic regulations.
● It is necessary to explore the domain of interest / research/ thrust area/ society needs.
● In 4th semester, Projects may be in-house research projects that are carried out under the guidance of an Internal faculty/Mentor. If a student gets an opportunity to work on an industry sponsored project, then he/she will be allowed for the same under the guidance of an Internal faculty/Mentor.
● In further remaining semesters, Projects may be in-house research, Sponsored or Multidisciplinary. Projects can be carried out inside or outside the institute, in any relevant industry/organization or research institution/organization.
● Project teams: 3-4 students can form a team within the same or different discipline and their area of interest is to be registered with the Coordinator.
● Types of projects: Projects may be in-house research, Sponsored or Multidisciplinary. Projects can be carried out inside or outside the institute, in any relevant industry/organization or research institution/organization.
● Selection of Project: Students shall identify the area or topics in recent trends and developments as well as with thrust areas in consultation with institute guide or industry or any research organization.

Guide Allotment:
A. Considering registered teams area of interest/domain and expertise of guide, the Project coordinator in consultation with

a panel of experts allots Project guides.

B. Guide should be allotted from the same program.

C. In case of an interdisciplinary project, along with the guide from the same program, co-guide should be allotted from the other program.

D. In case of a sponsored project(with a reputed industry or any research organization) external guide should be from sponsored company/Industry along with the internal guide from the program.

E. Teams in consultation with guides will prepare project Synopsis.

Project Review/ Evaluation:

1. The Project coordinator with the Head of the department shall constitute a review committee composed of domain experts and senior faculty members.

2. The review committee will approve the project group and title. Discussion / presentation may be arranged covering topics listed in the synopsis.

3. The Project Review committee will evaluate the timely progress of the projects through internal evaluation. where students have to present their ideas with topic selection, literature survey and mathematical modeling. Students with group members are expected to appear for minimum two reviews as per the project calendar.

4. Project-I Term Work evaluation will be done jointly by Internal and External mentors through oral examination where it is expected, students have to implement the basic model .

Project Work Progress Monitoring:

1. Every student is required to use Project Management Tools like JIRA for documentation purposes.

2. There is no limit on meeting of student groups with faculty mentors, External mentors to track and discuss the progress and record of the same should be maintained by the student in his/her individual Project work logbook.

Report:

- Report should be prepared using Latex only as per the template provided by the department.

- Project reports shall be submitted in softcopy form/ (Hard bound reports could be avoided).

- In the case of Sponsored project, students must submit a Completion certificate with the signature of an external guide from the sponsored company.

- In case of an Interdisciplinary project, students must submit a Completion certificate with the signature of Co-Guide from another department.

Project Deliverables/Outcomes:

As a project work's outcome, each group may complete at least one activity from the list below.

- Paper publication in quality journals/conferences (such as SCOPUS, SCIE, SCI).

- IPR (Patent / Copyright).

- Participation in various contests with awards.

- Application development.

Project Work syllabus guidelines:

The student is expected to complete all the assignments related to the project which will consist of selection of problem statements, literature review, Software Requirement Specifications, Project design, prototype development.

The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide (Internal External (in case of sponsored project)/ Co-Guide (in case of interdisciplinary project)) and head of the Department/Institute.

Department of Computer Science & Engineering (AI & ML)

Assignment No.	Suggested List of Assignments
1.	Select a problem/ case study and create SRS in IEEE format.
2.	Select the appropriate process model and apply to a problem/ case study.
3.	Create Work Breakdown Structure and schedule using project management tools for a problem/ case study.
4.	Prepare Risk Estimation document for a given problem/ case study. OR Express the amount of business functionality an information system (as a product) provides to a user: Estimation using function point.
5.	Apply project design principles and UML Modeling for a selected problem.
6.	Apply testing principles and develop a Test Plan for selected problem/ case study using tools.
7.	Implement the prototype for the selected problem.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI&ML)			Semester :			IV
Course :	Professional Skills for Engineers (HSMC-II)			Code :			BHM4101
Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	IE	MTE	ETE	Total
01	02	-	02	30	-	20	50

Prior Knowledge of Basic Language Skills **is essential.**

Course Objectives:

This course aims at enabling students:

1. To introduce students to the fundamentals of effective communication.
2. To introduce students to the skills to prepare and deliver effective presentations and learn techniques of mastering group discussions.
3. To introduce students to interview skills and corporate etiquettes
4. To introduce students to professional ethics and organizational skills

Course Outcomes:

After learning the course, students will be able to:

1. Understand the nuances of effective communication skills at the workplace.
2. Demonstrate presentation skills and group discussions skills to excel in the professional environment.
3. Apply interview skills and corporate etiquettes effectively to hone the opportunities of employability.
4. Analyze career management skills that can lead to improved employment.

Detailed Syllabus:		
Unit	Description	Duration (Hours)
I	**Introduction and Fundamentals of Communication:** Need for effective communication, Functions of Communication, Organizational Communication, Verbal-Oral and Written communication, Non-verbal communication, Barriers to Effective Communication.	11
II	**Presentation Skills:** 4Ps (Planning, Preparation, Practice, Presentation), guidelines for developing PPT, Outlining, Effective use of A/V aids and Modes of Delivery. **Mastering Group Discussion skills:** Skills evaluated in Group discussion, Types of Group discussion- Factual, Abstract, Controversial and Case studies, Do's and Don'ts in Group Discussion.	12
III	**Interview Skills:** Interview Process, Types of Interview: Job interview, Appraisal Interview, Exit, Interview, Panel Interview; Self Introduction, Pre and Post interview activities, Skills evaluated in interview, Do's and Don'ts during Interview **Cover letter & Resume**: Job Application letter, Difference between CV and Resume Writing skills, Resume writing, Writing SOPs **Corporate Étiquettes:** Dressing Etiquettes, Dining Étiquettes, Telephonic Etiquettes, Business card Etiquettes, Email Etiquettes.	11
IV	**Professional Ethics:** Integrity, Objectivity, Professional competence and due care, Confidentiality Professional behavior. **Organizational Skills:** Physical Organization, Digital Organization, Planning, Time management & Communication	11

Total	**45**

Text Book:

1. R.Gajendra Singh Chauhan and Sangeeta Sharma, "Soft Skills-An integrated approach to maximize personality", Wiley Publication, ISBN: 987-81-265-5639-7

Reference Books:

1. Muralikrishna C., Sunita Mishra "Communication Skills for Engineers" 2nd edition, Pearson, New Delhi 2010 .
2. Indrajit Bhattacharya, "An Approach to Communication Skills", Dhanpat Rai, Delhi, 2008.
3. Simon Sweeney, "English for Business Communication", Cambridge University Press.
4. Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press.
5. Barun K.Mitra, Personality Development & Soft Skills, Oxford University Press, 2012 New Delhi.

Web References:

1. https://nptel.ac.in/courses/109107121
2. https://nptel.ac.in/courses/122106031https://www.coursera.org/learn/principles-of-management (Ethics)

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)				Semester:		IV	
Course:	R programming (Proficiency Course -I)				Code:		BCS4911	

Teaching Scheme				Evaluation Scheme				
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total	
02	-	-	02	-	-	-	-	

Prior knowledge of: Basic principles of programming language, Object oriented programming, basics of data science **is** essential.

Course Objectives:
1. To understand the basic concepts of the R programming language with its syntax and rules.
2. To learn the installation, usage of R studio package and related libraries.
3. To learn about how to perform data visualization using R library

Course Outcomes:
After learning the course, students will be able to:
1. Implement basic and complex programs using various data structures of R
2. Compute the summary statistics using R library
3. Create various types of graphs to visualize the data and underlying distribution
4. Perform data preprocessing operations to clean the data using R library
5. Develop data analytics model for regression task using suitable packages of R
6. Develop data analytics model for classification task using suitable packages of R

Guidelines for Students:
1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, Index, and handwritten write-up of each assignment. Each assignment write-up should have Title, Objectives, Theory- Concept in brief, Algorithm/Flowchart, Test cases, Conclusion.
2. Program codes with sample output of all performed assignments are to be submitted as softcopy.

Guidelines for Laboratory Conduction
1. Set of suggested assignments are provided for reference. Lab instructors may design a suitable set of assignments.

Assignment No.	Suggested List of Assignments
1.	Assignments will be conducted based on topics of data handling and analysis like, data preprocessing, data validation, data visualization, etc. using Excel spreadsheets. The excel features and functions like Sorting, Filtering, COUNTIF, SUMIF, Pivot Tables, What-If Analysis with Solver, Data Analysis Toolpak, etc. can be used to perform the assignments. The assignments can also be suggested for Descriptive Statistics, hypothesis testing- ANOVA, Regression analysis, etc.

2.	Assignments will be conducted based on topics of Data Inputting: Data types and data structures in R–lists, vectors, data frame, etc. Reading data from files, Redirection of output. Different types of language constructs: operators, control structures, functions. The list of suggested assignments is as follows: a) Write a R program to create a list of random numbers in normal distribution and display the frequency of each value b) Write a R program to print the prime numbers from given range taken as per user's input c) Write a R program to read any .csv file as per user-provided input and display its content d) Write a R program to create a list of elements using vectors, matrices and functions. Print the content of the list. e) Write a R program to write the contents of a data frame in a file and save it f) Write a R program to find common elements present in any two data frames.
3.	Assignments will be conducted based on topics of Data preprocessing: Data cleaning, data transformation, outlier detection. The list of suggested assignments is as follows: a) Write a R program to handle missing values in any public dataset like titanic dataset, IRIS dataset, etc. b) Write a R program to detect and to handle outliers in any public dataset like titanic dataset, IRIS dataset, etc. c) Write a R program to perform any suitable data transformation technique on suitable attributes of any public dataset like titanic dataset, IRIS dataset, etc.
4.	Assignment will be conducted based on topics of Data Visualization: Creating different types of graphs/charts– Bar chart, histogram, box plot, pie chart, scatterplot, line plot, etc. Plotting with base graphics. Plotting with the ggplot2 package. The list of suggested assignments is as follows: a) Write a R program to plot bell-like gaussian curve of a random normal distribution b) Write a R program to plot a bar graph of marks of any five subjects obtained by a set of students in a class. Extend the plot to create stacked bar graphs for girl and boy students. c) Write a R program to plot pie chart for student performance of girl and boy students d) Write a R program to plot histogram to display for different flower species in Iris dataset
5.	Assignment will be conducted based on topics of Basic Statistics: Computing basic statistics: Data summarization using descriptive statistical measures. The list of suggested assignments is as follows: a) Write a R program to display a summary of descriptive statistics on any random data or any public dataset like social network analysis. b) Write a R program to summarize data by plotting boxplots to visualize statistical measures and to detect the outliers
6.	Assignments will be conducted based on topics of Predictive analytics: Linear regression, predictive analysis for classification tasks using the Naïve Bayes classifier. The list of suggested assignments is as follows: a) Write a R program to perform linear regression analysis using any public data like the Boston housing dataset to predict the house prices. b) Write a R program to perform classification using Naïve Bayes algorithm using any public data like the Iris dataset.

Reference Books:
1. Richard Cotton, "Learning R: A Step-By-Step Function Guide to Data Analysis", O'Reilly, ISBN: 13:978-1449357108, First Edition.
2. Garrett Grolemund, Hadley Wickham, "R for Data Science", O'Reilly Media, Inc., 2016, ISBN: 9781491910399 3. Robert I. Kabacoff, "R in Action", Manning Publications, 2nd edition, 2015, ISBN: 9781617291388

Web reference:

Handy reference site for R packages/dataset

1. https://r-dir.com/reference/

MOOC Course link

1. https://www.coursera.org/learn/r-programming?specialization=jhu-data-science
2. https://www.coursera.org/specializations/data-science-foundations-r

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)			Semester:		IV	
Course:	**Java Programming (Proficiency Course -I)**			**Code:**		**BCS4912**	
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**PR**	**OR**	**Total**
02	-	-	**02**	-	-	-	-

Prior Knowledge of: Decision control structures, loop control structures, arrays, Functions, pointers, structure and union, searching and sorting techniques is essential.

Course Objectives:
1. To understand the basic concepts of Java.
2. To learn object-oriented programming using Java.
3. To learn and understand exception handling and wrapper classes.
4. To learn and understand I/O packages and threading in Java.
5. To learn front end design using SWING and JavaFX.

Course Outcomes:
After learning the course, students will be able to:
1. Understand the basic concepts of Java programming.
2. Understand the Object-Oriented Programming concepts in Java.
3. Apply the concepts of Object-Oriented Programming to solve real time problems.
4. Use the concepts of exception handling, packages and collection in the Java environment.
5. Use I/O packages to perform I/O operations in Java programs.
6. Design and develop java applications using SWING and JavaFX.

Guidelines:
1. The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of a prologue, Certificate, table of contents, and handwritten write-up of each assignment.
2. Each assignment write-up should have Title, Objectives and Outcomes, Theory- Concept in brief, Algorithm, Flowchart, Test Cases, Conclusion, Assessment grade/marks and assessor's sign.
3. Program codes with sample output of all performed assignments are to be submitted as softcopy.

Assignment No.	Suggested List of Assignments
1.	Assignment will be conducted based on the following topics. Introduction to Java programming: The Java Virtual Machine, Variables and data types, Conditional and looping constructs, Arrays.
2.	Assignment will be conducted based on the following topics. Object-oriented programming with Java Classes and Objects: Fields and Methods, Constructors, Overloading methods, Garbage collection, Nested classes.
3.	Assignment will be conducted based on the following topics. Inheritance: Overriding methods, Polymorphism, Making methods and classes final, Abstract classes and methods, Interfaces. Exception handling with try-throw-catch-finally constructs: The Exception class, The Objectclass: Cloning objects, The JDK LinkedList class, Strings, Strings Conversions

4.	Assignment will be conducted based on the following topics. Collection Framework: List, Set & Map interfaces, Vector, ArrayList, LinkedList, Hashtable, HashMap, TreeMap, Iterator, Enumerator,Que, Deque, SortedQue, HashSet, TreeSet, LinkedHashSet, Compare and Comparable. Introduction of Generics. Working with types: Wrapper classes, Enumeration interface Packages Package access, Documentation comments.
5.	Assignment will be conducted based on the following topics. The I/O Package: InputStream and OutputStream classes, Reader and Writer classes,Threads: Synchronization
6.	Assignment will be conducted based on the following topics. SWING (JFC): Introduction Diff B/W AWT and SWING, Components hierarchy, Panes,Individual Swings components J Label, JButton, JTextField, JTextAres. JavaFX: JavaFX Architecture, JavaFX Program Structure, Shapes, Effects, LayoutComponents, Properties and Bindings, Basic UI Controls, Graphics and Animation.

Textbooks:
1. Herbert Schildt,"Java - The Complete Reference", The McGraw-Hill Education,11th Edition,2018, 78-1260440232.
2. Balagurusamy, "Programming with Java" McGraw Hill Education India, 6th Edition, 2019, 9789353162344

Reference Books:
1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press India Pvt. Ltd., Paperback, 2015 , 9789351197584.
2. Ken Arnold, James Gosling and David Holmes, "The Java Programming Language", Addison-Wesley, 4th Edition, 2005, 0321349806

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)				Semester:		IV
Course :	Life Skills-IV				Code :		BHM4940

Teaching Scheme				Evaluation Scheme			
Lecture	Practical	Tutorial	Credit	TW	PR	OR	Total
-	02	-	-	-	-	-	-

Prior knowledge: Nil

Course Objectives:
1. To learn about the social functioning and diverse culture in the country.
2. To be aware and improve interpersonal behavioral patterns.
3. To inculcate caring and serving qualities towards family, society and environment at large.

Course Outcomes:
After learning the course, students will be able to:
1. Apply social work practices in the context of diverse cultures.
2. Develop a broad understanding of Indian culture through various art forms.
3. Apply effective ways of interpersonal behavioral patterns eliminating their unhelpful thoughts, feelings and actions.
4. Develop skills which are necessary to initiate ideas and pursue them for holistic development of the individual.

Detailed Syllabus:		
Unit	**Description**	**Duration (Hours)**
I	**Social Welfare** Environment awareness such as Tree Plantation, Natural resources awareness etc, Donation Camp, Visit to Orphanage, Old Age home and Villages, Contribution in social activity like Pani Foundation, Swaccha Bharat Abhiyan, Save Girl Child/Animals/Birds/Trees etc., Activity based on societal projects / Project Exhibitions etc. **Cultural Awareness** Divisions of Indian classical music: Hindustani and Carnatic, Dances of India, Various Dance forms: Classical and Regional, Rise of modern theater and Indian cinema. **OR** **Transaction Analysis** Introduction to TA, Basic Assumptions of TA, Theory of Personality Ego States, Structural and Functional, Ego States Diagnosis, Egogram, Structural Pathology, Contamination, Theory of Communication, Types of Transactions, Strokes, Stroke Economy, Theory of Life Positions, Injunctions	12
II	**Caring and service** Hospital Caring, Personal Safety, First Aid, Disaster Management Gardening, Organic farming, Cooking, etc	12
Total		24

Reference Books:
1. K. Singh, "An introduction to Social Work", 14 April 2011.

2. Bishnu Mohan Dash, Mithilesh Kumar, D. P. Singh, Siddheshwar Shukla, "Indian Social Work", 1 October 2020.
3. Martin Davies, "Social work with Children and Families", 20 March 2012.
4. Anita Kainthla, "Baba Amte – A Biography", 1 January 2006.
5. Aroup Chatterjee , "Mother Teresa – The untold story", 1 January 2006.
6. Improving Behaviour and Raising Self-Esteem in the Classroom, A Practical Guide to Using Transactional
7. Analysis, Giles Barrow, Emma Bradshaw, Trudi Newton, David Fulton Publishers, 1 October 2001.
8. Transactional Analysis, 100 Key Points and Techniques, Mark Widdowson, 8 September 2009.
9. Benjamin Colodzin, "Helping ourselves by Helping Others", 3 August 2020.
10. Smith Mark K. "The Art of Helping Others", Jessica Kingsley Publishers,15 April 2008.
11. Chip Heath, "Decisive: How to Make Better Choices in Life and Work", March 26, 2013.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE (AI & ML)					Semester:		IV	
Course :	**Constitution of India (Audit Course)**					**Code :**		**BHM9962**	
Teaching Scheme				**Evaluation Scheme**					
Lecture	**Practical**	**Tutorial**	**Credit**	**IE**	**MTE**		**ETE**		**Total**
01	-	-	-	-	-		-		-

Prior knowledge: Nil

Course Objectives:
1. To enable the student to understand the importance of the constitution.
2. To identify individual roles and ethical responsibilities towards the nation.
3. To understand human rights and its implications
4. To know about central and state government functionalities in India.

Course Outcomes:
After learning the course, students will be able to:
1. Understand the functions of the Indian government and get acquainted with knowledge of Constitutional Amendments.
2. Identify and explore the basic features, modalities of the Indian constitution and assessment of the Parliamentary System in India.
3. Differentiate and relate the functioning of the Indian Political system at the Central and State level.
4. Comprehend the fundamental rights and abide by the rules of the Indian constitution.

	Detailed Syllabus:	
Unit	**Description**	**Duration (Hours)**
I	**Introduction to Constitution:** Meaning of the constitution, law and constitutionalism, making of constitution, Salient features and characteristics of the Constitution of India, Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties and its legal status, Citizenship.	**03**
II	**System of Government-** Center & State level and local level Structure and Function of Central Government, President, Vice President, Prime Minister, Cabinet, Parliament, Supreme Court of India, Judicial Review, Federal structure and distribution of legislative and financial powers between the Union and the States, local self-government	**03**
III	**Judiciary**: Governor, Chief Minister, Cabinet, State Legislature, Judicial System in States,High Courts and other Subordinate Courts,Parliamentary Form of Government in India.	**03**
IV	**Constitution Functions:** Indian Federal System and its characteristics, Center State Relations, President's Rule, ConstitutionalAmendmentsandpowers, Constitutional Functionaries,Emergency Provisions, Assessment of working of the Parliamentary System in India	**03**
	Total	**12**

Textbooks:
1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi,24th edition, 2020, ISBN-109388548868.

2. Clarendon Press, Subhash C, Kashyap, "Our Constitution: An Introduction to India's Constitution and Constitutional Law",NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1. Maciver and Page, "Society: An Introduction Analysis ", Laxmi Publications, 4th edition, 2007,ISBN 100333916166
2. PM Bakshi, "The constitution of India", Universal Law Publishing - An imprint of Lexis Nexis, 14th edition,2017, ISBN-108131262375

Vision and Mission of the Computer Science & Engineering (AI&ML) Department

Vision:

To provide value-based technical Education in Computer Science and Engineering with specialization in Artificial Intelligence and Machine Learning.

Mission:

- To develop technically competent and innovative computer science engineers with in-depth knowledge of Artificial Intelligence and Machine Learning.
- To build ethically responsible, knowledgeable and skilled engineers to serve the needs of industry and society at large.
- To provide a conducive environment and opportunities for holistic development of students.