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

TY B.Tech. CSE (AI & ML)

(Course 2021)

Effective from Academic Year 2023-24

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)
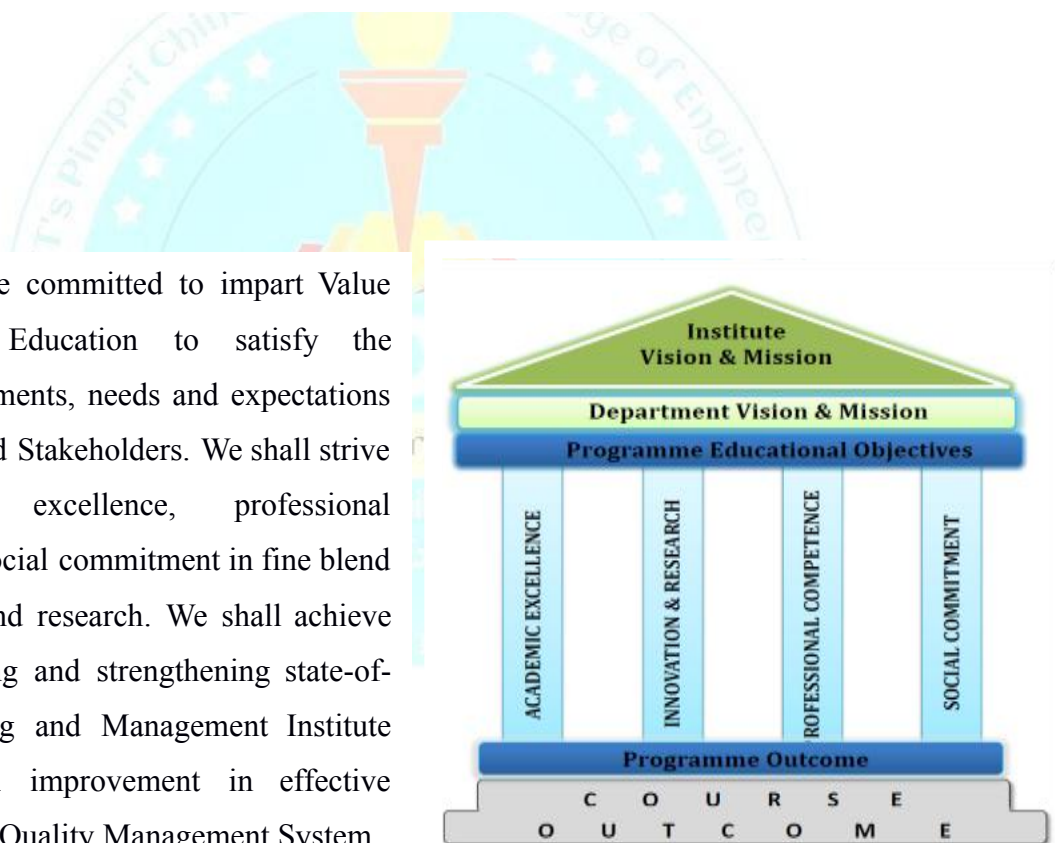
	Pimpri Chinchwad Education Trust's **Pimpri Chinchwad College of Engineering**	
	Course Approval Summary	

A) Board of Study-Applied Sciences and Humanities

Sr. No.	Course Name	Course Code	Page Number	Signature and Stamp of BoS
1.	Professional Development Training - I	BHM5917	35-36	
2.	Emotional Intelligence	BHM9963	37-38	
3.	Entrepreneurship Development	BHM9964	39-40	
4.	Research Article Writing	BHM9965	41-42	
5.	Multivariate Data Analysis using R	BAS6608	61-62	
6.	Professional Development Training - II	BHM6918	93-94	
7.	Environmental Sciences	BHM9961	97-98	

B) Board of Study- Department of Civil Engineering

Sr. No.	Course Name	Course Code	Page Number	Signature and Stamp of BoS
1.	Remote Sensing and GIS	BCI6603A	63-65	
2.	Building Services and Maintenance	BCI6603B	66-67	

C) Board of Study - Department of Computer Science & Engineering (AI&ML)

Sr. No.	Name of the Course	Course Code	Page Number	Signature and Stamp of BoS
1.	Algorithms Design & Analysis	BCS5416	11-13	
2.	Computer Networks & Internet of Things	BCS5417	14-16	
3.	Automata Theory	BCS5418	17-18	
4.	Computer Vision	BCS5419	19-20	
5.	Deep Learning	BCS5420	21-22	
6.	Algorithms Design & Analysis Lab	BCS5421	23-25	

Department of Computer Science & Engineering (AI & ML)

Sr. No.	Name of the Course	Course Code	Page Number	Signature and Stamp of BoS
7.	CN & IOT Lab	BCS5422	26-28	
8.	Computer Vision & Deep Learning Lab	BCS5423	29-31	
9.	Project Development-II	BCS6702	32-34	
10.	Big Data Analytics	BCS6424	44-46	
11.	Intelligent Systems & Robotics	BCS6501	47-48	
12.	Natural Language Processing	BCS6502	49-50	
13.	Information Security	BCS6503	51-52	
14.	Edge Computing	BCS6504	53-55	
15.	Cloud Computing	BCS6505	56-58	
16.	BioInformatics	BCS6506	59-60	
17.	Big Data Analytics Lab	BCS6425	76-78	
18.	Professional Elective -I Lab	BCS6507	79-83	
19.	Professional Elective -II Lab	BCS6508	84-89	
20.	Project Development- III	BCS6703	90-92	
21.	Web Development	BCS6913	95-96	

D) Board of Study - Department of Electronics & Telecommunication

Sr. No.	Course Name	Course Code	Page Number	Signature and Stamp of BoS
1.	Designing with Raspberry Pi	BET6601	68-69	
2.	Basics of Automotive Electronics	BET6602	70-71	

E) Board of Study - Department of Mechanical Engineering

Sr. No.	Course Name	Course Code	Page Number	Signature and Stamp of BoS
1.	3D Printing and Modeling	BME6603A	72-73	
2.	Material Informatics	BME6603B	74-75	

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
T.Y. B.Tech Computer Science & Engineering (AI & ML)

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

SEMESTER – V

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						
			L	P	T	Hrs		IE	MTE	ETE	TW	PR	OR	Total
BCS5416	PCC	Algorithms Design & Analysis	3	-	-	3	3	20	30	50	-	-	-	100
BCS5417	PCC	Computer Networks & Internet of Things	3	-	-	3	3	20	30	50	-	-	-	100
BCS5418	PCC	Automata Theory	2	-	-	2	2	20	30	50	-	-	-	100
BCS5419	PCC	Computer Vision	2	-	-	2	2	20	30	50	-	-	-	100
BCS5420	PCC	Deep Learning	2	-	-	2	2	20	30	50	-	-	-	100
BCS5421	PCC	Algorithms Design & Analysis Lab	-	2	-	2	1	-	-	-	25	25	-	50
BCS5422	PCC	CN & IOT lab	-	2	-	2	1	-	-	-	25	–	25	50
BCS5423	PCC	Computer Vision & Deep Learning Lab	-	4	-	4	2	-	-	-	25	25	-	50
BCS5702	PROJ	Project Development-II	-	8	-	8	4	-	-	-	50	-	50	100
BHM5917	MC	Professional Development Training-I	3	-	-	3	-	-	-	-	-	-	-	-
BHM9963-965	AC	Audit Course – II	1	-	-	1	-	-	-	-	-	-	-	-
Total			**16**	**16**	**-**	**32**	**20**							**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 - V

List of courses - Audit Course -II

Course Code	Course Name	
BHM9963	Emotional Intelligence	Choose any one
BHM9964	Entrepreneurship Development	
BHM9965	Research Article Writing (BHM9965)	

CURRICULUM STRUCTURE FOR TY B.Tech. COMPUTER SCIENCE & ENGINEERING- (AI & ML)
SEMESTER –VI

Course Code	Course Type	Course Name	Teaching Scheme				CR	Evaluation Scheme						
			L	P	T	Hrs		IE	MTE	ETE	TW	PR	OR	Total
BCS6424	PCC	Big Data Analytics	3	-	-	3	3	20	30	50	-	-	-	100
BCS6501-503	PEC	Professional Elective -I	3	-	-	3	3	20	30	50	-	-	-	100
BCS6504 -506	PEC	Professional Elective -II	3	-	-	3	3	20	30	50	-	-	-	100
-	OEC	Open Elective-I	3	-	-	3	3	20	30	50	-	-	-	100
BCS6425	PCC	Big Data Analytics Lab	-	4	-	4	2	-	-	-	50	50	-	100
BCS6507	PEC	Professional Elective -I Lab	-	2	-	2	1	-	-	-	25	50	-	75
BCS6508	PEC	Professional Elective -II Lab	-	2	-	2	1	-	-	-	25		50	75
BCS6703	PROJ	Project Development- III	-	8	-	8	4	-	-	-	50	-	50	100
BHM6918	MC	Professional Development Training-II	3	-	-	3	-	-	-	-	-	-	-	-
BCS6913	PFC	Proficiency Course – II (Web Development)	-	2	-	2	-	-	-	-	-	-	-	-
BHM9961	AC	Audit Course – III (Environmental Science)	1	-	-	1	-	-	-	-	-	-	-	-
Total			16	18	-	34	20							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 - VI

List of courses - Professional Elective Course -I

Course Code	Course Name	
BCS6501	Intelligent Systems & Robotics	
BCS6502	Natural Language Processing	Choose any one
BCS6503	Information Security	

List of courses - Professional Elective Course-II

Course Code	Course Name	
BCS6504	Edge Computing	
BCS6505	Cloud Computing	Choose any one
BCS6506	BioInformatics	

List of courses - Open Elective Course-I

Course Code	Course Name	
BAS6608	Multivariate Data Analysis Using R	
BCI6603A	Remote Sensing and GIS	
BCI6603B	Building Services and Maintenance	
BET6601	Designing with Raspberry Pi	Choose any one
BET6602	Basics of Automotive Electronics	
BME6603A	3D Printing and Modeling	
BME6603B	Material Informatics	

Course Syllabus
TY B.Tech CSE (AI & ML)
Semester- V

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)				Semester : V		
Course :	Algorithms Design & Analysis				Code : BCS5416		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of Data structures **is essential.**

Course Objectives:

1. To develop problem solving abilities using mathematical theories.
2. To analyze the performance of algorithms.
3. To apply algorithmic strategies for solving problems.
4. To design time and space efficient algorithms.
5. To study application oriented algorithms.

Course Outcomes:

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

1. Design a solution for a complex problem using suitable mathematical techniques.
2. Validate the correctness of algorithms by using loop invariant and inductive proofs.
3. Apply different problem-solving strategies to solve computational problems.
4. Compare the algorithms with respect to time and space complexity.
5. Identify P, NP, and NP Completeness of a problem.
6. Analyze the worst case run time performance of algorithms using asymptotic notations and amortized analysis.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Problem solving and Algorithmic Analysis**: Asymptotic notations, lower bound and upper bound: Best case, worst case, average case analysis, classification of time complexities (linear, logarithmic etc), Performance analysis of basic programming constructs. Recurrences: Formulation and solving recurrence, Equations using Master Theorem, Proving correctness of algorithms -Loop Invariant, Empirical studies to validate hypotheses about runtime measures.	08

II	**Divide and Conquer Strategy:** Problem subdivision – Divide and Conquer: Binary search, Quick sort, Merge sort, Integer Arithmetic. **Greedy Strategy :** Principle, control abstraction, time analysis of control abstraction, knapsack problem, Job scheduling algorithm, Huffman code generation algorithm, Single Source Shortest Path Dijkstra's, Bellman-Ford .	07
III	**Dynamic Programming Strategy** : Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomial coefficients, 0/1 knapsack, All Pair Shortest Path - Floyd-Warshall, OBST, Chain Matrix Multiplication, Sum of Subset.	08
IV	**Backtracking Strategy:** Principle, control abstraction, time analysis of control abstraction, 8-queen problem, graph coloring problem, sum of subsets problem. **Branch and Bound Strategy** : Principle, control abstraction, time analysis of control abstraction, strategies – FIFO, LIFOand LC approaches, knapsack problem, Branch and Bound using Assignment Problem or TSP .	07
V	**Complexity Theory:** Classification of Problem-P, NP, NPC, NP-Hard , Polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover, Maximum Clique and 3-SAT and NP hard problem - Hamiltonian cycle, Amortized Analysis.	07
VI	**Approximate Algorithm:** Traveling Salesman Problem. **Randomized Algorithm:**Min-Cut Algorithm. **Parallel and Concurrent Algorithms:** Quick Sort, Parallel Divide-and-Conquer Algorithms for Bubble Sort. **Introduction to Linear Programming:** Linear Programming, Linear Optimization problems. **String Matching-** Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm.	08
	Total	45

Text Books:
1. Thomas H Cormen and Charles E.L, Leiserson, "Introduction to Algorithms", The MIT Press; 4th edition, April 5, 2022, ISBN-13: 978-0262046305
2. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson, 2nd edition, 2013, ISBN-13: 978-1292023946.
3. Horowitz, Sahani, " Computer Algorithms", Universities Press. 2nd Edition, 2008, ISBN -13:978-8173716119

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Reference Books:
1. Brian Christian , Tom Griffiths, "Algorithms to Live By: The Computer Science of Human Decisions", 1st edition, October 2017, ISBN-10:0143191616
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, 2nd edition, 2011, ISBN 978-81-203-1131-2

Web References:
1. https://academic.oup.com/comjnl/article/65/10/2709/6334046
2. Design and Analysis of Algorithm course on NPTEL : https://nptel.ac.in/courses/106106131

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)			Semester : V			
Course :	Computer Networks & Internet of Things			Code : BCS5417			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of Computer Organization **is essential.**

Course Objectives:
1. To understand the fundamental concepts of networking standards, protocols and technologies.
2. To learn the role of protocols at various layers in the protocol stacks.
3. To explore a new paradigm of networking using IoT.
4. To select methodologies for IoT application development.
5. To know the IoT protocols.

Course Outcomes:

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

1. Understand various types of networks.
2. Compare various networking Protocols used in the network layer.
3. Illustrate the Building Blocks of the Internet of Things and characteristics.
4. Apply IoT design methodology for developing IoT applications.
5. Analyze IoT protocols for making IoT device communication.
6. Design cloud based IoT systems.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Computer Network:** Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for layers. Network Devices: Hub,Bridge, Switch, Router, Brouter, and Access Point.	06
II	**Data Link layer & Network Layer:** Design Issues: Services to Network Layer, Framing, Error Control and Flow Control. Error Control: Parity Bits and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol. Network Layer- switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, ICMP, subnetting. Routing algorithm & Protocols : Distance Vector, Link State, Routing	09

	in Internet: RIP, OSPF, BGP, Congestion control.		
III	**Transport Layer & Application Layer:** Transport Layer: Services, Berkley Sockets, Transmission control Protocol (TCP), Real Time Transport protocol (RTP), Stream Control Transmission Protocol (SCTP),Quality of Service (QoS). Application Layer: Domain Name System (DNS), HyperText Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, TELNET, Dynamic Host Control Protocol (DHCP).	**09**	
IV	**Introduction to IoT:** Definition, characteristics of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. Physical Design of IoT: Things in IoT, Sensors and Actuators, Logical Design of IoT: IoT functional blocks, IoT enabling technologies, IoT levels and deployment templates, Applications in IoT.	**08**	
V	**IoT Design Methodology:** Steps, Basics of IoT Networking, Networking Components, Internet Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of the IoT: M2M, SCADA, WSN, RFID.	**06**	
VI	**Communicating Smart Objects & WAMP:** Communication criteria, IoT access technologies IEEE 802.15.4e, IEEE 802.11ah, IEEE 1901.2a, and NB-IoT, Protocol standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. WAMP: AutoBahn for IoT, Xively Cloud for IoT Python Web Application Framework: Django Architecture and application development with Django, Amazon Web Services for IoT.	**07**	
	Total		**45**

Text Books:
1. Andrew S. Tanenbaum, "Computer Networks", Pearson Education India,6th Edition, 2021 ISBN: 9780136764052, 0136764053
2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw- Hill Publications, 2013 ISBN: 1259064751 · 9781259064753.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry; "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, 2018, Pearson India Pvt. Ltd.
4. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", 1st Edition, 2015, Universities Press (India) Pvt. Ltd.

Reference Books:
1. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 013285620

2. Yashavant Kanetkar and Shrirang Korde, "21 Internet of Things (IOT) Experiments: Learn IoT, the Programmer's way", 1st Edition, 2018, BPB Publications.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/.
2. https://onlinecourses.nptel.ac.in/noc21_ee85/
3. https://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**						**Semester : V**	
Course :	**Automata Theory**						**Code : BCS6418**	
Teaching Scheme				**Evaluation Scheme**				
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**	
02	**-**	**02**	**02**	**20**	**30**	**50**	**100**	

Prior knowledge of Discrete Mathematics & Data Structures **are essential.**

Course Objectives:

1. To recall and understand the basics of mathematical concepts, formal languages and machines.
2. To understand and design different computational models like finite automata, regular expression, push down automata, context free grammar, Turing machine for a given language.
3. To apply inter conversion between equivalent representations of a language.
4. To design appropriate computational models.

Course Outcomes:

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

1. Construct abstract models of Finite Automata, Pushdown Automata and Turing Machine.
2. Demonstrate significance of Non determinism in relation to various Automata.
3. Demonstrate the language generated by automata or regular expression.
4. Apply the regular expressions for pattern searching.
5. Design Context free grammar for formal languages.
6. Distinguish between Regular, Context free and recursively enumerable languages.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Finite Automata & Regular languages:** Introduction to Finite Automata, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition. Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages.	**08**
II	**Context Free Grammar & Languages:** Applications of Context Free Grammars, Applications of Context Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating	**07**

	Unit Productions, Chomsky Normal Form, Closure Properties of Context Free Languages.	
III	**Pushdown Automata:** Definition of the Pushdown Automaton, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.	**07**
IV	**Turing Machine:** Turing Machines: Formal definition of a Turing machine, Examples of Turing machines. Variants of Turing Machines: Multi-tape Turing machines, Nondeterministic Turing machines, Halting problem of Turing Machine, Recursively Enumerable languages.	**08**
	Total	**30**

Text Books:
1. Peter Linz, "An Introduction to Formal Languages and Automata", 6th Edition, Jones & Bartlett Learning, 2016, ISBN : 9781284077247, 1284077241
2. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Pearson, 3rd Edition, 2008, ISBN-13: 978-8131720479.

Reference Books:
1. Daniel I.A. Cohen, "Introduction to Computer Theory", 2nd Edition , John Willy & Sons Inc., Sons Inc., 2000
2. Vivek Kulkarni "Theory of Computation", Oxford University Press, 2013, ISBN-13 978-0198084587
3. John C Martin, "Introduction to Languages and Theory of Computation", 4th Edition, Tata McGraw-Hill, 2011, ISBN: 978-81-317-6177-9

Web References:
1. https://nptel.ac.in/courses/106104148

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : V	
Course :	**Computer Vision**					Code : BCS5419	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
02	**-**	**02**	**02**	**20**	**30**	**50**	**100**

Prior knowledge of Data Science **is essential.**

Course Objectives:

1. To introduce the fundamental problems of computer vision.
2. To provide an understanding of techniques, mathematical concepts, and algorithms used in computer vision to facilitate further study in this area.
3. To utilize programming and software tools for relevant application implementation.

Course Outcomes:

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

1. Identify image transformation techniques for computer vision applications.
2. Formulate and solve problems in computer vision using image processing techniques.
3. Apply appropriate feature extraction methods for computer vision applications.
4. Identify and apply methods for image segmentation.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Computer Vision:** Overview of computer vision, related areas, and applications; overview of software tools, Fundamentals of Image Formation, Image Transformation: Orthogonal, Euclidean, Affine, Projective.	**08**
II	**Filtering and Edge Detection:** Fourier transform, convolution and filtering, image enhancement, restoration, histogram processing, edges - Sobel, Canny, LOG, DOG; and line detectors (Hough transform).	**08**

III	**Corners:** Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian Derivative Filters, Gabor Filters, and DWT.	**07**
IV	**Segmentation of Images:** Region Growing, Edge Based Approaches to Segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object Detection.	**07**
	Total	**30**

Text Books:
1. R. Szeliski, Springer, Computer Vision: Algorithms and Applications, Publisher-Springer London, 2011, ISBN : 978-1-84882-934-3.
2. David A. Forsyth, "Computer Vision: A Modern Approach, 2nd Edition ", University of Illinois at Urbana-Champaign, Jean Ponce, 2014. ISBN - 9789332550117.

Reference Books:
1. Jan Erik Solen, " Computer Vision with Python" Published by O'Reilly media 2012.
2. Reinhard Klette, "Concise Computer Vision- An Introduction to Theory and Algorithm", Springer 2014
3. Robert M. Haralick and Linda G. Shapiro, "Computer and Robot Vision", Addison-Wesley, 1992-93.
4. Richard O. Duda, Peter E. Hart, and David G. Stork, "Pattern Classification", Wiley Interscience, 2001.

Web References:
1. https://onlinecourses.nptel.ac.in/noc19_cs58
2. https://onlinecourses.nptel.ac.in/noc21_ee23

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)					Semester : V	
Course :	Deep Learning					Code : BCS5420	
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
02	-	2	2	20	30	50	100

Prior knowledge of Machine Learning, Artificial Intelligence **are essential.**

Course Objectives:

1. To characterize different architectures and parameters of deep neural networks such as CNN, RNN.
2. To explain the theoretical foundations, algorithms, and methodologies of deep Learning.
3. To design and develop an application-specific deep learning model.
4. To elaborate various optimization techniques available in the field of deep learning.

Course Outcomes:

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

1. Analyze the different issues and needs of parameters required for the design of any deep neural network.
2. Apply convolutional neural networks-based techniques and analyze their performance.
3. Apply recurrent neural networks-based algorithms and analyze their performance.
4. Select appropriate models for the real-world applications for unsupervised/supervised learning tasks with suitable design decisions.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Deep Neural Networks (DNN):** Introduction to Deep Learning, Training DNN using Back Propagation, Hyperparameters. Effective training in Deep Net- early stopping, Dropout, regularizations, Batch Normalization. Introduction to transfer learning. Optimization in Deep Learning- Need, Stochastic gradient descent.	07
II	**Convolutional Neural Networks (CNN):** Building blocks – Convolution blocks, Padding, Strides, Pooling layer, activation functions. Mathematical modeling of CNN. Transfer learning techniques and popular CNN architectures - LeNet, AlexNet, VGGNet. Case study: Image classification using CNN or human pose detection using mask R-CNN.	08

III	**Recurrent Neural Networks (RNN):** Architectural Overview, Bidirectional RNNs: Encoder-decoder sequence to sequence architectures, Back-propagation through time for training RNN, Vanishing and exploding gradients, Long Short-Term Memory (LSTM) networks. Mathematical understanding of RNN. Generative modeling with DL: Variational Auto-encoders, Generative Adversarial Networks (GAN). Case Study: Text identification from video using RNN and Image deblurring using GAN.	**08**
IV	**Recent trends in Deep Learning Architectures:** Residual Network, transfer learning with ResNet, Skip Connections, Fully Connected CNN, Introduction to reinforcement learning. Classical Tasks with Deep Learning – Applications - Deep Computer Vision using Convolutional Neural Networks: Classification, data augmentation for Object detection. Natural Language Processing with DNN: Word Vector representation, word2vec model, Application: Sentiment analysis. Recent trends in Deep learning using AutoML and MLOps – Case study using auto-sklearn.	**07**
	Total	**30**

Text Books:
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, ISBN: 978-0262035613, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, ISBN-13: 978-1491914250, 2017
3. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer, ISBN: 978-3-319-94463-0, 2019

Reference Books:
1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", 2021.
2. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

Web References:
1. NPTEL course lecture links:
   https://onlinecourses.nptel.ac.in/noc23_cs24/, https://onlinecourses.nptel.ac.in/noc23_cs56
2. https://arxiv.org/abs/1103.0398
3. https://www.analyticsvidhya.com/blog/2020/02/learn-image-classification-cnn-convolutional-neural-networks-3-datasets/
4. https://www.analyticsvidhya.com/blog/2021/07/in-depth-explanation-of-recurrent-neural-network/
5. https://www.automl.org/automl/

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)			Semester : V			
Course :	Algorithms Design & Analysis Lab			Code : BCS5421			
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	25	-	50

Prior knowledge of Data structures and proficiency in python **are essential.**

Course Objectives:
1. To apply various design strategies of algorithms .
2. To develop time and space efficient algorithms.
3. To compare different strategies and find exact solutions.
4. To decide a suitable design strategy to solve a real-world problem.

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

1. Apply various problem solving strategies to solve computational problems.
2. Design and implement time and space efficient algorithms.
3. Analyze the worst case running time performance of algorithm.
4. Develop application oriented algorithms.

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 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.

Guidelines for Laboratory Conduction:
1. Recommended languages for the implementation of the assignments: Python, Java etc.
2. Open source tools are preferable if required.

Department of Computer Science & Engineering (AI & ML)

Assignme nt No.	Suggested List of Assignments
	Assignment Title
1.	Given two binary strings that represent the value of two large integers, find the product of two strings. Write a Program to perform large integer multiplication.
2.	Write a program to find the shortest path from a vertex to all other vertices of a weighted graph using Bellman Ford algorithm.
3.	Suppose we have given a table of the frequencies of occurrences of characters for the data. Write a program to generate Huffman Code.
4.	If the vertices of a graph represent radio stations, and two vertices are adjacent if the stations are close enough to interfere with each other, a Graph coloring can be used to assign non-interfering frequencies to the stations. Write a program to solve the given problem.
5.	Let there be N students and N clubs. Any student can be assigned to any club, incurring some cost that may vary depending on the student club assignment. It is required to allocate all clubs by assigning exactly one student to each club and exactly one club to each agent in such a way that the total cost of the assignment is minimized. Implement a club assignment problem.
6.	Given weights and values of n items, put these items in a knapsack of capacity W to get the maximum total value in the knapsack. You cannot break an item, either pick the item, or don't pick it.Write a program to solve 0/1 knapsack problem.
7.	Job Assignment Problem: Let there be N workers and N jobs. Any worker can be assigned to perform any job, incurring some cost that may vary depending on the work-job assignment. It is required to perform all jobs by assigning exactly one worker to each job and exactly one job to each agent in such a way that the total cost of the assignment is minimized.
8.	Given a password entered by the user, check its strength and suggest some password if it is not strong. Write a program to implement strong password suggester program .
9.	A vertex cover of an undirected graph is a subset of its vertices such that for every edge (u, v) of the graph, either 'u' or 'v' is in the vertex cover. Although the name is Vertex Cover, the set covers all edges of the given graph. Given an undirected graph, the vertex cover problem is to find minimum size vertex cover. Write a program to provide approximate Solution for Vertex Cover Problem.
10.	Write a program to implement parallel divide and conquer strategy for quick sort.

Reference Books:

1. George T. Heineman , Gary Pollice , Stanley Selkow , "Algorithms in a Nutshell", 2nd edition, 2016, ISBN-10-1491948922

2. Thomas H Cormen and Charles E.L Leiserson, "Introduction to Algorithms", The MIT Press; 4th edition, 2022, ISBN-13: 978-0262046305

3. Jon Kleinberg, Eva Tardos "Algorithm Design",Pearson, 2nd edition, 2013 ,ISBN-13 : 978-1292023946

4. Michael T. Goodrich, Roberto Tamassia , "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, 2006, ISBN 978-81-265-0986-7.

5. Gilles and Brassard, Paul Bratley, "Fundamentals of Algorithmics", PEARSON INDIA, 2015, ISBN 10: 9332549990.

Web References:

1. https://web.stanford.edu/class/archive/cs/cs106b/cs106b.1178/assn/huffman.pdf

2. https://www.whitman.edu/mathematics/cgt_online/book/section05.08.html

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)			Semester : V			
Course :	CN & IOT Lab			Code : BCS5422			
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	01	02	25	-	25	50

Course Objectives:

1. To establish communication among the computing nodes in various networking architectures.
2. To study IOT, their characteristics, components, and basic awareness of Arduino/Raspberry Pi.
3. To learn the different types of sensors used in the IOT environment.
4. To perform interfacing of sensors with Arduino/ Raspberry Pi.
5. To handle the real time data collection from the IOT cloud.

Course Outcomes:

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

1. Design network applications by using various concepts of layered architecture.
2. Install the software setup of the Arduino/ Raspberry Pi.
3. Use various sensors and connect them with an Arduino/ Raspberry Pi.
4. Implement real life applications on the IOT platform.

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 a title, objectives, outcomes, Theory- Concept in brief, dataset used, 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. The suggested list of assignments is given below. Instructors can frame suitable assignments.
2. Group A assignments are compulsory. Any two assignments from Group B and 1 Mini project is compulsory from Group C. Use of open source software is encouraged.

Department of Computer Science & Engineering (AI & ML)

Guidelines for the Mini Project:	
	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. The instructor should maintain the progress report of the mini project from the students project group.

<table>
<tr><td colspan="2" align="center">Suggested List of Assignments</td></tr>
<tr><td></td><td align="center">Group A</td></tr>
<tr><td align="center">Assignment No.</td><td align="center">Assignment Title</td></tr>
<tr><td align="center">1.</td><td>Study of networking commands. 1. ping 2. ipconfig/ifconfig 3. Tracert 4. Netstat 5. NSLookup.</td></tr>
<tr><td align="center">2.</td><td>Study of Raspberry-Pi, Arduino or other microcontroller (History & Elevation).</td></tr>
<tr><td align="center">3.</td><td>Write a Program to interface LED/Buzzer with Raspberry-Pi/ Arduino and write a program to turn on LED for 1s after every 2 sec.</td></tr>
<tr><td align="center">4.</td><td>Understanding and connectivity of Raspberry-Pi / Arduino with camera. Write an application to capture and store the image.</td></tr>
<tr><td></td><td align="center">Group B</td></tr>
<tr><td align="center">5.</td><td>Write a server application to be deployed on the Raspberry-Pi / Arduino. Write client applications to get services from the server application.</td></tr>
<tr><td align="center">6.</td><td>Write a program using TCP sockets for wired network to implement peer to Peer Chat (Use JAVA/PYTHON).</td></tr>
<tr><td align="center">7.</td><td>Create a simple web interface for the Raspberry-pi board / Arduino to control the connected LEDs remotely through the interface.</td></tr>
<tr><td align="center">8.</td><td>Write a program on the Raspberry-pi board / Arduino to upload temperature data to /from Thingspeak cloud.</td></tr>
<tr><td align="center">9.</td><td>Setup a wired LAN using Layer 2 Switch and then IP switch of minimum four computers. It includes preparation   of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and preparing server to send file to client. Demonstrate the PING packets captured traces using Wireshark Packet Analyzer Tool.</td></tr>
</table>

	Group C
10.	**Real Life applications/ Mini-projects based on IoT. - Suggested List** Home Automation Health care Automobiles Security System Image Processing Communication System Robotics Smart City

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515

2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition,Wiley Publication, ISBN: 978-1-119-99435-0.

3. Charles Crowell, "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT",ISBN-13 : 979-8613100194

4. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_cs53

2. https://archive.nptel.ac.in/courses/106/105/106105166

Program:	**B. Tech. CSE(AI & ML)**					Semester : V	
Course :	**Computer Vision & Deep Learning Lab**					Code : BCS5423	
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**PR**	**OR**	**Total**
04	**-**	**02**	**04**	**25**	**25**	**-**	**50**

Course Objectives:

1. To introduce students to the fundamental concepts and techniques of computer vision.
2. To familiarize students with important computer vision algorithms and their implementation.
3. To provide an understanding of advanced topics in computer vision, such as deep learning and 3D reconstruction.
4. To understand the basic principles and techniques of computer vision, including image processing, feature extraction, and object recognition.

Course Outcomes:

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

1. Apply various image filtering techniques.
2. Implement computer vision algorithms using popular programming languages and frameworks such as Python and OpenCV.
3. Select and evaluate suitable deep learning models to implement computer vision related applications.
4. Evaluate the performance of various deep learning models.

Guidelines for Students:

1. First 4 Assignments are compulsory, Implement any 6 assignments from the remaining all.
2. The laboratory assignments are to be submitted by students in the form of a journal.
3. Each assignment write-up should have Title, Objectives, Outcomes, Theory- Concept in brief, dataset used, data description, conclusion, and assessor's sign.
4. 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 and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

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 student and include an element to attract and promote intelligent students. Use of open source software is encouraged.

Assignment No.	Assignment Title
Suggested List of Assignments	
1.	Image Filtering: Implement various image filters like Sobel, median, Gaussian and apply them to sample images to observe their effects on image properties such as edges, noise, and blurriness.
2.	Image Segmentation: Implement different segmentation techniques like thresholding, region growing, watershed segmentation and apply them to sample images to extract different regions of interest.
3.	Image Registration: Implement different image registration techniques, like affine transformation, and apply them on pairs of images of the same scene captured from different perspectives to align them.
4.	Visualizing and understanding convolutional neural networks (CNNs).
5.	Object detection using deep learning frameworks like YOLO or Mask R-CNN.
6.	Facial recognition using OpenCV and deep learning.
7.	Gesture recognition using computer vision techniques.
8.	Image denoising and restoration using deep learning models.
9.	Semantic segmentation of images using CNNs.
10	Image classification using convolutional neural networks (CNNs).
11.	Time series prediction using RNN – stock market analysis or weather forecasting.
12.	Text identification using OpenCV, Tesseract (OCR) and deep neural network.
13.	Sentiment analysis using LSTM network.
14.	Music composition using any one or combination of suitable deep neural networks - CNN/RNN/LSTM/GAN.

Reference Books:
1. Jan Erik Solen, " Computer Vision with Python" Published by O'Reilly media 2012.
2. Reinhard Klette, "Concise Computer Vision- An Introduction to Theory and Algorithm", Springer 2014
3. Robert M. Haralick and Linda G. Shapiro, "Computer and Robot Vision", Addison-Wesley, 1992-93.
4. Richard O. Duda, Peter E. Hart, and David G. Stork, "Pattern Classification", Wiley Interscience, 2001.
5. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", 2021.
6. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017

Web References:
1. https://onlinecourses.nptel.ac.in/noc23_cs24/, https://onlinecourses.nptel.ac.in/noc23_cs56
2. https://www.analyticsvidhya.com/blog/2020/02/learn-image-classification-cnn-convolutional-neural-networks-3-datasets/

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)		Semester : V
Course :	Project Development - II		Code : BCS5702

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
8	-	4	8	50	-	50	100

Course Objectives:
1. To visualize the problems and understand mathematical contexts more deeply.
2. To apply design and development principles in the construction of software systems of varying complexity.
3. To decide a suitable design strategy to solve a real-world problem.
4. To validate and evaluate the Project work undertaken.
5. To work in a team and demonstrate the knowledge, skills and attitudes of a professional engineer.
6. To prepare good quality technical reports based on the selected project statement.

Course Outcomes:

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

1. Create mathematical models by applying knowledge of computing and mathematics to algorithm design.
2. Analyze the performance of algorithms.
3. Identify class of problem and formulate solutions using standard approaches.
4. Apply advanced algorithms from the different domains to implement the problem.
5. Compare the algorithms with respect to time and space complexity.
6. Develop proficiency in problem solving and programming.

General Guidelines for Project Development -II Work:

1. Project Development-II is one of the significant contributory work that has to be completed based on the required number of credits as per academic regulations.
2. It is necessary to explore the domain of interest / research/ thrust area/ society needs.
3. In 5th 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.
4. 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.
5. 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.
6. 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.

7. 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 Development - II 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:

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

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

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

4. 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, mathematical modeling, use case writing, use of algorithmic strategies.analysis of performance etc.

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.

\begin{center}**Suggested List of Assignments**\end{center}	
Assignment No.	**Assignment Title**
1.	Select a problem/ project and study the mathematical modeling process.
2.	Perform Usecase writing in detail for the selected problem.
3.	Develop a mathematical model for the selected project.
4.	Select and Apply appropriate algorithmic strategies or problem solving paradigms for selected projects.
5.	Design computationally efficient algorithms for the selected project.
6.	Perform worst-case running time analysis of algorithms.
7.	Select appropriate algorithms and implement them for the selected project.
8.	Develop the prototype for the selected problem and analyze the results and their interpretation, and infer findings.

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**			Semester : V			
Course :	**Professional Development Training - I**			Code : **BHM5917**			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-	-	**03**	-	-	-	-

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes:

After learning the course, the students will be:

1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills.
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Modern Maths:** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	**06**
II	**Algebra:** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	**06**
III	**Mensuration :** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics**.	**06**
IV	**Logical Reasoning :** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	**06**

V	**Data Interpretation :** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	
VI	**Verbal Ability & Reading Comprehension :** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	**06**
	Total	**36**

Reference Books:
1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3 rd Edition, S. Chand Publishing, Delhi.
4. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance.

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : V	
Course :	**Emotional Intelligence (Audit Course-II)**					Code : BHM9963	

Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	1	-	-	-	-

Prior knowledge : Nil

Course Objectives:
1. To develop an awareness of Emotional Intelligence models.
2. To understand intelligence and develop emotional competence.
3. To understand how you use emotion to facilitate thought and behavior.
4. To know and utilize the difference between reaction and considered response.

Course Outcomes:

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

1. Understand how to manage emotions, behavior and self-control in any situation resulting in better productivity.
2. Employ emotional intelligence competencies to effectively interact with people, colleagues and employees in building stronger relationships at work and at home.
3. Articulate emotions using the right verbal and non-verbal language.
4. Use tools to regulate their emotions and recognize and respond appropriately to emotions in self and others.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Emotional Intelligence (EI):** What is Emotional Intelligence, Emotional Intelligence and various EI models, The EQ competencies of self-regulation, motivation, empathy and interpersonal skills, Understand EQ and its importance in life.	03
II	**Self-awareness (SA):** Seeing the other side, giving in without giving up. **Tools :** Think, Feel, Act Cards, Plutchik's Wheel of Emotions & Emotional intelligence **test Self-Regulation/Managing Emotions:** The science of Emotions, Self-emotional quotient.	03

III	**Gaining Control:** Use of Coping Thoughts and Relaxation Techniques to manage emotions, Activities: Be the Fog, Temperament Analysis. **Emotion recognition in others:** The universality of emotional expression, perceiving emotions accurately in others to build empathy. **Activities :** Mindful Listening, Perceptual Positions.	**03**
IV	**Emotional Intelligence at Work place:** Importance of Emotional Intelligence at Work place, role of empathy and trust in relationships, building effective work relationships,conflict resolution strategy, Cohesive team building, **Tests :** My Colored Hat, ―I Am‖ Circle, Empathy Cards.	**03**
	Total	**12**

Text Books:
1. Daniel Goleman, ―Emotional Intelligence – Why It Matters More Than IQ, Bantam, 10th Anniversary edition, 2005, ISBN: 978-0553383713
2. Steven C. Hayes, Spencer Smith, ―Get Out Of Your Mind And Into Your Life: The New Acceptance and Commitment Therapy‖, Read How You Want, [Large Print] edition, 2009, ISBN-13 : 978-1458717108

Reference Books:
1. Steven Stein, ―The EQ Edge, Jossey-Bass, 3rd edition, 2011, ISBN-13: 978-0470681619
2. Drew Bird , ―The Leader‘s Guide to Emotional Intelligence, Createspace Independent Pub, Kindle Edition, 2016, ISBN-13 : 978-1535176002

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : V	
Course :	**Entrepreneurship Development(Audit Course-II)**					Code : BHM9964	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	**1**	-	-	-	-

Prior knowledge : Nil

Course Objectives:
1. To inspire students and help them imbibe an entrepreneurial and start-up mind-set.
2. To develop and strengthen entrepreneurial quality among students.
3. To understand the abilities to become an Entrepreneur.
4. To acquaint with legalities in product development, IPR, Trademarks, Copyright and patenting.
5. To know the facets of Business plans, Entrepreneurial Finance.

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

1. Develop an entrepreneurial mind-set by learning key skills such as product design, salesmanship, marketing and interpersonal skills.
2. Interpret their own business plan and analyze factors that contributed to the failure of a start-up.
3. Understand how to determine the best source of capital for a company and how to find revenue and expense assumptions.
4. Understand the legalities in product development, IPR, Trademarks, Copyright and patenting.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Concept and Scope:** Entrepreneurship as a career, Traits of Successful Intrapreneur/ Entrepreneur, Why to become entrepreneur, Entrepreneurship Development Phases, Problem Solving and Ideation Process, Design Validation, Types of Start-ups.	**03**
II	**Creating Entrepreneurial Venture** : Sources of Innovation, methods of generating ideas, Prototype preparation and validation, Legal Issue, Private/Public Limited Company formation requirements, Intellectual Property Protection: Patents Trademarks and Copyrights, **Entrepreneurial Failure** : Case study of patterns, Early failures: Good idea bad planning, False start , False positive, Late-stage failures: Speed trap, Cascading miracle , False confidence.	**03**

III	**Business Plan Preparation:** Sources of product for business: Feasible study, Ownership, capital, budgeting, Marketing plan for the new venture, steps in preparing marketing plan, Business Model Canvas (BMC), Financial plan- proforma income statements, Ratio Analysis.	03
IV	**Financial Modeling and Metrics:** Spreadsheets, Benchmarks, Revenue assumptions, expense assumptions, Metrics customer Acquisition cost and life time model, Metrics viral coefficient, Funnel Analysis, **Entrepreneurial Finance:** venture capital, financial institutions supporting entrepreneurs, Lease Financing; Funding opportunities for Start-ups in India, Crowdfunding, Angel investing.	03
	Total	**12**

Text Books:
1. Kumar Arya, ―Entrepreneurship: Creating and Leading an Entrepreneurial Organization‖, Pearson Education India, First edition, 2012, ISBN-10: 8131765784; ISBN-13: 978-8131765784
2. S.S.Khanka, ―Entrepreneurial Development‖, S Chand and Company Limited, Revised 2012th edition, 2012, ISBN : 81-219-1801-4.

Reference Books:
1. Taneja, Gupta, Entrepreneur Development New Venture Creation‖, Galgotia Publishing Company, 2nd edition. 2017, ISBN: 9788185989594
2. Charantimath, Poornima, ―Entrepreneurship Development and Small Business Enterprises Pearson Education, 3rd edition, 2018, ISBN: 8177582607, 9788177582604
3. Blake Masters and Peter Thiel, ―Zero to One‖, Plata Publishing, 2nd edition,2014, ISBN-10 : 9780804139298 - ISBN-13 : 978-0804139298

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**			Semester : V			
Course :	**Research Article Writing (Audit Course-II)**			Code : BHM9965			

Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	**-**	**-**	**1**	**-**	**-**	**-**	**-**

Prior knowledge : Nil

Course Objectives:

1. To understand how to write effective research articles.

2. To create awareness about grammar, lexical choices, citations in the text.

3. To develop a full-length article, proposal or conference presentation.

4. To familiarize the basic methods and techniques of research writing.

Course Outcomes:

After completion of this course, the students will be able to,

1. Understand necessary traits to write effective research article with appropriate grammatical and lexical choices in text.

2. Comprehend the importance of citations, indexing, indexed articles and plagiarism.

3. Develop an ability of critical thinking necessary to analyze research reports.

4. Write a research article, review article, thesis chapter and other related academic research text effectively and demonstrate the importance of revising and proofreading for writing research article.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Research Writing:** What is a research article? Understanding what is Research Writing', Qualities and skills required in a Research writer, Types of Research writing, choosing a suitable journal/conference/book chapter, How to conduct an effective Research, Abstract Writing, Selection of keywords, defining problem statement.	**03**
II	**Sources of citations**: Understanding of giving citation to other works, Identifying relevant citations, Understanding impact factor, Importance of Indexing and Indexed articles, learning to scan research articles quickly and effortlessly, Using Your Sources Wisely**:** what to	**03**

	cite, where to find good sources and how to use them, avoiding plagiarism. **Plagiarism tools**: iThenticate, Grammarly. **Citation Tools :** Mendeley, ,BibMe, Citefast, APA, MLA.	
III	**Drafting:** Structure of a basic research paper, stages of writing and research, learn to write the first draft, Understanding the components of an article: Abstract, Introduction, Preliminary concepts, proposed system, Experimental section, result analysis and discussion, Conclusion, Reference.	**03**
IV	**Revising and Editing:** Importance of revision, Understanding the comments of reviewer, Point-to-Point address of reviewer comments, What/Whatnot to revise, Emphasis on Journal formats, Proper usage of Grammar and sentence formatting, Steps for submitting the revised manuscript/article.	**03**
	Total	**12**

Text Books:
1. Charles A. MacArthur , ―Handbook of Writing Research‖, The Guilford Press; 2nd edition, 2016, ISBN- 10: 1462529313, ISBN-13: 978-1462529315
2. Margaret Cargill, Patrick O'Connor, ―Writing Scientific Research Articles‖, Wiley-Blackwell, 2nd Edition, 2013, ISBN: 978-1-118-57070-8

Reference Books:
1. Booth W., Colomb G. and Williams J., ―The Craft of Research‖, University of Chicago Press,4th edition, 2016, ISBN-13: 978-0226239736
2. Jennifer Peat, Elizabeth Elliott, Louise Baur, Victoria Keena ,―Scientific Writing Easy when you know how‖, Wiley & Sons, Inc, 2 nd edition, 2013, ISBN:9780727916259

Course Syllabus
TY B.Tech CSE (AI & ML)
Semester- VI

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**				**Semester : VI**		
Course :	**Big Data Analytics**				**Code : BCS6424**		
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Data Science and Database Systems **is essential.**

Course Objectives:

1. To understand Big Data Analytics Life Cycle.
2. To understand and apply Big Data Analytic Methods.
3. Frequent Itemsets Mining and Clustering for Big Data Analysis.
4. To apply visual Data Analysis Techniques.
5. To select appropriate techniques and tools to solve Big Data problems.

Course Outcomes:

After learning the course, the students will be able to:
1. Apply data analytics life cycle to big data projects.
2. Write case studies in Business Analytic and Intelligence using mathematical models.
3. Apply Frequent Itemsets Mining and Clustering for data analysis.
4. Apply Data Stream Mining to Analytics Problems.
5. Identify and apply Visual Data Analysis Techniques.
6. Analyze unstructured data using tools and techniques.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Big Data:** Introduction to BigData, Challenges of Conventional Systems, Web Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Operationalize, Case studies.	**08**
II	**Big Data Analytic Methods:** Multivariate Analysis, Bayesian Modelling, Inference and Bayesian Networks, Analysis of Time Series: Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks: Learning and Generalization, Competitive Learning, Principal Component Analysis and Neural Networks, Stochastic Search Methods. Statistics for Model Building and Evaluation.	**07**

III	**Frequent Item Sets and Clustering:** Mining Frequent item sets: Market Based Model, Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent item sets in a Stream, Clustering Techniques: Hierarchical, K-Means- determining number of clusters, diagnostics, reasons to choose and cautions, Frequent Pattern based Clustering Methods.	**08**
IV	**Mining data streams:** Introduction to Streams Concepts: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream: Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Case Studies, Real Time Sentiment Analysis, Stock Market Predictions.	**07**
V	**Big Data Visualization & Graph Analytics:** Introduction, Challenges to Big data visualization, Visual Data Analysis Techniques, Interaction Techniques; Systems and Analytics Applications, Industry challenges and application of Analytics. **Graph Analytics:** Introduction, Graph Analytics for analyzing large amounts of transactional data & relationships among Data Models.	**08**
VI	**Framework, Technologies and Tools:** Analytics for unstructured data- Use cases, Map Reduce, Apache Hadoop. Hadoop Distributed File Systems, The Hadoop Ecosystem- Pig, HIVE, HBase, Mahout, NoSQL Databases, **Cloud-based Big Data Analytics** : Case study on Data Analytics using cloud platform, interface, services etc.	**07**
	Total	**45**

Text Books:
1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to data Science and its Applications", Wiley publications, 2014.
2. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
3. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6
4. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2003
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 2012.

Reference Books:
1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866,
3. Glenn J. Myatt, "Making Sense of Data", Wiley, 2006

4. V.K. Jain, Big Data & Hadoop, Khanna Book Publishing Co., Delhi. (ISBN 978-93-82609-131)

Web References:

1. NPTEL Course: Big Data Computing by Prof. Rajiv Misra, IIT Patna
2. NPTEL Course: Introduction to Data Analytics by Prof. Nandan Sudarsanam Prof. Balaram Ravindran, IIT Madras

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : VI	
Course :	**Intelligent Systems & Robotics (Professional Elective - I)**					Code : BCS6501	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
3	**-**	**3**	**3**	**20**	**30**	**50**	**100**

Prior knowledge of Data structures, Internet of Things (IoT) **is essential.**

Course Objectives:
1. To provide students with an in-depth understanding of the theory, design, and implementation of intelligent systems and robotics.
2. To learn about the principles and algorithms behind intelligent systems, including knowledge representation, reasoning, and planning.
3. To learn about the latest trends and developments in the robotics and intelligent system fields.
4. To gain hands-on experience in designing, building, and programming robotic systems.

Course Outcomes:

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

1. Understand the various aspects of intelligent systems and robotics.
2. Select and apply intelligent agents for various intelligent system applications.
3. Apply the concept of fuzzy logic to robotic applications.
4. Comprehend the principles and applications of various sensors and actuators used in robotics.
5. Integrate intelligent systems and robotics with other technologies such as IoT and cloud computing.
6. Design intelligent robotic systems.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Intelligent Systems:** Definition and characteristics of intelligent systems, A spectrum of intelligent behavior, The knowledge base, knowledge acquisition, computational intelligence, overview of applications, and impact on various industries and societies.	**07**
II	**Intelligent Agents:** Introduction to Intelligent Agents, Agent Architectures, Agent programming, Perception and Reasoning, Agent Learning, and Agent Adaptation Multi-Agent Systems- Introduction to multi-agent systems, Cooperative and Competitive Agents, building multi agent systems, contract nets, Negotiation and Coordination, Game Theory, and Social Choice.	**08**

III	**Fuzzy Logic:** Introduction to Fuzzy Logic, Crisp set, Fuzzy Sets and Operations, Fuzzy control system, Fuzzy Logic Systems Architecture, Applications of Fuzzy Logic.		**08**
IV	**Introduction to Robotics**: Fundamentals, Path Planning for Point Robots, Sensing and Mapping for Point Robots, Mobile Robot Hardware. Non Visual Sensors like: Contact Sensors, Inertial Sensors, Infrared Sensors, Sonar, Radar, Laser Rangefinders, and Biological Sensing. Fuzzy-Based Robotic Path Planning.		**08**
V	**Robot System Control:** Horizontal and Vertical Decomposition, Hybrid Control Architectures, Middleware, High-Level Control, Human-Robot Interface. Robot Pose Maintenance and Localization: Simple Landmark Measurement, Servo Control, Recursive Filtering, and Global Localization.		**08**
VI	**Mapping:** sensory maps, topological maps, geometric maps, exploration Robots in Practice: Delivery Robots, Intelligent Vehicles, Mining Automation, Space Robotics, Autonomous Aircraft, Agriculture, Forestry, and Domestic Robots.		**06**
	Total		**45**

Text Books:
1. Adrian Hopgood, " Intelligent Systems for Engineers and Scientists", 3rd Edition, ISBN: 9781498783798.
2. Stuart Russell and Peter Norvig , Artificial Intelligence: A Modern Approach," Fourth edition, Pearson, 2020.
3. Sebastian Thrun, Wolfram Burgard, and Dieter Fox , "Probabilistic Robotics" 2005, ISBN: 9780262201629.
4. Michael Jenkin, Gregory, " Computational Principles of Mobile Robotics," Cambridge University Press, 2010, ISBN : 978-0-52-187157-0

Reference Books:
1. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH
2. Shai shalev-shwartz, Shai Ben-David: Understanding Machine Learning from Theory to Algorithms, Cambridge University Press, ISBN-978-1-107-51282-5, 2014

Web References:
1. https://nptel.ac.in/courses/108104049
2. https://onlinecourses.nptel.ac.in/noc21_me32

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : VI	
Course :	**Natural Language Processing (Professional Elective - I)**					Code : BCS6502	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
3	-	3	3	20	30	50	100

Prior knowledge of Data Structures, proficiency in python and familiarity with probability **is essential.**

Course Objectives:
1. To understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
2. To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.
3. To familiarize various NLP software libraries and datasets publicly available.
4. To develop systems for various NLP problems with moderate complexity.
5. To learn various strategies for NLP system.

Course Outcomes:
After learning the course, the students will be able to:
1. Apply the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
2. Demonstrate semantics and pragmatics of English language for text processing.
3. Analyze and apply the Language Modelling for Natural Language Processing.
4. Apply the semantic techniques for Natural Language Processing.
5. Apply POS Tagging using Neural Model.
6. Apply Information Extraction models to the problems of Natural Language Processing.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to NLP:** NLP introduction and applications, NLP phases, Difficulty of NLP including ambiguity, Spelling error and Noisy Channel Model, Concepts of Parts - of - speech :Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure and Formal Grammar of English.	08
II	**Text Preprocessing and Morphology :** Character Encoding, Word Segmentation, Sentence Segmentation,. Inflectional and Derivation Morphology , Morphological analysis and generation using Finite State Automata and Finite State transducer. **Case study**: Language Corpora - Text mining & text analysis.	07
III	**Language Modelling N-gram and Neural Language Models :** Language Modelling with N-gram, Simple N-gram models, Smoothing basic techniques, Evaluating language models; Neural Network basics, Training; Neural Language Model.	07

	Case study: Application of neural language model in NLP system development.	
IV	**Semantics :**Basic ideas in Lexical Semantics, Vector Semantics, Words and Vector, Semantics with dense vectors, Singular Value Decomposition (SVD) and Latent Semantic Analysis, Embeddings from prediction: Skip-gram and CBOW, Concept of Word Sens **Case study**: WordNet and WordNet based similarity measures .	**08**
V	**Parts-of-speech Tagging** : Basic concepts, Approaches: Rule based and Transformation Based Learning (TBL), Hidden Markov Model (HMM) POS Tagging, Introduction to POS Tagging using Neural Model . **Parsing Basic concepts:** top down and bottom up parsing, Syntactic parsing: CKY parsing, Probabilistic Context Free Grammar (PCFG).	**07**
VI	**Information Extraction:** Introduction to Named Entity Recognition and Relation Extraction , Natural Language Generation-Architecture, Machine Translation, Sentiment and Emotion Analysis, Text Entailment, Question Answering, Analytics and Social Networks , Multilingual word embedding, Introduction to Transformer learning. **Case study**: BLEU Score — BiLingual Evaluation Understudy.	**08**
	Total	**45**

Text Books:
1. Dan Jurafsky, James H. Martin. "Speech and Language Processing. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Prentice-Hall, 3rd edition, January 12, 2022 [Official Link for 3 rd edition draft.https://web.stanford.edu/~jurafsky/slp3/ed3book_jan122022.pdf

2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing", O'Reilly Media, Inc.,First edition, June 2020, ISBN: 9781492054054

Reference Book:

1. Delip Rao, Brian McMahan, "Natural Language Processing with PyTorch", O'Reilly Media, 1st edition, February 2019, ISBN: 9781491978238

2.   Aman Kedia, Mayank Rasu, "Hands-On Python Natural Language Processing",Packt Publishing Limited, 1st edition, June 2020, ISBN-10 -1838989595

Web References:
1.   https://web.stanford.edu/~jurafsky/slp3/ed3book_jan122022.pdf
2.   https://jair.org/index.php/jair/article/view/11030
3.   https://engineering.fb.com/2018/01/24/ml-applications/under-the-hood-multilingual-embeddings/
4.   Swayam Course on NLP : https://onlinecourses.nptel.ac.in/noc19_cs56/preview

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**		Semester : VI
Course :	**Information Security (Professional Elective - I)**		Code : BCS6503

Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Basic Mathematics , Computer Networks **are essential.**

Course Objectives:
1. Learn fundamentals of cryptography.
2. Understand network security threats, security services, and countermeasures.
3. To encourage investigation into what factors are likely to result in successful network security.
4. To provide foundations of the basic system security testing for vulnerabilities and procedures of backup and recovery.
5. Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.
6. To provide an understanding of principal concepts, major issues, technologies, and basic approaches in information security.

Course Outcomes:

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

1. Understand and explain the risks faced by computer systems and networks.
2. Analyze the various techniques of encryption, key management in security.
3. Develop security mechanisms using symmetric key Cryptographic Techniques .
4. Apply Asymmetric key Cryptographic Techniques to encrypt and decrypt the messages.
5. Use different Hash Techniques to provide the Authentication and to check the Integrity of messages in transit.
6. Demonstrate various network security applications.

<table>
<tr><td colspan="3" align="center">Detailed Syllabus</td></tr>
<tr><td>Unit</td><td align="center">Description</td><td>Hours (H)</td></tr>
<tr><td>I</td><td>Introduction to Information Security:
Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Threats and Vulnerability, Difference between Security and Privacy.</td><td>08</td></tr>
<tr><td>II</td><td>Conventional Cryptographic Techniques :
Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography.</td><td>07</td></tr>
</table>

III	**Symmetric and Asymmetric Cryptographic Techniques :** DES, AES, RSA algorithms, Public-key Cryptography, Diffie-Hellman key exchange, man-in-the-middle attack, DDoS.		**08**
IV	**Authentication and Digital Signatures :** Use of Cryptography for authentication, Secure Hash function, Key management – Kerberos.		**07**
V	**Program Security :** Non-malicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the-middle attacks.		**08**
VI	**Security in Networks :** Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls.		**07**
	Total		**45**

Text Books:
1. William Stallings, Cryptography and Network Security: Principles and Practice, 7th Edition, Global Edition, Pearson Education, 201, ISBN: 129215859X, 9781292158594.
2. Behrouz A. Forouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security" Mc Graw Hill Education (India) Private Limited, 2015, ISBN: 9339220943, 9789339220945.

Reference Books:
1. Roberta Bragg, Mark Rhodes-Ousley, Keith Strassberg, "Network Security: The Complete Reference" , McGraw-Hill Education, 2004, ISBN: 0072226978, 9780072226973.

2. Atul Kahate, "Cryptography And Network Security",Tata Mcgraw-Hill Publishing Company Limited, 2003, ISBN: 0070494835, 9780070494831.

Web References:
1. **https://nptel.ac.in/courses/106106129,** Introduction to Information Security I, IIT Madras, Prof.V.Kamakoti.

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Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**		Semester : VI	
Course :	**Edge Computing (Professional Elective - II)**		**Code : BCS6504**	

Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Internet of Things, Cloud Computing **is essential.**

Course Objectives:
1. To familiarize edge computing concepts with different use cases.
2. To explain various edge computing platforms.
3. To recognize the Edge networking related requirements.
4. To examine the need of security in edge computing.
5. To design an application-specific edge analytics model using edge AI/ML.
6. To elaborate various communication models of edge computing.

Course Outcomes:

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

1. Identify the need for new computing paradigms and compare the edge computing with existing paradigms.
2. Analyze the need of hardware and software-based components in edge computing architectures and platforms.
3. Recognize Edge networking related requirements and components.
4. Describe various communication models of edge computing.
5. Analyze data/application requirements related to security in edge computing.
6. Design edge analytics models using edge AI/ML methods.

	Detailed Syllabus	
Unit	**Description**	**Hours (H)**
I	**Introduction to Edge Computing:** Edge computing purpose and definition, key components of edge ecosystem, Edge computing devices, Edge vs Fog Computing vs Cloud computing, Working of edge computing. Edge computing use cases and examples: video surveillance, smart cities, autonomous vehicles.	**07**

II	**Edge Computing platforms and frameworks** Edge hardware architectures: processors, storage, and memory, hardware accelerators in edge computing: Use of Hardware accelerators like Intel Compute Stick/Google Coral with companion to Raspberry Pi or Jetson Edge platforms: Architectures, Virtualization, containers Edge computing popular frameworks: Microsoft Azure IoT Edge or Google cloud IoT Edge.	**08**
III	**Edge Networking:** Edge routing and networking: TCP/IP network functions at the edge, Edge-level network security, Software-defined networking.	**07**
IV	**Communication Models:** Edge, Fog, M2M: Building M2M and WSN network (HTTP/MQTT) – Topologies and applications. Edge to Cloud Protocols: Edge MQTT: architecture details, state transitions, packet structure, data types, communication formats. Introduction to protocols like CoAP.	**08**
V	**IoT and Edge Security:** Introduction to IoT and Edge security: cybersecurity, physical and hardware security, Edge security best practices, Threats and vulnerabilities related to edge computing. Case study: Anomaly Detection in Edge Computing.	**07**
VI	**Edge Analytics:** Basic data analytics in Edge IoT, Machine learning in Edge IoT, Edge AI. Edge Analytics applications and examples: Deep Learning at the Edge, Exploiting Edge Computing in Health Monitoring, Edge Computing Model for Evolving Smart Transportation, Deployment of deep model on edge devices using Edge Impulse platform.	**08**
	Total	**45**

Text Books:
1. Perry Lea , "IoT and Edge Computing for Architects", Packt Publishing, ISBN: 9781839214806, March 2020.
2. Rajkumar Buyya, Satish Srirama, "Fog and Edge Computing: Principles and Paradigms", Wiley publication, ISBN: 9781119524984, January 2019.

Reference Books:

1. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, Springer India, ISBN-13 978-1484275504, January 2022.

2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, ISBN 9781032509266, June 2022

Web References:

1. NPTEL course lecture links:

    https://onlinecourses.nptel.ac.in/noc23_cs65/

2. educba.com/edge-computing-architecture/

3. https://atos.net/wp-content/uploads/2022/06/Vision_paper_edge_computing_finale.pdf

4. https://advcloudfiles.advantech.com/ecatalog/2021/08041406.pdf

5. https://blogs.nvidia.com/blog/2019/10/22/what-is-edge-computing/

6. https://www.nvidia.com/en-in/edge-computing/

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)				Semester : VI		
Course :	Cloud Computing (Professional Elective - II)				Code : BCS6505		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of Computer Networks and Operating Systems **is essential.**

Course Objectives:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students with a sound foundation of Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios.
3. To enable students to explore cloud computing-driven commercial systems and applications.
4. To expose the students to frontier areas of Cloud Computing and information systems.

Course Outcomes:

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

1. Describe the Paradigm and architecture of a cloud computing system.
2. Analyze various cloud Computing models and apply them to solve problems on the cloud.
3. Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems.
4. Outline the function of system and storage virtualization.
5. Develop an application for a given business case using various cloud platforms.
6. Identify various security threats and challenges faced by cloud providers.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to cloud computing** **Introduction to cloud computing**: What is cloud, What is cloud computing, history of cloud computing,Cloud Computing Paradigm, Cloud Characteristics, Benefits and drawbacks of cloud computing. **Cloud Computing Architecture**: Components of cloud computing architecture, cloud computing technologies: Virtualization, Grid computing, Service oriented architecture(SOA), Utility computing. Working in cloud computing. **Case Study:** Google App Engine.	08

II	**Cloud deployment and Service Models** **Cloud Service Models**: Infrastructure-as-a-service (IaaS), Platform-as-a-service (PaaS), Software-as-a-service (SaaS). **Cloud computing deployment models:** public cloud, private cloud, hybrid cloud and Community cloud. Hybrid-multi cloud, Deployment of ML models on Cloud. **Case Study:** Microsoft Azure (Azure stack).	07
III	**Data Management in Cloud Computing** **Cloud data stores**: Datastore and Simple DB, relational DB, Parallel DB. Cloud data Storage-techniques, Cloud Storage Providers. **Cloud file systems**: GFS, Amazon S3 and HDFS, BigTable, HBase and Dynamo . **Case Study:** Amazon DynamoDB.	08
IV	**Virtualization** Introduction, Characteristics of Virtualized environments, Hypervisor, Taxonomy of Virtualization techniques, Pros and Cons of Virtualization, different models and key approaches to virtualization in CPU, Memory, and Device Virtualization. **Case Study:** Microsoft Hyper-V	07
V	**Cloud Service Providers** **AWS**: Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Understanding Amazon Database Services. **Azure**: Exploring Microsoft Cloud Services, The Azure Platform, The Windows Azure service. **Google**: Exploring Google Applications, Exploring the Google Toolkit, and Working with the Google App Engine. **Case Study:** Airbnb.	08
VI	**Cloud Security** **Infrastructure Security:** Network level security, Host level security, Application level security. **Data security and Storage:** Data privacy and security Issues, Jurisdictional issues raised by Data location. Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations. **Case Study:** Symantec/Cloud Security Tool: Acunetix.	07
	Total	45

Text Books:

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley,India, ISBN: 978-1-118-02399-0, 2010.

2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, ISBN: 978-0-470-93894-2, 2010

Reference Books:

1. Thomas Erl and Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Pearson,2nd Edition, ISBN: 9780133387568, May 2013

2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", The McGraw-Hill, ISBN: 978-0070683518,2017.

Web References:

1. https://nptel.ac.in/courses/106105167

2. Cloud Computing https://onlinecourses.nptel.ac.in/noc21_cs14/preview?

3. https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf

Department of Computer Science & Engineering (AI & ML)

Program:	**B.Tech. CSE(AI & ML)**			Semester : VI			
Course :	**Bioinformatics (Professional Elective -II)**			**Code : BCS6506**			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Databases , Design and Analysis of Algorithms **are essential.**

Course Objectives:

1. To understand the scope of Bioinformatics.
2. To familiarize popular bioinformatics databases.
3. To understand Sequence comparison and Alignment algorithms.
4. To apply Predictive Methods Using DNA and Protein Sequences.

Course Outcomes:

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

1. Identify the various challenges and applications of bioinformatics.
2. Analyze various biological sequence databases.
3. Apply Methods for searching sequence databases.
4. Analyze performance of sequence comparison methods.
5. Compare and apply sequence alignment Methods.
6. Apply predictive methods on DNA and protein sequences.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction**: History, scope and important contributions, aims and tasks of Bioinformatics, applications of Bioinformatics, challenges and opportunities, introduction to NCBI data model, various file formats for biological sequences.	**07**
II	**Biological Databases:** Importance of databases, biological databases, primary sequence databases, composite sequence databases, secondary databases, nucleic and sequence databases, protein sequence databases, structure databases, bibliographic databases, specialized genomic resources, analysis packages.	**08**

III	**Data Search Methods:** Methods for searching sequence databases like FASTA and BLAST algorithms, Statistical analysis and evaluation of BLAST results.	**07**
IV	**Sequence Comparison Methods:** Methods for comparison of two sequences, Needleman Wush and Smith Waterman algorithms. Analysis of computational complexities, merits and demerits of these algorithms, theory of scoring matrices and their use for sequence comparison.	**08**
V	**Sequence Alignment Methods:** Sequence analysis of biological data, significance of sequence alignment, pairwise sequence alignment methods, use of scoring matrices and gap penalties in sequence alignments, multiple sequence alignment methods, tools and applications of multiple sequence alignment.	**07**
VI	**Predictive Methods Using DNA, Protein Sequences and Functional Genomics:** Gene prediction strategies, protein prediction strategies, molecular visualization tools, Covid 19 Genome Data Analysis, Study of the expression and function of the genome. Analysis of interactions between genes and between genes and the environment.	**08**
	Total	**45**

Text Books:

1. Andreas D Baxevanis & B F Francis, "Bioinformatics-A practical guide to analysis of Genes and Proteins", John Wiley, 2010
2. T K Attwood, D J Parry-Smith, "Introduction to Bioinformatics", Pearson Education, 2005
3. David W. Mount, "Bioinformatics: Sequence and Genome Analysis"
4. Arthur M. Lesk, "Introduction to Bioinformatics"

Reference Books:

1. Neil C. Jones, Pavel A. Pevzner, "An introduction to Bioinformatics Algorithms", MIT Press, 2005
2. Gary Benson Roderic, "Algorithms in Bioinformatics", Springer, 2004
3. Foundations of Bioinformatics, Manoj Darbari, Khanna Book Publishing Co., 2013.
4. Jean-Michel Claverie and Cedric Notredame, "Bioinformatics for Dummies".
5. Phillip Compeau and Pavel Pevzner, "Bioinformatics Algorithms: An Active Learning Approach"
6. Jonathan Pevsner, "Bioinformatics and Functional Genomics".

Web References:

1. NPTEL Course: Bio-Informatics: Algorithms And Applications by Prof. Michael Gromiha, IIT Madras

Program:	**B. Tech. CSE(AI & ML)**					Semester : VI	
Course :	**Multivariate Data Analysis using R (OEC-I)**					**Code : BAS6608**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Descriptive Statistics, Inferential Statistics, Probability **is essential.**

Course Objectives:
1. This course aims at enabling the students to learn multivariate data collection, visualization, and preprocessing techniques for data science.

Course Outcomes:
After learning the course, the students will be able to:
1. Use data preprocessing methods in R and generate quality data for analysis.
2. Implement R packages and related functions to data science to analyze multivariate data.
3. Describe the multivariate data using different data visualization techniques.
4. Analyze the multivariate data using dependent analysis methods using the R.
5. Analyze the multivariate data using independent analysis methods using the R.
6. Develop a model for Prediction and Decision Making for a data set.

	Detailed Syllabus	
Unit	**Description**	**Hours (H)**
I	**Data Wrangling:** Understanding the multivariate data, Standardizing Variables, Accessing Databases with R Software, Merging multiple data sources into a single dataset for analysis, Dealing with Missing values, dealing with extreme outliers in data, discrepancies or removing.	**07**
II	**Multivariate Data and Multivariate Analysis:** Calculating Summary Statistics for Multivariate Data: Means and Variances Per Group, Between-groups Variance and Within-groups Variance for a Variable, Between-groups Covariance and Within-groups Covariance for Two Variables, Calculating Correlations for Multivariate Data, The multivariate normal density function.	**08**

III	**Multivariate Data Visualization in R Software:** Geometric projection techniques: Scatter plot matrix, Hyper box, Trellis display, Parallel coordinates, Icon-based techniques: Chernoff faces, Stick figures, Star plots, Color icons, Pixel-oriented techniques: Query-independent techniques: visualize the entire dataset, Query-dependent techniques: visualize a subset of data that are relevant to the context of a specific user query, Hierarchical techniques, Hybrid techniques.	**08**
IV	**Dependent Analysis:** Multiple linear regression, Conjoint Analysis, Multiple Discriminant Analysis, Linear Probability Analysis, Multivariate analysis of variance (MANOVA), Canonical Correlation Analysis, Structural Equation Modeling.	**07**
V	**Independent Analysis:** Factor Analysis: Factor analysis model, the k-factor analysis model, Estimating the parameters in the k-factor analysis model. Cluster Analysis: Cluster analysis, K-means clustering, Displaying clustering solutions graphically, multidimensional Scaling, Correspondence Analysis.	**07**
VI	**Multidimensional Scaling:** Models for proximity data, Spatial models for proximities: Multidimensional scaling, Classical multidimensional scaling, non-metric multidimensional scaling. **Linear Discriminant Analysis :** Loadings for the Discriminant Functions, Separation Achieved by the Discriminant Functions, A Stacked Histogram of the LDA Values, Scatter plots of the Discriminant Functions, Allocation Rules and Misclassification Rate.	**08**
	Total	**45**

Reference Books:
1. Montgomery and Runger, "Applied Statistics and Probability for Engineers", Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, "Probability and Statistics for Engineers", Prentice India Ltd, 8 Edition, ISBN 13:978- 8120342132.
3. S.P.Gupta, "Statistical Methods", Papperbook publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Everitt and Hothorn , "Use R!" series on using R for multivariate analyses, An Introduction to Applied Multivariate Analysis with R.
5. Barbara G. Tabachnick, Using Multivariate Statistics (4th Edition), Allyn & Bacon; 4th edition (August 9, 2000), ISBN-10:0321056779.
6. Yasunori Fujikoshi, Vladimir V. Ulyanov, Ryoichi Shimizu, Multivariate Statistics: High-Dimensional and Large-Sample Approximations, John Wiley & Sons, 15-Aug-201, ISBN:0470539860

Web References:
NPTEL Course lectures links:
1. https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ma53 (Introduction to R software)
2. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ma37 (Descriptive statistics using R software)

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)				Semester : VI		
Course :	Remote Sensing and GIS (OEC-1)				Code : BCI6603A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of
Fundamental related to Surveying , Types and Importance of various surveys, Global Positioning System **(GPS) are essential.**

Course Objectives:
1. To comprehend fundamentals and principles of RS and GIS techniques.
2. To enhance students' capacity to interpret images and extract information of earth surface from multiresolution imagery at multi-scale level.
3. To develop skills of Image processing and Geographical Information Systems.
4. To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
5. To learn buffering and layer analysis for various engineering applications.

Course Outcomes:
After learning the course, the students will be able to:
1. Articulate fundamentals and principles of RS techniques.
2. Demonstrate the knowledge of remote sensing and sensor characteristics.
3. Distinguish working of various spaces-based positioning systems.
4. Analyze the RS data and image processing to utilize in civil engineering.
5. Explain fundamentals and applications of RS and GIS.
6. Acquire skills of data processing and its applications using GIS.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Remote Sensing:** Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning.	07
II	**Remote Sensing Satellites and Sensor Characteristics:** Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to	08

	various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image interpretation, image interpretation.	
III	**GPS and GNSS:** Introduction to GNSS and Types, IRNSS, GPS, GPS components, differential GPS, types of GPS tracking, application of GNSS in surveying, mapping and navigation.	**07**
IV	**Image Processing and Analysis:** Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.	**08**
V	**Fundamentals of GIS:** Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.	**07**
VI	**GIS Data and Case Studies:** GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies.	**08**
	Total	**45**

Text Books:

1. J. George "Fundamentals of Remote Sensing", Universities Press, Hyderabad, 2005
2. Principles of Remote Sensing, Panda B C, Viva Books Private Limited, 2008.
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022.
4. S.K. Sinha "Fundamental of Remote Sensing and GIS", Ayushman Publication House,2014.

Reference Books:
1. Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia, 4th Edition, 2017
2. Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John, 7th Edition, 2015

3. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000.

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_ce84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ce52/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/
5. https://www.classcentral.com/course/swayam-remote-sensing-and-gis-14272

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**		Semester : VI			
Course :	**Building Services and Maintenance (OEC-1)**		Code : BCI6603B			
Teaching Scheme				**Evaluation Scheme**		
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Course Objectives:
1. To understand the different building services provisions.
2. To study the suitable electrical and mechanical services, fire protection, acoustic, water supply and sound Insulations.
3. To examine the the purpose and type of building maintenance.

Course Outcomes:

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

1. Understand different building services provisions.

2. Interpret the importance of building ventilation.

3. Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.

4. Discover the knowledge of Fire Protection, Acoustic, Sound Insulations.

5. Provide awareness of laws and regulations of water supply systems related to building services.

6. Select different types of maintenance in building services.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Building Services:** Definitions, Objective and uses of services, different types of building, Classification of building services, Types of services and selection of appropriate services for given project.	07
II	**Building Ventilation:** Natural and artificial lighting principles and factors, Arrangement of luminaries, Distribution of illumination, Utilization factors, Necessity of Ventilation Types – Natural and Mechanical Factors to be considered in the design of Ventilation.	08
III	**Electrical Services & Mechanical Services in Buildings:** Electrical services in the building technical terms and symbols for electrical installations and Accessories of wiring, Systems of wiring Plumbing & Air-Conditioning, Air Distribution system, Cleaners.	08

IV	**Fire Protection Acoustic and Sound Insulations:** Introduction, causes of fire and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2005, Requirement of good Acoustic, Various sound absorbent, Factors to be followed for noise control in residential building.	**08**
V	**Water and Sanitation:** Water quality, Purification and treatment- water supply systems-distribution systems municipal bye laws and regulations, Rain Water Harvesting Sanitation in buildings arrangement of sewerage systems in housing.	**07**
VI	**Building Maintenance:** Role of maintenance in durability and serviceability of buildings Economic aspects of maintenance. Different types of maintenance.	**07**
	Total	**45**

Text Books:
1. A text book on Building Services R. Udaykumar Eswar Press, Chennai
2. Building Services S. M. Patil Seema Publication, Mumbai Revised edition
3. National Building Code of India - 2005 Bureau of Indian Standards BIS, New Delhi

Reference Books:
1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd

Web References:
1. https://nptel.ac.in/courses/105102176.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)		Semester : VI	
Course :	Designing with Raspberry Pi (OEC-1)		Code : BET6601	

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of Basics of Programming
is essential.

Course Objectives:
1. To explain fundamentals of Raspberry pi (Rpi) and installation of OS in Rpi.
2. To demonstrate the Python programming and interfacing of sensors and actuators with Rpi
3. To describe the Node-RED tool used in Rpi and its applications.

Course Outcomes:

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

1. Describe the basic specifications and operating systems of Raspberry Pi.
2. Illustrate the usage of Node-RED tool for Raspberry Pi programming.
3. Understand the Python programming concepts.
4. Apply the concepts of programming for sensor interfacing with RPi.
5. Apply the concepts of programming for actuator interfacing with RPi.
6. Design IoT based applications with Python programming and Raspberry Pi.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Getting started with Raspberry Pi:** Basic functionality of Raspberry Pi board, Physical design and specifications, GPIO Pin description of Rpi, Reading the datasheet of RPi, comparison of various Rpi models, Rpi as mini- computer. Introduction of various operating systems of Rpi, Installation of Raspbian/Noobs/OSMC operating system on Rpi, first boot and basic configuration of Rpi, Introduction to Linux commands required to configure Rpi, Overview of Graphic User Interface (GUI).	08
II	**Getting started with Node-RED tool on Rpi:** Prerequisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED app locally and as a service on network, auto-start on boot, opening the editor, installation of various libraries for Node-RED, adding node, add debug node, wire the nodes, deploy the flow.	06

III	**Programming the Raspberry Pi:** Introduction to Python programming language: Python Programming Environment, Python Expressions, Strings, Functions, Data types in python, importing libraries, flow control, conditional statement, Loops.	10
IV	**Sensor interfacing with Rpi:** Basics of sensors: What are sensors? Types of sensors Sensor interfacing: Temperature and Humidity sensor (DHT11), PIR Motion sensor, obstacle detection using Ultrasonic sensor, soil moisture sensor.	06
V	**Actuator interfacing with Rpi** Basics of actuators: What are actuators?, Their need in making a closed loop system Actuator interfacing: Electronic Relays, LED's, Buzzers/Fan, DC Motor, Stepper motor, LCD.	07
VI	**Case Study based following topics :** Home Automation, Smart City, Smart Farming, Smart Transportation, Health and Lifestyle, Pollution Monitoring system.	08
	Total	45

Text Books:
1. Gary Mitnick,"Raspberry Pi 3: An Introduction to using Python Scratch, javascript and more", Createspace Independent publishing Platform 2017.
2. Tim Cox, "Raspberry Pi for python program cookbook" Packet Publishing Limited, 2 nd edition, 2016 .
3. John C. Shovic,"Raspberry Pi IoT Projects", Apress Berkeley CA, 2016.

Reference Books:
1. Sean McManus, Mike Cook, "Raspberry Pi for Dummies"Wiley Publishers, 4th edition, 2021
2. Maik Schmidt, "Raspberry Pi: A Quick-Start Guide", The pragmatic programmers, LLC, 2012.
3. Simon Monk,"Programming the Raspberry Pi", 2nd Edition, McGraw Hill publications, 2012.
4. Matt Richardson,"Getting started with Raspberry pi", 3rd Edition, Make community, LLC 2016
5. Derek Molloy,"Exploring Raspberry pi", 1st Edition, Wiley, 2016

Web References:
1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs74/preview

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**				Semester : VI		
Course :	**Basics of Automotive Electronics (OEC-1)**				Code : BET6602		

Teaching Scheme				Evaluation Scheme			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Electrical & Electronics **is essential.**

Course Objectives:

1. To introduce the Electronics Control Unit (ECU) used in Automotive applications..
2. To apply operating principles of sensors and actuators used in automotive.
3. To explore the role of electronic systems in Active and passive safety systems**.**

Course Outcomes:

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

1. Apply the concept of electronics systems in automotive applications.
2. Explore different sensors and actuators.
3. Illustrate vehicle motion control systems.
4. Understand algorithms used in Engine Control System.
5. Describe the role of electronics in Active and passive safety systems.
6. Make use of automotive components, subsystems, and basics of Electronic Engine Control in the automotive industry.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Automotive Systems Overview**: Automotive vehicle technology, Present trends in automobiles with emphasis on increasing role of electronics and software, Overview of typical automotive subsystems and components, Body, Chassis, and Powertrain Electronics.	**07**
II	**Sensors:** Basic sensor arrangement, Types of sensors such as oxygen sensors, Crankshaft angle position sensors, Fuel metering/ vehicle speed sensors, Flow sensor, Temperature, Exhaust Gas Oxygen (O2/EGO), Air mass flow sensors, Throttle position sensor, Strain Gauge MAP sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Piezoelectric Knock Sensor. **Actuators :**	**09**

	Solenoids, Stepper Motors, Relays, Fuel Injector, EGR Actuator, Ignition System.	
III	**Vehicle Motion Control :** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS).	07
IV	**Engine Control System:** Algorithms for engine control including open loop and closed loop control system, Electronic ignition, EGR for exhaust emission control.	07
V	**Active and passive safety systems:** Body electronics including lighting control, Remote keyless entry, Immobilizers, Electronic instrument clusters and dashboard electronics, Antilock braking system, Computer vision based ADAS.	07
VI	**Future Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control.	08
	Total	**45**

Text Books:
1. William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", 7th edition, Butterworth-Heinemann Publications, 2017.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill, 1999.
3. Oliverscheid, "Autosar Compendium, Part 1: Application & RTE", Create Space Independent Publishing Platform, 2015

Reference Books:
1. Robert Bosch, "Automotive Hand Book", 10th edition, Wiley Publications, 2018.
2. Kiencke, Uwe, Nielsen & Lars, "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication, 2005.
3. John F. Kershaw, James D. Halderman, "Automotive Electrical and Electronic Systems", 5thEdition, Pearson Prentice Hall, 2007

Web References:
1. https://autosartutorials.com/
2. https://www.udemy.com/course/learn-autosar-from-scratch/

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**				Semester : VI		
Course :	**3D Printing and Modeling (OEC-1)**				**Code : BME6603A**		
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Materials Engineering, CAD software **are essential.**

Course Objectives:
1. To understand the importance of 3D Printing process of various applications.
2. To be familiar with the different 3D printing process.
3. To create CAD model that satisfy product development/prototyping requirements.

Course Outcomes:
After learning the course, the students will be able to:
1. Understand the meaning and generic steps of the 3D printing process.
2. Identify the effects of critical parameters in the Stereo lithography and Solid ground curing process.
3. Identify the effects critical parameters in the Laminated object manufacturing and Fused Deposition Modeling Process.
4. Identify the effects critical parameters in the Selective laser sintering process and Direct Energy deposition.
5. Develop the .STL file and create sliced model by using open source software.
6. Understand the various application of 3D printing process.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to 3D Printing:** Meaning of 3D Printing, The Generic/steps in 3D printing Process, Materials used in 3D Printing, Types of 3D Printing process and Benefits of 3D printing, Design for Additive manufacturing (DFAM).	**08**
II	**Liquid based systems:** Stereo lithography apparatus (SLA): Specifications, parameters, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages. Solid ground curing (SGC): Specifications, parameters, process, working, principle, applications, advantages and disadvantages.	**07**

III	**Solid based systems:** Laminated object manufacturing (LOM): Specifications, parameters, Process, Working principle, Applications, Advantages and disadvantages. Fused Deposition Modeling (FDM): Specifications, Process, parameters, Working principle, Applications, Advantages and disadvantages.	**07**
IV	**Powder Based Systems:** Selective laser sintering (SLS): Specifications, process, parameters, working principle, applications, advantages and disadvantages. Direct Energy deposition (DED): Specification, parameters, process, working principle, applications, advantages and disadvantages.	**08**
V	**Modelling in 3D printing:** Meaning of STL file, Special rules for the STL format, Meaning of Slicing, Components of Slicing software, Preparation of CAD models, Converting into STL file, slicing by using open source software.	**08**
VI	**Applications of 3D Printing**: Prototyping and manufacturing, Medical applications, Automotive applications, Aerospace & Defence applications, Constructions applications. Art and Jewellery applications.	**07**
	Total	**45**

Text Books:

1. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Second Edition, Springer Publications, ISBN 978-1-4939-2112-6.
2. Vannessa Goodship , Bethany Middleton, Ruth Cherrington, Design and Manufacture of Plastic Components for Multi functionality, Elsevier Publications, ISBN: 978-0-323-34061-8

Reference Books:

1. Henrique Amorim Almeida and Paulo Jorge da Silva Bártolo, Mathematical Modeling of 3D Tissue Engineering Constructs, Springer International Publishing, ISBN: 978-3-319-45444-3.

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**			Semester : VI			
Course :	**Material Informatics (OEC-1)**			Code : BME6603B			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	**-**	**03**	**03**	**20**	**30**	**50**	**100**

Prior knowledge of Data Science, Machine Learning, Python/R programming **are essential.**

Course Objectives:

1. To Aquitaine students about materials, their properties, structure property relationship.
2. To create awareness about the importance of statistics in materials data analysis.
3. To imbibe significance of data science, machine learning in use, selection and analysis of materials.

Course Outcomes:

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

1. Compare different materials based on their structures.
2. Interpret material property data and draw conclusions.
3. Apply statistical methods for materials data analysis.
4. Use programming languages like python/R programming for materials data analysis.
5. Apply machine learning algorithm for interpretation of materials data.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Introduction to Materials:** Classification of materials, structure of materials: atomic structure, crystal structure and microstructure, material properties: Physical, Mechanical, Electrical, Magnetic etc.	**07**
II	**Materials Information:** Structure property relationship, Applications and selection of materials, Analysis and synthesis of materials.	**07**
III	**Statistics and Materials:** Basic probability and statistics, basic R/ Python, Inaccurcacies and error and its propagation, Descriptive data analysis, Probability distributions, Probability distributions using R/Python, Fitting functions to data: regression, testing significance of fit.	**08**

IV	**Experimental Data:** Processing of experimental data using R/Python, R/Python for graphical handling of data and fitting.	**07**
V	**Feature Extraction:** Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in materials Engineering.	**08**
VI	**Classification:** Decision tree, Random Forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in materials Engineering.	**08**
	Total	**45**

Text Books:
1. Material Science and engineering an introduction, William D.Callister, Wiley Publication
2. Machine Learning and Artificial Intelligence, B Joshi, Springer, 2020.
3. R for Beginners, Emmanuel Paradis, Open source online
4. Databases: MaterialsProject.org, MaterialsWeb.org
5. Pymatgen, MPInterfaces software for materials analysis

Reference Books:
1. Materials Informatics: Methods, Tools, and Applications, Wiley VCH
2. Informatics for Materials Science and Engineering, Elsevier
3. Emerging Trends and Applications of Machine Learning, Solanki, Kumar, Nayyar, IGI Global, 2018.

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)		Semester : VI
Course :	Big Data Analytics Lab		Code : BCS6425

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	TW	PR	OR	Total
04	-	02	04	50	50	-	100

Prior knowledge of Data Science, Algorithms **is essential.**

Course Objectives:

1. To apply Big Data Analytic Methods.
2. Frequent Itemsets Mining and Clustering for Big Data Analysis.
3. To apply visual Data Analysis Techniques.
4. To select appropriate techniques and tools to solve Big Data problems.

Course Outcomes:

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

1. Apply appropriate techniques and tools to solve big data problems.
2. Apply Multivariate Analysis on sample Big Data.
3. Perform Big Data cluster analysis using clustering techniques.
4. Perform Data Stream Mining.
5. Apply Data Visualization techniques on Big Data.
6. Apply map-reduce and tools for big data analytics using Hadoop.

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 / TW 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.

Department of Computer Science & Engineering (AI & ML)

	Guidelines for Laboratory Conduction:
	1. The Course Instructor is expected to frame a detailed assignment statement referring to a suggested list of assignments.
	2. Group A and Group B assignments are mandatory.

Suggested List of Assignments

Assignment No.	Assignment Title
	Group A- Assignments based on Big Data Analytics
1.	Write a program using Multivariate Analysis methods on selected Big Data.
2.	Write a program for Cluster Analysis of Big Data using Clustering techniques.
3.	Write a program for Data Stream Mining. **OR** Write a program for Time Series Analysis: Use time series and forecast traffic on a mode of transportation. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problemtime-series-2
4.	Use Twitter data for sentiment analysis. The dataset is 3MB in size and has 31,962 tweets. Identify the tweets which are hate tweets and which are not. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problemtwitter-sentiment-analysis /
5.	Write a program for Stock Market Analysis and related predictions. OR Bigmart Sales Analysis: For data comprising transaction records of a sales store. The data has 8523 rows of 12 variables. Predict the sales of a store. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/
6.	Write a program for analyzing large amounts of transactional data using Graph Analytics and build Data Visualization reports using various components such as List, crosstabs, Statistics, Chart, map, Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Run or schedule report, different output forms – PDF, excel, csv, xml etc.
	Group B- Assignments based on Hadoop.
7.	Install, configure, and run Hadoop and HDFS. Write a Hadoop program that counts the number of occurrences of each word in a text file.
8.	Implement matrix multiplication with Hadoop Map Reduce
9.	Write a program with Hadoop platform that interacts with the weather database. Find the day and the station with the maximum snowfall in a particular year.
10	Perform map-reduce analytics using Hadoop: Select Movies Dataset. Write the map and reduce methods to determine the average ratings of movies. The input consists of a series of lines, each containing a movie number, user number, rating, and a timestamp: The map should emit movie number and list of rating, and reduce should return for each movie number a list of average rating.

Reference Books:

1. Glenn J. Myatt, "Making Sense of Data", Wiley, 2006

2. V.K. Jain, Big Data & Hadoop, Khanna Book Publishing Co., Delhi. (ISBN 978-93-82609-131)

3. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X

4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley, 2012.

Program:	**B. Tech. CSE(AI & ML)**			Semester : VI			
Course :	**Professional Elective-I Lab**			Code : BCS6507			
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Credit**	**Hours**	**TW**	**PR**	**OR**	**Total**
2	**-**	**1**	**2**	**25**	**50**	**-**	**75**

Course Objectives:

Option I: Intelligent Systems & Robotics

1. To provide students with an in-depth understanding of the theory, design, and implementation of intelligent systems and robotics.
2. To learn about the principles and algorithms behind intelligent systems.

OR

Option II : Natural Language Processing

1. To grasp the significance of natural language processing in solving real-world problems.
2. To map the appropriate processing technique to a problem and implement the technique.
3. To demonstrate required design skills for large collection sets.
4. Develop software to carry out NLP tasks based on leading existing libraries for natural language processing and machine learning.

OR

Option III : Information Security

1. To understand the concepts of Cryptography mechanisms.
2. To be able to secure a message over an insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of data.
4. To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes:

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

Option I: Intelligent Systems & Robotics

1. Familiar with modeling and simulation techniques for intelligent robotic systems.
2. Apply the concept of intelligent system to develop robotic applications.
3. Demonstrate knowledge of robots and its characteristics .
4. Develop intelligent robotic applications.

OR

Option II : Natural Language Processing	

1. Apply concepts of computational models underlying NLP to solve the problems.
2. Apply Part-of-speech Tagging to assign syntactic tags.
3. Design and implement a text pre-processing technique used in natural language processing.
4. Analyze text for sentiment and implement it for opinion mining.

OR

Option III : Information Security

1. Use tools and techniques in the area of Information Security .
2. Use the knowledge of security for problem solving .
3. Apply the concepts of Information Security to design and develop applications.

Intelligent Systems & Robotics

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 and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

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 inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged.

Suggested List of Assignments (Select any 4)	
Assignment No.	**Assignment Title**
1.	Create a chatbot: with Natural Language Processing libraries, you can create a chatbot that can respond to user queries.

2.	Develop an autonomous drone that can navigate through an obstacle course using machine learning algorithms.
3.	Build a virtual assistant chatbot that can answer customer inquiries and provide personalized recommendations based on their purchase history.
4.	Create an intelligent system that can predict and prevent equipment failures in industrial settings using anomaly detection algorithms.
5.	Design a robotic arm with computer vision capabilities that can pick and sort items on a conveyor belt.
6	Implement a reinforcement learning algorithm to teach a robotic dog to fetch objects in a simulated environment.

Reference Books:

1. Adrian Hopgood, " Intelligent Systems for Engineers and Scientists", 3rd Edition, ISBN: 9781498783798.
2. Stuart Russell and Peter Norvig , Artificial Intelligence: A Modern Approach," Fourth edition, Pearson, 2020.
3. Sebastian Thrun, Wolfram Burgard, and Dieter Fox , "Probabilistic Robotics" 2005, ISBN: 9780262201629.
4. Michael Jenkin, Gregory, " Computational Principles of Mobile Robotics," Cambridge University Press, 2010, ISBN : 978-0-52-187157-0

Web References:
3. https://nptel.ac.in/courses/108104049
4. https://onlinecourses.nptel.ac.in/noc21_me32

Natural language Processing

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 sign.
3. Program codes with sample output of all performed assignments should be submitted.

Guidelines for Laboratory /TW 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, NLTK etc.

Suggested List of Assignments (Select any 4)

Assignment No.	Assignment Title
1.	Use the "News category dataset" which provides news headlines from the year 2012 to 2018 obtained from HuffPost. Implement a program to perform language detection, Word Count, Sentence Count, and tokenization.
2.	Import the German language Stemmer and write a program to perform stemming for non-english words.
3.	Write a program to perform POS Tagging or Word Embeddings.
4.	Write a program for lemmatizing words using WordNet.
5.	Write a program for identifying sentiment (positive or negative) and emotions expressed in text.
6.	Write a program to determine the probability of a sequence of words using N-gram Language Model.

Reference Books:

1. Dan Jurafsky, James H. Martin. "Speech and Language Processing. An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Prentice-Hall, 3 rd edition, January 12, 2022 [Official Link for 3 rd edition draft.https://web.stanford.edu/~jurafsky/slp3/ed3book_jan122022.pdf
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, "Practical Natural Language Processing", O'Reilly Media, Inc.,First edition, June 2020, ISBN: 9781492054054
3. Delip Rao, Brian McMahan, "Natural Language Processing with PyTorch", O'Reilly Media, 1st edition, February 2019, ISBN: 9781491978238
4. Aman Kedia, Mayank Rasu, "Hands-On Python Natural Language Processing",Packt Publishing Limited, 1st edition, June 2020, ISBN-10 -1838989595

Web References:

1. https://web.stanford.edu/~jurafsky/slp3/ed3book_jan122022.pdf
2. https://jair.org/index.php/jair/article/view/11030.

Information Security

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 /TW 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 and submission, performance, innovation, efficiency, punctuality, neatness and soundness of the contents.

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 inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged.

Suggested List of Assignments	
Assignment No.	**Assignment Title**
1.	Perform encryption, decryption using the following substitution techniques i. Caesar cipher ii. Playfair cipher iii. Hill Cipher iv. Vigenere cipher.
2.	Perform encryption and decryption using following transposition techniques i. Rail fence ii. Row & Column Transformation.
3.	Apply the DES algorithm for practical applications.
4.	Apply the AES algorithm for practical applications.
5.	Implement RSA Algorithm using HTML and JavaScript.
6.	Implement the SIGNATURE SCHEME - Digital Signature Standard.
7.	Study of the features of firewalls in providing network security and to set Firewall Security in windows.
8.	Study of different types of vulnerabilities for hacking websites / Web Applications.

Reference Books:

1. Stallings, W. (2018). Cryptography and network security. 7th edition. Pearson Education

2. Atul Kahate, "Cryptography and Network Security", 3e, McGraw Hill Education

3. Prakash C. Gupta, "Cryptography and Network Security", PHI

4. V.K. Pachghare, "Cryptography and Information Security", PHI Learning.

Program:	B. Tech. CSE(AI & ML)			Semester : VI			
Course :	Professional Elective - II Lab			Code : BCS6508			
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**TW**	**PR**	**OR**	**Total**
2	-	1	2	25	-	50	75

Course Objectives:

Option I: Edge Computing

1. To use various edge computing platforms.
2. To identify and analyze the Edge computing related requirements like edge devices, deployment issues.
3. To design and develop an application-specific edge analytics model using edge AI/ML.

OR

Option II : Cloud Computing

1. To identify the technical foundations of cloud systems architectures.
2. To analyze the problems and solutions to cloud application problems.
3. To apply principles of best practice in cloud application design and management.
4. To identify and define technical challenges for cloud applications and assess their importance

OR

Option III : BioInformatics

1. To understand the biological databases.
2. To provide analytical solutions to bioinformatics problems.
3. To provide software solutions for Sequence comparison and Alignment algorithms.

Course Outcomes:

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

Option I: Edge Computing

1. Analyze the need of hardware and software-based components in edge computing platforms.
2. Recognize Edge computing related requirements and components during networking, security management or deployment.
3. Select a suitable edge computing platform as per data/application requirements.
4. Develop edge analytics models using edge AI/ML methods.

OR

Option II : Cloud Computing

1. Develop simple Web Application using Google App Engine.
2. Implement Virtualization in Cloud Computing .
3. Implement Machine Learning Models using Cloud Services.
4. Create a cloud computing Database using various cloud service providers.
5. Design and develop cloud based applications.

OR

Option III : BioInformatics

1. Use FASTA and BLAST algorithms for searching sequence databases.
2. Write a program for various types of Sequence Alignments.
3. Perform Sequence Analysis of biological databases.
4. Perform Genomic Data Analysis using software tools.
5. Apply map-reduce and tools for big data analytics using Hadoop.

Edge Computing

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/TWAssessment:

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:

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

Students should perform assignment no. 1 to 5 compulsorily and any five assignments from assignment no. 6 to 14.

Suggested List of Assignments

Assignment No.	Assignment Title
1.	Build a basic IoT sensor application using Python, MQTT, and AWS DynamoDB or MongoDB.
2.	Develop a Web application for Edge IoT Communications by using WebAPI data, MQTT notifications, and dashboard visualization. MQTT data may be accessed using REST API.

3.	Study about Azure IoT Edge and prepare a report on "Install and provision IoT Edge" .
4.	Study about Google Cloud IoT Edge and prepare a report on "Install and provision IoT Edge" .
5.	Study Microsoft Azure or Google Cloud IoT Edge Security model and prepare a report on "How to build security model daemon".
6.	Develop an application using Microsoft Azure or Google Cloud IoT Edge platform: Smart Bus Transportation.
7.	Develop an application using Microsoft Azure or Google Cloud IoT Edge platform: Intelligent Traffic light management system.
8.	Develop an Edge Analytics application for exploiting Edge Computing in Health Monitoring using Raspberry Pi.
9.	Develop the following use case related to Edge AI or Edge Robotics using Nvidia Jetson platform - Develop a device for Social Distancing Detector. Use machine learning or deep learning and configure it to run on edge AI devices of NVIDIA Jetson.
10.	Develop the following use case related to Edge AI or Edge Robotics using Nvidia Jetson platform - Deep Learning based Automatic Speech Recognition. Use machine learning or deep learning and configure it to run on edge AI devices of NVIDIA Jetson.
11.	Develop the following use case related to Edge AI or Edge Robotics using Nvidia Jetson platform - Deep Learning based Automatic Object Recognition. Use machine learning or deep learning and configure it to run on edge AI devices of NVIDIA Jetson.
12.	Develop the following use case related to Edge AI or Edge Robotics using M5stack Core2 and ESP32 microcontroller: Face mask detection.
13.	Develop the following use case related to Edge AI or Edge Robotics using M5stack Core2 and ESP32 microcontroller - Health monitoring parameter analysis
14.	Design any suitable Edge computing application using Tensorflow-Lite. May use any suitable hardware platform.

Reference Books:

1. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, Springer India, ISBN-13 978-1484275504, January 2022.
2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, ISBN 9781032509266, June 2022.

Web References:

1. https://github.com/Azure/iotedge/blob/main/edgelet/doc/devguide.md
2. https://advcloudfiles.advantech.com/ecatalog/2021/08041406.pdf
3. https://openautomationsoftware.com/knowledge-base/how-to-access-mqtt-data-rest-api/
4. https://learn.microsoft.com/en-us/azure/iot-edge/about-iot-edge?view=iotedge-1.4
5. https://www.upgrad.com/blog/iot-project-ideas-topics-for-beginners/
6. https://www.tensorflow.org/lite

Cloud Computing

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/TWAssessment:

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, Google App Engine, OpenStack, Azure, AWS.
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.

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

	Suggested List of Assignments
Assignment No.	**Assignment Title**
1.	Install Google App Engine. Create a hello world app and other simple web applications using python.
2.	Installation and Configuration of virtualization using Open Source Operating System.
3.	Study and implementation of infrastructure as Service using OpenStack.
4.	Creating a linear regression model for vehicle price prediction using Microsoft Azure Cloud services.
5.	Replicate and migrate virtual machine servers with Azure Migrate.
6.	Create and Design a relational database in Azure SQL Database.
7.	Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store.

8.	Mini Project:
	 Develop a Real life cloud Application on:
	     1. Healthcare
	     2. Geoscience
	     3. ERP System	

Reference Books:
1. Thomas Erl and Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Pearson, 2nd Edition, ISBN: 9780133387568, May 2013
2. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", The McGraw-Hill, ISBN: 978-0070683518, 2017.

Web References:
1. https://learn.microsoft.com/en-us/training/modules/describe-cloud-compute
2. https://aws.amazon.com/what-is-aws/?nc2=h_ql_le_int
3. https://education.oracle.com/learn/oracle-cloud-infrastructure/pPillar_640

Bioinformatics

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 /TW 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. The Course Instructor is expected to frame a detailed assignment statement referring to a suggested list of assignments.
2. Assignments 1 to 4 are compulsory. Students can select any one assignment out of 5 and 6 and implement it in the laboratory.

<table>
<tr><td colspan="2" align="center">Suggested List of Assignments</td></tr>
<tr><td align="center">Assignment No.</td><td align="center">Assignment Title</td></tr>
<tr><td align="center">1.</td><td>Write a program to use FASTA and BLAST algorithms for Searching Sequence Databases.</td></tr>
<tr><td align="center">2.</td><td>Write a program for Sequence Alignment: Basic local and global sequence alignment, pairwise and multiple sequence alignment, and visualization of sequence alignment results.</td></tr>
<tr><td align="center">3.</td><td>Write a program for Sequence Analysis: Sequence similarity searches, motif and domain searches, prediction of protein secondary structure and solvent accessibility.</td></tr>
<tr><td align="center">4.</td><td>Write a program or use software tools for Genomic Data Analysis: Genome assembly, genome annotation, identification of gene regulatory elements, and analysis of genomic variation and evolution.</td></tr>
<tr><td align="center">5.</td><td>Develop an application for Covid 19 Genome Data Analysis using machine learning algorithms, software tools and visualization techniques.</td></tr>
<tr><td align="center">6.</td><td>Develop an application for Proteomic Data Analysis using Machine Learning and Artificial Intelligence: Protein identification, quantification, and characterization, protein-protein interaction analysis, and functional annotation of proteins.</td></tr>
</table>

Reference Books:

1. David W. Mount, "Bioinformatics: Sequence and Genome Analysis"
2. Arthur M. Lesk, "Introduction to Bioinformatics".
3. Jean-Michel Claverie and Cedric Notredame, "Bioinformatics for Dummies"
4. Phillip Compeau and Pavel Pevzner, "Bioinformatics Algorithms: An Active Learning Approach".
5. Jonathan Pevsner, "Bioinformatics and Functional Genomics"

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)				Semester : VI		
Course :	Project Development - III				Code : BCS6703		
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
8	-	4	8	50	-	50	100

Course Objectives:
1. To Gain a deep understanding of different ML algorithms and their performance characteristics.
2. To Identify the most suitable algorithms for specific problem domains based on their performance measures.
3. To Develop a practical understanding of optimization algorithms commonly used in ML.
4. To Develop practical solutions for real-world problems using ML techniques.
5. To validate and evaluate the Project 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, the students will be able to:

1. Apply the Machine learning algorithms to datasets and evaluate their performance.
2. Design and Develop computationally efficient software projects.
3. Optimize the performance of Machine Learning models by reducing the unnecessary computations.
4. Test and validate the prototypes on relevant datasets.
5. Use statistical tool to gain appropriate results and findings.
6. Develop proficiency in problem solving and programming .

General Guidelines for Project Development -III Work:
1. Project Development-III is one of the significant contributory work that has to be completed based on the required number of credits as per academic regulations.
2. It is necessary to explore the domain of interest / research/ thrust area/ society needs.
3. In 6th 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.
4. 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.
5. 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.
6. 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.
7. 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 Development -III 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:

1. Report should be prepared using Latex only as per the template provided by the department.
2. Project reports shall be submitted in softcopy form/ (Hard bound reports could be avoided).
3. In the case of Sponsored project, students must submit a Completion certificate with the signature of an external guide from the sponsored company.
4. 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, Compare and analyze the various algorithms, select optimized algorithm.

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)

Suggested List of Assignments	
Assignment No.	**Assignment Title**
1.	Perform Usecase writing in detail for the selected problem.
2.	Select a dataset from a standard repository and implement a minimum 10 machine learning algorithms for solving the problem.
3.	Evaluate and compare the performance of Machine learning algorithms by applying suitable performance measures and statistical tools.
4.	Optimize the algorithm by reducing unnecessary computations or iterations.
5.	Implement optimized algorithms for the selected project.
6.	Implement a prototype for the selected project and analyze the results.

Department of Computer Science & Engineering (AI & ML)

Program:	**B. Tech. CSE(AI & ML)**					Semester : VI	
Course :	**Professional Development Training-II**					Code : BHM6918	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
03	-	-	**03**	-	-	-	-

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes:

After learning the course, the students will be:

1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills.
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Modern Maths:** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	06
II	**Algebra :** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	06
III	**Mensuration :** Cube cuboid cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics**.	06
IV	**Logical Reasoning :** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and	06

	Arrangements, Game-Based Aptitude.	
V	**Data Interpretation:** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	**06**
VI	**Verbal Ability & Reading Comprehension :** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	**06**
	Total	**36**

Reference Books:
1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3 rd Edition, S. Chand Publishing, Delhi.
4. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance

Department of Computer Science & Engineering (AI & ML)

Program:	B. Tech. CSE(AI & ML)			Semester : VI			
Course :	Proficiency Course-II (Web Development)			Code : BCS6913			
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	PR	OR	Total
02	-	-	02	-	-	-	-

Prior knowledge of Database Systems, Programming language **is essential.**

Course Objectives:
1. To develop a strong foundation in HTML, CSS, and JavaScript, and be able to use them to create basic web pages and applications.
2. To introduce students to server-side programming with Node.js and client-side programming with AngularJS.
3. To provide students with practical experience in software development methodologies and tools used in web development.
4. To develop strong problem-solving skills and be able to troubleshoot common issues in web development.

Course Outcomes:

After learning the course, the students will be able to:
1. Create responsive websites using responsive web design principles.
2. Build web applications that interact with external data sources using APIs and AJAX.
3. Develop single-page applications using NodeJS, AngularJS framework.
4. Work effectively in a team to develop a web application, and be able to communicate technical concepts and ideas effectively.

Suggested List of Assignments

Assignment No.	Assignment Title
1.	Design the following static web pages required for an online store website. a. Home Page b. Login Page c. Catalog Page d. Registration Page.
2.	Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contain alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 8 characters length and contains at least one special character). 3. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be Empty).

3.	Develop and demonstrate the usage of inline, internal and external style sheet using CSS.
4.	Develop and demonstrate JavaScript with POP-UP boxes and functions for the following problems: a) Input: Click on Display Date button using onclick( ) function Output: Display date in the textbox b) Input: A number n obtained using prompt Output: Factorial of n number using alert . c) Input: A number n obtained using prompt Output: A multiplication table of numbers from 1 to 10 of n using alert. d) Input: A number n obtained using prompt and add another number using confirm Output: Sum of the entire n numbers using alert.
5.	Design single page web application using Node JS.
6.	Create single page web application using AngularJS.
7.	Mini Project: Create Responsive Web Application using any web development tool and database connectivity.

Reference Books:
1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Marty Hall, Larry Brown, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
3. Chris Bates, "Web Programming Building Internet Applications", 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, "The Web Warrior Guide to Web Programming", Thomson, 2003.
5. Giulio Zambon, "Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10: 1430246235; ISBN-13: 978-1430246237
6. Jeremy McPeak& Paul Wilton, "Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937

Web References:
1. HTML, The Complete Reference http://www.htmlref.com/
2. http://www.nptelvideos.in/2012/11/internet-technologies.html
3. https://freevideolectures.com/course/2308/internet-technology/25 video lecture by Prof. Indranil Sengupta, IIT, Kharagpur.
4. https://www.digimat.in/nptel/courses/video/106105191/L01.html.
5. http://www.nptelvideos.com/php/php_video_tutorials.php

Program:	**B. Tech. CSE(AI & ML)**					Semester : VI	
Course :	**Environmental Science (Audit Course - III)**					Code : BHM9961	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Credit**	**Hours**	**IE**	**MTE**	**ETE**	**Total**
1	-	-	**1**	-	-	-	-

Course Objectives:

1. To gain an understanding on the concepts and strategies related to sustainable development and identify and analyze various conservation methods for renewable and non-renewable resources.

2. To examine biotic and abiotic factors within an ecosystem and to identify energy flow in an ecosystem.

3. To understand the value of biodiversity and identify current efforts for its conservation at national and local level.

4. To provide a comprehensive overview of environmental pollution and technology associated with monitoring and control.

Course Outcomes:

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

1. Demonstrate an integrative approach to environmental issues with a focus on sustainability and identify the role of organisms in energy transfer in different ecosystem.

2. Distinguish between renewable and non-renewable resources and analyze consumption of resources.

3. Identify key threats to biodiversity and develop appropriate policy options for it's conservation.

4. Analyze the impact of environmental pollution and the science behind those problems and potential solutions.

Detailed Syllabus

Unit	Description	Hours (H)
I	**Multidisciplinary nature of environmental studies:** Definition, scope and importance, Need for Public awareness, Natural Resources: Renewable and non- renewable resources: Natural resources and associated problems a) Forest b)Water c)Mineral d)Food e) Land f) Energy, Role of an individual in conservation of natural resources, Use of resources for sustainable lifestyle.	**03**
II	**Ecosystems**: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposer, Energy flow in the ecosystem, Ecological Succession, Food chains, food webs and ecological pyramids, Characteristic features, Case study	**03**

	on Forest ecosystem, Aquatic ecosystem.	
III	**Biodiversity and its conservation:** Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values, Biodiversity at global, national and local levels,India as a mega-diversity nation, Hotspots of biodiversity, Threats to biodiversity, Conservation of biodiversity, Case study on any oneHotspot of biodiversity.	**03**
IV	**Environmental Pollution:** Definition, Cause, effects and control measures of different pollution: a. Air b. Water c. Soil d. Noise e. Thermal f. Nuclear hazards, Solid waste management, Relevance of environmental ethics for environmental protection,**Social Issues and the Environment :**From Unsustainable to Sustainable development ,Urban problems related to energy ,Water conservation, Impact of Climate change, Innovative ideas for creating public environmental awareness.	**03**
	Total	**12**

Text Books:
1. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., ―Environmental Encyclopedia‖, Jaico Publications House, 1ˢᵗedition, 2000, ISBN-13: 978-8172247867
2. Agarwal, K.C, ― Environmental Biology‖, Nidhi Publishers, 2ⁿᵈedition, 2008, ISBN-13978-818915301

Reference Books:
1. BharuchaErach, ―The Biodiversity of India‖, Mapin Publishing Pvt. Ltd., 1ˢᵗ edition, 20021, ISBN-108188204064

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.