B.E. SCHEME OF EXAMINATION 2021-22

Scheme of Teaching & Examination of Bachelor of Engineering III Semester B.E. (Artificial Intelligence and Data Science)

Sr. No.	Course Code	Category	Course Name	Hours/Week			Credits	Maximum Marks					Minimum Passing Marks	
								Theory		Practical		Total		
				L	T	P		Internal	University	Internal	University		Theory	Practical
1	BEAI&DS301T	Basic Science Course	Discrete Mathematics and Graph Theory	3	1	0	4.00	30	70	-	-	100	45	
2	BEAI&DS302T	Professional core courses	Operating Systems	3	1	0	4.00	30	70	-	-	100	45	
3	BEAI&DS303T	Professional core courses	Computer Architecture & Organization	3	0	0	3.00	30	70	-	-	100	45	
4	BEAI&DS304T	Professional core courses	Data Structures	3	1	0	4.00	30	70	-	-	100	45	
5	BEAI&DS304P	Professional core courses	Data Structures LAB	0	0	2	1.00	-	-	25	25	50		25
6	BEAI&DS305T	Professional core courses	Digital Circuits and Fundamentals of Microprocessor	3	0	0	3.00	30	70			100	45	
7	BEAI&DS305P	Professional core courses	Digital Circuits and Fundamentals of Microprocessor Lab	0	0	2	1.00	-	-	25	25	50		25
8	BEAI&DS306P	Engineering Sciences	Professional Skills I (Core Python)	0	0	2	1.00			25	25	50		25
9	BEAI&DS307T	HSMC	Universal Human Values	2	0	0	2.00	15	35			50	23	
10	BEAI&DS308T	Mandatory	Environmental Science	2	0	0	Audit	-	-	-	-	Audit	-	
		Total		**19**	**3**	**6**	**23.00**	165	385	**75**	75	700		

B.E. SCHEME OF EXAMINATION 2021-22

Scheme of Teaching & Examination of Bachelor of Engineering IV Semester B.E. (Artificial Intelligence and Data Science)

Sr. No.	Course Code	Category	Course Name	Hours/ Week			Credits	Maximum Marks					Minimum Passing Marks	
								Theory		Practical		Total		
				L	T	P		Internal	University	Internal	University		Theory	Practical
1	BEAI&DS401T	Professional core courses	Introduction to AI	3	0	0	3.00	30	70	-	-	100	45	
2	BEAI&DS402T	Professional core courses	Theory of Computation	3	1	0	4.00	30	70	-	-	100	45	
3	BEAI&DS403T	Basic Science Course	Mathematical Foundations of Data Science	3	0	0	3.00	30	70	-	-	100	45	
4	BEAI&DS404T	Professional core courses	Object Oriented Programming with JAVA	3	0	0	3.00	30	70	-	-	100	45	
5	BEAI&DS404P	Professional core courses	Professional Skills II (Java)	0	0	2	1.00	-	-	25	25	50		25
6	BEAI&DS405T	Professional core courses	Database Management Systems	3	0	0	3.00	30	70			100	45	
7	BEAI&DS405P	Professional core courses	Database Management Systems Lab	0	0	2	1.00	-	-	25	25	50		25
8	BEAI&DS406T	Professional core courses	Microcontroller & Embedded System	3	1	0	4.00	30	70	-	-	100	45	
9	BEAI&DS406P	Professional core courses	Microcontroller & Embedded System Lab	0	0	2	1.00	-	-	25	25	50	-	25
10	BEAI&DS407		Internship	0	0	2	1.00			50		50		
Total				**18**	**2**	**8**	**24.00**	180	420	**125**	75	800		

B.TECH SCHEME OF EXAMINATION 2021-22

Scheme of Teaching & Examination of Bachelor of Technology V Semester B.TECH(Artificial Intelligence & Data Science)

Sr. No.	Course Code	Category	Course Name	Hours/ Week			Credits	Maximum Marks					Minimum Passing Marks	
								Theory		Practical		Total		
				L	T	P		Internal	University	Internal	University		Theory	Practical
1	BTECH_AI&DS-501T	Professional core courses	Data Mining	3	0	0	3.00	30	70			100	45	
2	BTECH_AI&DS-502T	Professional core courses	Design and Analysis of Algorithms	3	0	0	3.00	30	70	-	-	100	45	
3	BTECH_AI&DS-502P	Professional core courses	Design and Analysis of Algorithms lab	0	0	2	1.00			25	25	50	45	25
4	BTECH_AI&DS-503T	Professional core courses	Machine Learning Techniques	3	0	0	3.00	30	70	-	-	100	45	
5	BTECH_AI&DS-504T	Engineering Sciences	Internet of Things and its Application	3	0	0	3.00	30	70	-	-	100	45	
6	BTECH_AI&DS-504P	Engineering Sciences	Internet of Things -Lab	0	0	2	1.00	-	-	25	25	50		25
7	BTECH_AI&DS-505T	Professional Elective Course	Elective- I	3	0	0	3.00	30	70			100	45	
8	BTECH_AI&DS-506P	Professional core courses	Professional Skills-III	0	0	2	1.00			25	25	50	45	25
9	BTECH_AI&DS-507T	HSMC	Effective Technical Communication	2	0	0	2.00	15	35			50	23	
		Total		**17**	**0**	**6**	**20**	**165**	**385**	**75**	**75**	**700**		

Elective I- 1. NoSQL 2. Information Security 3. Wireless Communication Technologies 4. ARM Processor & its Essentials

B.TECH SCHEME OF EXAMINATION 2021-22

Scheme of Teaching & Examination of Bachelor of Technology VI Semester B.TECH(Artificial Intelligence & Data Science)

Sr. No.	Course Code	Category	Course Name	Hours/Week			Credits	Maximum Marks					Minimum Passing Marks	
								Theory		Practical		Total		
				L	T	P		Internal	University	Internal	University		Theory	Practical
1	BTECH_AI&DS-601T	Professional core courses	Deep Learning	3	0	0	3.00	30	70	-	-	100	45	
2	BTECH_AI&DS-601P	Professional core courses	Deep Learning Lab	0	0	2	1.00			25	25	50		25
3	BTECH_AI&DS-602T	Engineering Sciences	Computer Communication Network	3	0	0	3.00	30	70	-	-	100	45	
	BTECH_AI&DS-603T	Professional core courses	Digital System Design using Verilog	3	0	0	3.00	30	70	-	-	100	45	
4	BTECH_AI&DS-603P	Professional core courses	DSD-Lab	0	0	2	1.00	-	-	25	25	50		25
5	BTECH_AI&DS-604T	Professional Elective Course	Elective-II	3	0	0	3.00	30	70			100	45	
6	BTECH_AI&DS-605T	Open Elective	Open Elective-1	3	0	0	3.00	30	70			100	45	
7	BTECH_AI&DS-606P	Professional core courses	Professional Skills-IV	0	0	2	1.00	-	-	25	25	50		25
8	BTECH_AI&DS-607T	Mandatory course	Intellectual Property Rights	2	0	0	Audit					Audit		
10	BTECH_AI&DS-608P	Project Work/Internship	Mini Project /Internship	0	0	6	3.00	-	-	25	25	50	-	
		Total		17	0	12	21.00	150	350	100	100	700		

Elective II: 1. Web and Social Media Analytics 2. Block Chain and Cyber Security 3. Intelligent Sensor & Instrumentation 4. Robotics and Intelligent Systems

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Discrete Mathematics and Graph Theory** Subject Code: **BEAI&DS-301T**

Load	Credits (TH+T)	College Assessment Marks	University Evaluation	Total Marks
[36 + 12] Hrs	**3+1=4**	30	70	100

Aim: Discrete mathematics is of direct importance to the fields of Computer Science and Information Technology. This branch of mathematics includes studying areas such as sophisticated forms of counting (combinatorics, etc), set theory, logic, relations, graph theory, and analysis of algorithms. This course is intended to provide students with an understanding of these areas and their use in the field of Information Technology.

Prerequisite(s): Require mathematical basic knowledge and should be familiar with sequences and series, limits, and integration and differentiation of univariate functions.

Course Objectives:

1	A primary objective is to provide a bridge for the student from lower-division mathematics courses to upper-division mathematics.
2	Obtain skills and logical perspectives in introductory (core) courses that prepare them for subsequent courses.
3	Develop proficiency with the techniques of mathematics and/or computer science, the ability to evaluate logical arguments, and the ability to apply mathematical methodologies to solving real world problems
4	A primary objective is to provide a bridge for the student from lower-division mathematics courses to upper-division mathematics.

Course Outcomes:
By the end of the course students shall be able to:

1	Apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction.
2	Gain an introduction into how mathematical models for engineering are designed, analyzed and implemented in industry and organizations.
3	Reason mathematically about basic data types and structures (such as numbers, sets, graphs, and trees) used in computer algorithms and systems; distinguish rigorous definitions and conclusions from merely plausible ones.
4	Analyze real world scenarios to recognize when Logic, sets, functions are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches.
5	Apply knowledge of mathematics, physics and modern computing tools to scientific and engineering problems.
6	Apply their knowledge in life-long learning.

UNIT 1: Set Theory, Relations and Functions **[7 Hours]**

Sets: Review of propositions and logical operations, Principle of mathematical induction, Review of sets, Types and operations on sets.

Relations: Ordered pairs and n-tuples, Types of relations, Composite relation, Transitive closure of a relation, Partially ordered set, Hasse diagrams.

Functions: Definition, Composition of functions, Types of functions, Characteristics function and its properties.

UNIT 2: Fuzzy Set and Fuzzy Logic **[7 Hours]**

Fuzzy sets and systems, Crisp set, Operations and combinations on Fuzzy sets, Relation between Crisp set and Fuzzy set, Fuzzy relations, Overview of Fuzzy logic and classical logic.

UNIT 3: Group Theory and Ring Theory **[7 Hours]**

Binary operation, Algebraic structure, Groupoid, Semigroup, Monoid, Group, Subgroup, Normal subgroup (Only definitions and examples), Ring, Commutative ring, Ring with unity, Zero divisor, Integral domain, Field (Only definitions and simple examples).

UNIT 4: Graph Theory **[8 Hours]**

Basic concepts of graph theory, Digraphs, Basic definitions, Matrix representation of graphs, Subgraphs and quotient graphs, Isomorphic graphs, Paths and circuits, Reachability and connectedness, Node base, Euler's path & Hamilton's path, Tree, Binary tree, Undirected tree, Spanning tree, Weighted graphs (Only definitions and examples), Minimal spanning tree by Prim's algorithm & Kruskal's algorithm, Representation of algebraic expressions by Venn diagram and binary tree.

UNIT 5: Combinatorics **[7 Hours]**

Permutations and combinations, Pigeonhole principle with simple applications, Recurrence relations (Concept and definition only), Generating functions, Solution of recurrence relations using generating functions.

Text/ Reference Books

1. Discrete Mathematical Structures (PHI), B. Kolman, R. Busby, S. Ross.
2. Discrete Mathematical Structures with Applications to Computer Science (TMH), Tremblay and Manohar.
3. Fuzzy Sets Uncertainty and Information, George, J. Klir, Tina A. Folger.
4. Discrete Mathematics for Computer Scientists & Mathematicians, J. Mott, A. Kandel, T. Baker.
5. Discrete Mathematics, S. Lipschutz.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Operating Systems** Subject Code: **BEAI&DS-302T**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks :
[36 + 12] Hrs	3+1=4	30	70	100

Aim: To understand the basic principles and the working of Computer systems.

Prerequisite(s): Basic knowledge of microprocessors, data structures and any programming language.

Course Objectives:

1	To understand the services provided by and the design of an operating system.
2	To understand the structure and organization of the file system.
3	To understand what a process is and how processes are synchronized and scheduled.
4	To understand different approaches to memory management.

Course Outcomes:

At the end of this course students are able to:

CO1	Disassemble and reassemble a working computer
CO2	Handle and repair components in a safe manor for both the student and the component
CO3	Evaluate a nonworking computer system and suggest repairs or upgrades
CO4	Identify hardware in a computer system
CO5	Establish a local computer network
CO6	Load and configure a working Windows Operating System

SYLLABUS

UNIT I: **[08 Hours]**

Introduction: Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, File systems: File concept, Access methods

UNIT II: **[07 Hours]**

Disk space management and space allocation strategies, directory structures, disk arm scheduling strategies.
CPU Scheduling: Process concept, process control block, Types of scheduler, context switch, threads, multithreading model, goals of scheduling and different scheduling algorithms

UNIT III: **[07 Hours]**

Memory management: Contiguous allocation, Relocation, Paging, Segmentation, Segmentation with paging, demand paging , page faults and instruction restart , page replacement algorithms, Locality, Thrashing, Garbage Collection.

UNIT IV **[07 Hours]**

Process cooperation and synchronization: Concurrency conditions, Critical section problem, software and hardware solution, semaphores, classical inter process communication problems.

UNIT V **[07 Hours]**

Deadlocks & Protection: Deadlock definition, Prevention, Avoidance, Detection and recovery, Goals of Protection, access matrix, implementation, Security problem.

Text books:

6. Operating System concepts – Silberchatz& Galvin, Addison Wesley, 6th Edn.
7. Modern Operating Systems – Tanenbaum, Pearson Edn. 2ndedn
8. Operating Systems – A.Godbole: TMH Pubilcations

Reference books: *Operating System –Milan Milenkovik*

1. Operating Systems, 3rd Edition by Gary Nutt, Pearson Education

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Computer Organization and Architecture** Subject Code: **BEAI&DS-303T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	3	30	70	100

Aim: To understand the basic principles and the working of Computer systems.

Prerequisite(s): Student should have basic knowledge of computers and mathematics.

Course Objectives:

1	How Computer Systems work & the basic principles
2	Ability to perform computer mathematical operations on arithmetic and floating point numbers.
3	To impart the knowledge on micro programming
4	How I/O devices are accessed and its principles.

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the basic components of a computer, and the execution of complete instruction and design of control unit.
CO2	Perform mathematical operations on arithmetic and floating point numbers similar to the manner computer does.
CO3	Impart the knowledge on micro programming
CO4	Understand the concept of input/output and their organization.
CO5	Conceptualize the concepts of pipelining techniques and memory management.

SYLLABUS

Unit I: Functional blocks of a computer **[07 Hours]**

CPU, memory, input-output subsystems, control unit, Instruction set architecture of a CPU – registers, instruction execution cycle, addressing modes.

Unit II: Data representation **[07 Hours]**

Fixed and floating point representations, Computer arithmetic – integer addition and subtraction, carry look- ahead adder, multiplication – shift-and add, Booth multiplier, Division restoring and non-restoring techniques.

Unit III: CPU control unit design **[07 Hours]**

Hardwired and micro-programmed design approaches.

Memory system design: semiconductor memory technologies, memory organization

Unit IV Peripheral devices and their characteristics **[08 Hours]**

Input-output subsystems, I/O device

interface, I/O transfers – program controlled, interrupt driven and DMA, software interrupts and exceptions I/O device interfaces – USB,

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Unit V: **[07 Hours]**

Parallel Processors and Pipelining

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Text books:

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David
   A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Reference books:

1. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill
2. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
3. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **DATA STRUCTURES** Subject Code: **BEAI&DS-304T**

Load	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
[36 + 12] **Hrs**	**3+1=4**	30	70	100

Aim: To introduce and practice the implementation of various data structures used for indexing, searching, and sorting operations and also introduce basic mathematical techniques for algorithm analysis and design.

Prerequisite(s): Computer Programming Language knowledge

Course Objectives:

1	Students will construct and analysis various data structures and abstract data types including lists, stacks, queues, trees, and graphs.
2	Students will implement various sorting, searching, and hashing algorithms.
3	Students will build a substantial, complex data structure.

Course Outcomes:

At the end of this course Student are able to:

CO1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation.
CO2	Describe common applications for stacks, queues [ABET (a, b, c)]
CO3	Understand basic applications for Linked List
CO4	Demonstrate different methods for traversing trees
CO5	Solve problem involving graphs, trees and heaps

SYLLABUS:

Unit I: **[7 Hours]**

Introduction: Basic Terminologies, Data Structure,Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Unit II: **[7 Hours]**

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Unit III: **[7 Hours]**

Linked Lists: Singly linked lists: Representation in memory (Static & Dynamic), Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Unit IV: **[8 Hours]**

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis, Binary Heaps

Unit V: **[7 Hours]**

Graphs: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis: Breadth and depth first searches, connected component, spanning trees, shortest path–single source & all pairs , topological sort, Hamiltonian path.

Text books:

1. Data Structures with C, Seymour Lipschutz, Schaums Outlines, Tata McGraw Hill Education.
2. Data Structures using C and C++ by Y. Langsam, Pearson Education.
3. Data Structures using C by Tanenbaum, Pearson Education

Reference books:

1. Data Structures and program design in C by Robert Kruse, Bruce Leung & Clovis Tondo.
2. Data Structures: A Pseudocode Approach with C by Richard F. Gilberg and Behrou Forouzan.
3. Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni,Computer Science Press.
4. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Data Structures Lab** Subject Code: **BEAI&DS-304P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	**1**	25	25	50

Aim: To introduce and practice the implementation of various data structures used for indexing, searching, and sorting operations and also introduce basic mathematical techniques for algorithm analysis and design.

Prerequisite(s): Computer Programming Language knowledge

Course Objectives:

1	To understand basic techniques and strategies of algorithms
2	To strengthen the ability to identify and apply the suitable data structure for the given real world problem
3	To analyze advanced data structure

Course Outcomes:

At the end of this course Student are able to:

CO1	Understand the ADT, hash tables and dictionaries to design algorithms
CO2	Choose most appropriate data structure and apply algorithms
CO3	Apply and analyze non linear data structure to solve real world complex problems
CO4	Apply and analyze algorithm design techniques
CO5	Analyze the efficiency of most appropriate data structure
CO6	Design and implement different algorithms

Programming Language/Tools to be used C++, JAVA, Python

Practical List: (Programs Based on following topics)

1. Array Implementation of List ADTs
2. Linked List Implementation of List ADTs
3. Array Implementation of Stack ADTs
4. Linked List Implementation of Stack ADTs
5. Array Implementation of Queue ADTs
6. Linked List Implementation of Queue ADTs
7. Applications of List : Polynomial Manipulation

8. Applications of Stack: Infix To Postfix Expression
9. Implementation of Binary trees And operations of Binary trees
10. Implementation of Binary Search Trees
11. Implementation of AVL Trees
12. Implementation of Heaps Using Priority Queues
13. Depth First Search
14. Breadth First Search
15. Applications of Graphs
16. Linear Search
17. Binary Search
18. Bubble Sort
19. Insertion Sort
20. Hashing With Separate Chaining
21. Hashing With Open Addressing

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Digital Circuits And Fundamentals Of Microprocessor** Subject Code: **BEAI&DS-305T**

Load	Credits Th	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	3	30	70	100

Prerequisites:

1. Differences between Analog and Digital Circuits.
2. Advantages of Digital Circuts over Analog Circuits.
3. Transistor concepts
4. Basics of all electronics components

Course Objectives

1. To acquaint students with various basic digital gates used in digital system and develop logical circuits using Boolean gates, construction of various logic circuits using basic gates.
2. To lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor.

Course Outcomes (CO's)

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

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design and evaluate combinational circuits.
3. Design and evaluate sequential circuits.
4. Understand the architecture of microprocessor for the basic operations
5. To understand architecture and features of 8086 Microprocessors.

SYLLABUS:

Unit I: (8 hours)

Boolean Algebra, Types of Number Systems, Types of Codes and Forms of Expression: Analog Vs. Digital Systems, Boolean Algebra, D' Morgan's Laws. Types of Number System: Decimal, Binary, Octal, He x, Type of Codes: Reflected (Gray), Self Complementary (Excess-3), BCD and ASCII codes, Conve rsion of Codes, Gates and their truth tables.

Forms of Expression: Sum of products and Product of Sums, Standard Sum of products and Product of Sums, Minterms and Maxterms, Karnaugh map: simplification of functions using K- map (up to 4 variables) and their implementation using logic gates.

Unit II: Combinational Circuits: (8 hours)

Decoders, Encoders. Priority Encoder, Multiplexers, Demultiplexers, Code converters. Implementation of Functions using Decoder. Arithmetic Circuits: Adder (Half and Full),

Subtractor (Half and Full). BCD adder / Subtrac tor, Concept of ALU.

Unit III: Types Flip Flops & Sequential Circuits: (7 hours)

SR, JK, Ma ster Slave JK, D and T. Race around Condit ion (Racing) and Toggling. Charac teristics Table and Excitation Table, Conversion of FlipFlop.

Sequential Circuits: Counters, Modulus of Counter, Types- Synchronous Counter and Asynchronous (Ripple) counter.

Unit IV: Architecture & Programming of 8085: (7 hours)

8085 microprocessor architecture, addressing modes, instruction sets,

Programming in 8085.

Unit V: Introduction to 8086: (6 hours)

Features, Architecture and addressing modes of 8086

Text Books:

1. Modern digital Electronics- R. P. Jain, McGraw Hill.
2. Digital Integrated Electronics- Herbert Taub, McGraw Hill.
3. Digital Logic and Computer Design- Morris Mano (PHI).
4. Digital Integrated Electronics- Herbert Taub, McGraw Hill.
5. Digital Electronics Logic and System – James Bingnell and Robert Donovan, Cengage Learning
6. Digital Circuits & Systems by K.R.Venugopal & K. Shaila
7. 8 bit Microprocessor by Ramesh Gaonkar.
8. 8 bit microprocessor & controller by V. J. Vibhute, Techmak Publication.

9. Microprocessor and interfacing : Douglas Hall

10. Advanced Microprocessors And Peripherals A.K.Ray ,K.M.Bhuchandi

11. 8085 Microprocessor & its Applications by A. Nagoor Kani, Mc Graw Hill.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,

NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.)

DEGREE COURSE SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Digital Circuits And Fundamentals of Microprocessor Lab Subject Code: BEAI&DS-305P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,

NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.)

DEGREE COURSE SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Professional Skills I (Core Python) Subject Code: **BEAI&DS-306P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

Aim: To achieve programming skills using Python coding.

Prerequisite(s): Nil

Course Objectives:

1	To understand fundamentals of writing Python scripts
2	Learn core Python scripting elements such as variables and flow control structures.
3	Write Python functions to facilitate code reuse

Course Outcomes:

At the end of this course Student are able to:

CO1	To understand the environment of Python Programming
CO2	To apply the operation on conditions using simple programs
CO3	To analyze the different platform on the same conditions of program structures
CO4	To recognize built-in and User-defined module
CO5	To understand the use of inheritance
CO6	To apply handling of user defined exception

Programming Language/Tools to be used
Installing Anaconda 3
Jupyter Notebook
In addition similar platform Colab

Instructions

- Install and configure python IDE
- Basic operator's: Arithmetic, logical, Bitwise, Membership, Identity operators, python operator precedence, Control Flow, Conditional statement (if, if ...else, nested if), Looping in python (while, for, nested loops)

Python built-in functions and User defined functions.

- Global variable & local variable. Modules: Writing modules, importing modules, importing objects from modules, python built-in modules (e.g. Numeric & mathematical module, functional programming module) namespace & scoping.
- Python package: Introduction, writing python package, using standard (e.g. math, scipy, numpy, matplotlib, pandas etc.) & User defined package.

Method overloading, Data hiding.
File Handling and Exception handling.

List of Programs:

1. Python and Pycharm Installation
2. Programs on basic control structures & loops.
3. Programs on operators & I/O operations.
4. Programs on Python Script
5. Programs on Lists.
6. Programs on Strings.
7. Programs on recursion & parameter passing techniques.
8. Programs on Tuples.
9. Programs using Python Dictionary
10. Programs on file Handling.
11. Programs on searching & sorting Techniques.
12. Programs on Exception handling concepts.
13. Programs on Testing.
14. Programs on NumPy and
15. Programs on Data Manipulation Using Pandas

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Universal Human Values **Subject Code: BEAI&DS-307T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
24 Hrs	2	15	35	50

Aim: To inculcate sensitivity among students towards themselves and their surrounding including family, society and nature.

Prerequisite(s): Nil

Course Objectives:

1	Development of a holistic perspective based on self-exploration, about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3	Strengthening human relationship.
4	Development of commitment and courage to act.

Course Outcomes:

At the end of this course Student are able to:

CO1	Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
CO2	Students would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	They would become sensitive to their commitment towards human relationship
CO4	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

SYLLABUS

Unit 1 **[6 Hours]**

Value education, definition, need for value education. The content and the process of value education, basic guidelines for value education, self-exploration as a means of value education, happiness and prosperity as part of value education.

Unit 2 **[6 Hours]**

Harmony of self with body, coexistence of self and body, understanding the needs of self and the needs of body, understanding the activities in the self and the activities in the body.

Unit 3 **[6 Hours]**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships), Understanding meaning of Trust; Difference between intention and competence, Understanding harmony in society: Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

Unit 4 **[6 Hours]**

Basics for ethical human conduct, defects in ethical human conduct, human rights violations and social disparities, value based life.

Text Book:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria,ExcelBooks, NewDelhi,2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak,1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Indian Ethos and Modern Management: Amalgam of the best of the ideas from the East and the West, B.L. Bajpai, New Royal Book Bo., Lucknow, 2004
4. Human society in ethics and politics, Bertrand Russel, Routledge Publications, 2009

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE SEMESTER: III (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Environmental Science **Subject Code: BEAI&DS-308T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
24 Hrs	-		-	

Course Objectives:

1	Identify different types of air pollutions as well as explain their causes, detrimental effects on environment and effective control measures.
2	Recognize various sources of water pollutants and interpret their causes and design its effective control measure.
3	Illustrate various types of pollutants and waste management.
4	Analyze various social issues related to environment and challenges in implementation of environmental laws.

Learning Objective Learning Outcomes:

1. Student will be able to learn the natural sources available.
2. Students will also learn about ecosystem, biodiversity, pollution.
3. Student will also learn the effect on environment on social aspects and Human population.
4. The student on completion of course will understood the Ecosystem
5. Environmental issues related with social and human population.
6. Biodiversity and its conversion

UNIT-1 Air pollution and its control techniques: **[6 Hours]**

Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution

Natural pathways for degradation: Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle.

Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs).
Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

UNIT-2 Water pollution and its control techniques: **[6 Hours]**

Major sources of water pollution: Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics

Techniques to control water pollution: Conventional waste water treatment-types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal and its utility.
Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills

UNIT-3 Other Environmental Pollution& Waste Management: [6 Hours]

Soil pollution: Soil around us, Soil water characteristics, soil pollution.

Causes, effects & control : noise pollution, nuclear & radiation hazards, marine pollution (Oil spills & Ocean Acidification)
Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment, bioremediation technologies, conventional techniques (land farming, constructed wetlands), and phytoremediation.
Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

Unit-4 Social Issues and the Environmental Laws: [6 Hours]

Concept of Sustainable development
Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns. Environmental Laws (brief idea only)
Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act

Issues involved in enforcement of environmental legislation.

Different government initiatives (brief idea only)- National ambient air quality standard 2009, Swachh Bharat Abhiyan, National afforestation program and Act- 2016, National River conservation plan and National Ganga River basin authority, Formation of National Green Tribunal

Activity

1. Field Trip & Report Writing
2. Case-study & Report Writing

Books suggested:

1. Benny Joseph, Environmental Studies, Mc Graw Hill Education (India) Private Limited
2. B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut

3. P Aarne Vesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth-Heinemann
4. D. D. Mishra, S. S. Dara, A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd.
5. Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6. Indian Environmental Law: Key Concepts and Principles edited by Shibani Ghosh, Publisher, Orient BlackSwan, 2019. ISBN, 9352875796.
7. P. Thangavel & Sridevi, Environemental Sustainability: Role of Green technologies, Springer publications

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE SEMESTER: IV (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Introduction to Artificial Intelligence **Subject Code: BEAI&DS-401T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	**03**	**30**	**70**	**100**

Aim: To understand the basic principles and concepts of Artificial Intelligence and Data Science.

Prerequisite(s): Student should have basic knowledge of computers and mathematics.

Course Objectives:

1	To create appreciation and understanding the achievements of AI and the theory underlying those achievements
2	To create an understanding of the basic issues of knowledge representation

Course Outcomes:

At the end of this course students are able to:

CO1	Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
CO2	Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.
CO3	To create an understanding of the basic issues of knowledge representation
CO4	Formulate and solve problems with uncertain information using Bayesian approaches.
CO5	Attain the capability to represent various real life problem domains using logic based techniques and

SYLLABUS

UNIT-I **[6 Hours]**

Introduction: What is AI? History & Applications, Artificial intelligence as representation & Search, Production system, Basics of problem solving: problem representation paradigms, defining problem as a state space representation, Characteristics.

UNIT-II **[7 Hours]**

Search Techniques: Uninformed Search techniques, Informed Heuristic Based Search, Generate and test, Hill-climbing, Best-First Search, Problem Reduction, and Constraint Satisfaction.

UNIT-III **[8 Hours]**

Knowledge representation: Knowledge representation Issues: First order logic, Predicate Logic, Structured Knowledge Representation: Backward Chaining, Backward Chaining, Resolution,Semantic Nets, Frames, and Scripts, Ontology.

UNIT-IV **[8 Hours]**

Uncertainty: Handing uncertain knowledge, rational decisions, basics of probability, axioms of probability, Baye's Rule and conditional independence, Bayesian networks, Exact and Approximate inference in Bayesian Networks, Fuzzy Logic.

Intelligent Agents: Introduction to Intelligent Agents, Rational Agent, their structure, reflex, model-based, goal-based, and utility-based agents, behavior and environment in which a particular agent operates.

UNIT-V **[7 Hours]**

Learning: What is learning?, Knowledge and learning, Learning in Problem Solving, Learning from example, learning probabilistic models

Expert Systems: Fundamental blocks, Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Basic understanding of Natural language

Text Books:

1. E.Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2008.
2. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education, 2015.
3. Artificial intelligence and soft computing for beginners by Anandita Das Bhattachargee, Shroff Publishers
4. Artificial Intelligence – A Practical Approach : Patterson , Tata McGraw Hill, 3rd Edition

Reference Books:

1. Introduction to Artificial Intelligence – Charniak (Pearson Education)

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE SEMESTER: IV (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Theory of Computation** Subject Code: **BEAI&DS-402T**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
[36 + 12] Hrs	3+1=4	**30**	**70**	**100**

Aim: It deals with how efficiently problems can be solved on a model of computation using an algorithm.

Prerequisite(s): Students entering this course should have a strong background in Discrete Mathematics, and basics of Data Structures and Algorithms.

Course Objectives:

1	To give an overview of the theoretical foundations of computer science from the perspective of formal languages
2	To illustrate finite state machines to solve problems in computing
3	To explain the hierarchy of problems arising in the computer sciences.
4	To familiarize Regular grammars, context frees grammar.

Course Outcomes:

At the end of this course Student are able to:

CO1	To know key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity, through problem solving.
CO2	To function effectively as a member of a team in order to accomplish a common goal.
CO3	To function effectively as a member of a team in order to accomplish a common goal.
CO4	To apply design and development principles in the construction of software systems of varying complexity.
CO5	To define more powerful computing models.
CO6	To solve various problems of applying normal form techniques.

SYLLABUS

UNIT I: **[7 Hours]**

Strings, Alphabet, Language operations, Finite state machine definitions, Finite automation model, Acceptance of strings and language, Non deterministic finite automation, Deterministic finite automation, Equivalence between NFA and DFA, Conversion of NFA into DFA, Moore and Mealy machines

UNIT II: **[8 Hours]**

Regular sets, Regular expressions, Identity rules, Manipulation rules, Manipulation of regular expressions, Pumping lemma, Closure properties of regular sets(proofs not required), Chomsky hierarchy of languages, Regular grammars, Right linear and left linear grammars, Equivalence between regular linear programming and FA.

UNIT III: **[7 Hours]**

Context free grammar, Derivation trees, Chomsky normal form, Greibach normal form, Push down automata, Definition, Model acceptance of CFL, Equivalence of CFL and PDA, Inter conversion, Closure properties of CFL(Proofs omitted),Pumping Lemma of CFL

UNIT IV: **[7 Hours]**

Turing Machine: Definition, Model of TM, Design of TM, Universal Turing Machine, Computable function, Recursive enumerable language, Types of TM"s (proofs not required), Linear bounded automata and Context sensitive language.

UNIT V: **[7 Hours]**

Decidability and Undecidability of problems, Properties of recursive & recursively enumerable languages, Halting problems, Post correspondence problem, Ackerman function, and Church"s hypothesis, Recursive and Primitive Functions, Bounded Minimization, Unbounded Minimization.

Text books:

1. Introduction to Automata Theory, Languages and Computation by J. E. Hopcraft,R. Motwani, J. D Ullman, second Edition, Pearson Education, Aisa
2. An Introduction to Formal Languages and Automata by Peter Linz
3. Introduction to Langauges and the theory of Automata by John Martin, Third Edition (TMH)

Reference books:

1. Theory of Computer Science, Automata, Languages and Computation by K. L. P. Mishra and N. Chandrasekaran, Third Edition, PHI Learning.
2. Elements of Theory of Computation by Lewis H.P and Papadimition C.H

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE SEMESTER: IV

(C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Mathematical Foundation for Data Science **Subject Code: BEAI&DS-403T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs(Theory)	3	30	70	100

Aim: To understand the basic mathematical concepts of data science.

Prerequisite(s): -

Course Objectives:

1. To develop the understanding of theory of probability and its applicability in data science
2. To derive inference by using concepts of sampling theory and testing of hypothesis.
3. To formulate mathematical models of real world problems.

Course Outcomes : Students will be able to

1. Apply the concepts of probability. Understand the random variables and probability functions.
2. Analyze the data of real world problems using special probability distributions and Mathematical expectations.
3. understand concepts of sampling theory and estimation which is used in the field of data science.
4. Learn the techniques of testing hypothesis and apply it to test the significance of various data samples.
5. Apply the concept of Regression analysis to mathematical model generated by various data samples.

SYLLABUS

Unit I : Theory of Probability and Mathematical Expectation (8 Hrs)

Probability: Review of probability of an event, Conditional probability, Baye's rule, Review of discrete and continuous random variables, Joint probability function and Joint probability distribution of DRV, Marginal probability function and Conditional distribution of DRV.

Mathematical Expectation (DRV): Mathematical expectation, Variance and Standard deviation, Moments, Moment generating function, Expectation, Variance and Covariance of Joint Distribution, Measures of central tendency: Mean, Median, Mode, Skewness and Kurtosis.

Unit II: Special Probability Distributions (7Hrs)

Introduction to discrete and continuous distributions, Geometric distribution, Binomial distribution,Poisson distribution, Normal distribution, Exponential distribution, Uniform distribution.

Unit III : Sampling Theory and Estimation (7Hrs)

Sampling Theory: Definition of population, sampling, static parameter, Types of sampling,Expectedvalues of sample mean and variance, Standard error, Sampling distribution of meanandsampling distribution of variance.

Estimation: Estimation of parameters, Point estimation,Interval estimation, Bayesian estimation.

Unit IV : Testing of Hypothesis (7Hrs)

Hypothesis, Null hypothesis, Alternative hypothesis, Testing a hypothesis, Level of significance,Confidence limits, Test of significance of difference of means, t-test, F-test and Chi-squaretest, One way and two way Analysis of Variance (ANOVA).

Unit V : Multidimensional Analysis (7 Hrs)

Multiple Linear Regression Model: Least square estimation, R^2 and adjusted R^2 coefficients, Problem of multi-colinearity, Regression equation of three variables, Lasso regression, Ridge regression.

Factor Analysis: Centroid method, Principal component method.

Cluster Analysis: Non-hierarchical clustering, Hierarchical clustering.

Text/ Reference Books:

(1) Advanced Engineering Mathematics (Wiley), Erwin Kreyzig.
(2) Higher Engineering Mathematics (Khanna Publishers), B. S. Grewal.
(3) Advanced Engineering Mathematics (S. Chand), H. K. Dass.
(4) Probability and Statistics (Schaum's Outline Series), Murray Spiegel, John Schiller, R. A. Srinivasan.
(5) Fundamentals of Statistics (Himalaya Publishing House), S. C. Gupta.
(6) Research Methodology Methods and Techniques (New Age Publications), C.R. Kothari, Gaurav Garg.

SEMESTER: IV (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Object Oriented Programming using Java** Subject Code: **BEAI&DS-404T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	3	30	70	100

Aim:

This course explains the fundamental ideas behind the object-oriented approach to programming. Knowledge of java helps to create the latest innovations in programming. Like the successful computer languages that came before, java is the blend of the best elements of its rich heritage combined with the innovative concepts required by its unique environment. This course involves OOP's concepts, java basics concepts, inheritance, polymorphism, interfaces, inner classes, packages, Exception handling, multithreading and objects Oriented Methodology basic concepts.

Prerequisite(s): Knowledge of structure programming language and Application development Course Objectives:

1	To impart fundamentals of object-oriented programming in Java, including defining object and classes
2	To inculcate concepts of inheritance to create new classes from existing one, Design & implement various forms of inheritance and to analyze the Programming through examples.
3	To familiarize the concepts of packages and interfaces & to demonstrate the concept of String handling
4	To Explore exception handling and various Concepts of Multithreading & to understand the basic concept of Object Oriented Methodology

Course Outcomes:

At the end of the course students will be able to:

1	Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in Java
2	Design and develop concept of Inheritance and Polymorphism.
3	Design and object oriented system with packages and interfaces.
4	To demonstrate the concept of String handling
5	Design an object-oriented system, AWT components and multithreaded processes as per needs and Specifications

SYLLABUS

UNIT – I **[7 Hours]**

Java Basics: Basics of objects and classes in java: Constructors, Visibility modifier, History of Java, JVM architecture, Data types, Variables, arrays, operators, control statements .Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java.

UNIT – II **[7 Hours]**

Inheritance And Polymorphism: Basic concepts of Inheritance, Types of inheritance, Member access rules, this keyword, Super keyword, Method Overloading, Method overriding, abstract classes, final keyword.

UNIT – III **[8 Hours]**

Interfaces And Packages: Defining an interface, implement interfaces, accessing implementations through interface references, Extending interface. Packages: Defining, creating and accessing a package, understanding Class path, importing packages.

UNIT – IV **[7 Hours]**

I/O Streams: Concepts of streams, Stream classes- Byte and Character stream, reading console Input and Writing Console output, File Handling.

UNIT – V **[7 Hours]**

Multithreading in java :Thread life cycle and methods, Runnable interface, Thread synchronization, Exception Handling: Benefits of exception handling, the classification of exceptions , exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally.

Text Books:

1. C++: The Complete Reference, by Herbert Schildt4th edition Mc-Graw-Hill.
2. The C++ Programming Language by BjarneStroustrupe 3rd edition Pearson EducationHerbert Schildt, "Java the complete reference", McGraw Hill, Osborne, 7th Edition, 2011.
3. T.Budd, "Understanding Object- Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage), 1999.
4. Object Oriented Modeling and Design by James Rumbaugh, Michal Blaba, William Premerlani, Frederic Eddy, William Lorerson, PHI, 1997

Reference Books:

1. T. Budd (2009), An Introduction to Object Oriented Programming, 3rd edition, Pearson Education, India.

2. J. Nino, F. A. Hosch (2002), An Introduction to programming and OO design using Java, John Wiley & sons, New Jersey.
3. Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education, India.
4. Object Oriented Programming with C++ by E Balagurusamy, Fifth Edition, TMH.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,
NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.)
DEGREE COURSE

SEMESTER: IV (C.B.C.S.) BRANCH:

ARTIFICIAL INTELLIGENCE AND DATA

SCIENCE

Subject: **Professional Skills II (Java)** Subject Code: **BEAI&DS-404P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	**1**	25	25	**50**

Aim:
Object oriented Programming with java is intended for software engineers, systems analysts, program managers and user support personnel who wish to learn the Java programming language. Java programming aims to implement real-world entities like inheritance, hiding, polymorphism, etc in programming. The main aim of OOP is to bind together the data and the functions that operate on them so that no other part of the code can access this data except that function

Prerequisite(s): Experience with a high level language C & Programming Fundamentals, is a prerequisite

Course Objectives:

1	The objectives of the course are to have students identify and practice the java programming concepts and techniques, practice the use of java classes and class libraries, arrays, vectors, inheritance and file I/O stream concepts
2	The objective of course is to develop programming skills of students, using object oriented programming concepts, learn the concept of class and object using java and develop classes for simple applications

Course Outcomes:
At the end of this course Student are able to:

CO1	Identify classes, object, and members of a class using the concept of java programming.
CO2	Create a java application program using OOP principles and proper program structuring.
CO3	Analyze, write, debug, and test basic OOPS with java codes using the approaches introduced in the course.
CO4	Demonstrate the concepts of polymorphism and inheritances.
CO5	To demonstrate the concept of String handling.
CO6	Create java program to implements error handling techniques using exception handling

Programming Language/Tools to be used
Hardware Requirement: Desk Top Computer

Software Requirement: Linux Operating System with g++ or eclipse

Practicals:

1. Programs using constructor and destructor.
2. Creation of classes and use of different types of functions.
3. Count the number of objects created for a class using static member function.
4. Write programs on interfaces.
5. Write programs on packages.
6. Write programs using function overloading.
7. Programs using inheritance.
8. Programs using IO streams.
9. Programs using files.
10. Write a program using exception handling mechanism.
11. Programs using AWT
12. Programs on swing.
13. Programs using JDBC.
14. Database Connectivity

Instructions
a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE

SEMESTER: IV (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Database Management System Subject Code: **BEAI&DS-405T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
36 Hrs	**3**	**30**	**70**	**100**

Course Objectives:

1	To explain basic database concepts, applications, data models, schemas and instances.
2	Describe the basics of SQL and construct queries using SQL.
3	To emphasize the importance of normalization in databases.
4	To facilitate students in Database design

Course Outcomes:

At the end of this course Student are able to:

CO1	Apply the basic concepts of Database Systems and Applications.
CO2	Understand database concepts and structures and query language
CO3	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
CO4	Understand Functional Dependency and Functional Decomposition.
CO5	Understand query processing and techniques involved in query optimization and the principles of storage structure and recovery management.

SYLLABUS

UNIT I: **[7 Hours]**

General introduction to database systems, Database-DBMS distinction, Approaches to building a database, Data models, Three-schema architecture of a database, various components of a DBMS, Data Abstraction, Data Independence, E/R Data model. SQL Concept.

UNIT II: **[7 Hours]**

Relational Data Model, Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys, Relational algebra operators, Tuple relation calculus.

UNIT III: **[7 Hours]**

Physical and logical hierarchy Concept of index, B-trees,Concepts of Functional dependency, Normalization, Business data analysis.

UNIT IV: **[7 Hours]**

Overview: Query Processing and Optimization, measures of query cost estimation in query optimization, Structure of query evaluation plans.

UNIT V: **[8 Hours]**

Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log based recovery, Locking mechanism, deadlock, two-phase locking protocol, Isolation. Recovery System: failure classification, recovery and atomicity, log based recovery, checkpoints, buffer management, Introduction to Web databases.

Text books:

1. Database System Concepts by AviSilberschatz, Henry F. Korth , S. Sudarshan, Tata McGraw Hill, Fifth Edition
2. Fundamentals of Database Systems – Elmasiri and Navathe, Addison Wesley, 2000.
3. An introduction to Database Systems,C J Date,A.Kannan,S.Swamynathan –Eight Edition.

Reference books:

1. Database Management Systems - by Raghu Ramakrishnan and Johannes Gehrke, Tata McGraw Hill Publication, Third Edition
2. Introduction to Database Management Systems by Kahate

5. Views
6. Procedures
7. PL-SQL
8. Cursors
9. Triggers
10. Exception Handling
11. Sub-Programs, Procedures
12. Normalization
13. Checking Normalization
14. Java –Mysql Database Connectivity
15. PHP-Mysql Database Connectivity

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY,
NAGPUR FOUR YEAR BACHELOR OF ENGINEERING (B.E.)
DEGREE COURSE

SEMESTER: IV (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Database Management System **Subject Code: BEAI&DS-405P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	**1**	25	25	**50**

Aim: This course introduces the core principles and techniques required in the design and implementation of database systems

Course Objectives:

1	To explain basic database concepts, applications, data models, schemas and instances.
2	To demonstrate the use of constraints and relational algebra operations
3	To emphasize the importance of normalization in databases
4	To facilitate students in Database design

Course Outcomes:

At the end of this course Student are able to:

CO1	Transform an information model into a relational database schema and to use a data definition language and/or utilities to implement the schema using a DBMS.
CO2	Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
CO3	Formulate, using SQL, solutions to a broad range of query and data update problems.
CO4	Use a desktop database package to create, populate, maintain, and query a database.
CO5	Demonstrate a rudimentary understanding of programmatic interfaces to a database and be able to use the basic functions of one such interface.
CO6	Analyze an information storage problem and derive an information model expressed in the Form

Programming Language/Tools to be used: SQL PLUS, ORACLE, MY SQL

List of Experiments:

1. Introduction to MYSQL
2. Data Definition Language(DDL) commands
3. Data Manipulation Language (DML)
4. Sub Queries and Joins

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF ENGINEERING (B.E.) DEGREE COURSE
SEMESTER: IV (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject:: **Microcontroller And Embedded Systems** Subject Code: **BEAI&DS-406T**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
[36 + 12] Hrs	**3+1=4**	30	**70**	**100**

Prerequisites:

1. Digital Circuits & Microprocessor concepts and applications
2. Assembly language concepts
3. Operating system concepts
4. Basics of all electronics components

Course Objectives:

1. To study fundamentals of microcontroller systems.
2. To study architecture of microcontroller & to understand the concept of memory organization. stack memory.
3. To study Assembly language programming & interfacing of microcontroller with different peripheral devices.
4. To give sufficient background for understanding embedded systems design.

Outcome:

After completing this course students shall be able to:

6. Describe internal organization of 8051 microcontrollers.
7. Describe the concept of addressing modes and assembly language programming of 8051 microcontroller.
8. Interface 8051 with various peripheral devices.
9. Understand basic concept of embedded systems.
10. Describe several communication devices and Buses.

SYLLABUS

Unit 1: Introduction to Microcontroller: (7 Hours)

8-bit Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. , Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures,Data and Program Memory

Unit 2 : Instruction Set and Programming (7 Hours)

Addressing modes: Introduction, Instruction syntax, Data types, Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Counters/Timers, Serial port and Interrupts of 8051, Assembly language programs

Unit 3: Memory and I/O Interfacing (8 Hours)

Interfacing of external RAM & ROM with 8051, I/O expansion using 8255, Interfacing keyboard, LEDdisplay, ADC & DAC interface, stepper motor interface

Unit 4: Introduction to Embedded System: (7 Hours)

Embedded system vs General computing system, History of Embedded system, Classification of ES, Skills required in Embedded system design, Design metrics, Characteristics and quality attributes of Embedded system.Processor used in Embedded system, Embedded hardware units and devices in a system,Embedded software in a system, examples of embedded system, Design process in ES,

Unit 5: Devices and Communication: (7 Hours)

Serial Communication devices, Parallel device port, Serial Communication standards and Buses: I2C, UART,USART, CAN Bus

Devices : Wireless Devices, Timer and Counting Devices, Watch Dog Timer, Real Time Clock

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: UsingAssembly and C",Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
3. The 8051 Microcontroller Based Embedded System By Manish K. Patel TMH.
4. Embedded System Architecture, Programming and Design by Raj Kamal, 3rd Edition TMH.
5. Introduction to Embedded System by Shibu K. V. 3rd Edition TMH

RASHTRASANT TUKADOJI MAHARAJ NAGPUR

UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF

ENGINEERING (B.E.) DEGREE COURSE SEMESTER: IV

(C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Microcontroller And Embedded Systems Lab **Subject Code: BEAI&DS-406P**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 **Hrs/Week (Practical)**	1	25	25	50

RASHTRASANT TUKADOJI MAHARAJ NAGPUR

UNIVERSITY, NAGPUR FOUR YEAR BACHELOR OF

ENGINEERING (B.E.) DEGREE COURSE SEMESTER: IV

(C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Internship **Subject Code: BEAI&DS-407**

Load	Credit	College Assessment Marks	University Evaluation	Total Marks
1 Hrs	1	50	-	50

Internship (Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship for 2- 3 week)

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Data Mining   Subject Code: BTECH_AI&DS-501T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3.00	30	70	100

Prerequisite(s): DBMS

Course Objectives:

1	To understand the concepts related to knowledge extraction and data preparation
2	To comprehend the concepts of association rule mining
3	To appreciate the working of supervised algorithms for data analysis
4	To understand various advanced data mining techniques

Course Outcomes:

At the end of this course students are able to:

CO1	Use the data preprocessing techniques to prepare data for knowledge extraction
CO2	Apply the association rule mining on data
CO3	Apply various supervised techniques to mine the data
CO4	Describe various advanced concepts and techniques of data mining

Syllabus:

UNIT I: Introduction to data mining (DM): What is data mining, Related technologies - Machine Learning, DBMS, OLAP, Statistics Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications, Data pre-processing, Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies	**[07 Hours]**
UNIT II: Mining frequent patterns and Association Rules: Market basket analysis, Frequent item sets and association rules, Apriori algorithm, FP growth algorithm, Improving efficiency of Apriori and FP growth algorithms.	**[07 Hours]**
UNIT III: Classification: Introduction, Decision tree, Building decision tree- tree induction algorithm, Split algorithm based on information theory, Split algorithm based on gini index, Decision tree rules, Naive based methods.	**[07 Hours]**
UNIT IV: Clustering: Cluster analysis, Desired features, Types of data in cluster analysis, Computing distance, Categorizations of major clustering methods – Partitioning methods (K-means, EM), Hierarchical methods (agglomerative, divisive).	**[07 Hours]**
UNIT V: Web Data Mining: Introduction, Graph properties of web, Web content mining, Web structure mining, Web usage mining, Text mining, Visual web data mining, Temporal and Spatial data mining.	**[08 Hours]**

TEXT BOOKS:

1. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
2. A. K. Pujari, "Data Mining Techniques", Second Edition, University press, 2013.
3. Jason Bell, "Machine Learning for Big Data: Hands-on for Developers and Technical Professionals, Wiley India Publications, 2013.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Design and Analysis of Algorithms Subject Code : BTECH_AI&DS-502T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3.00	30	70	100

Prerequisite(s): Data Structure

Course Objectives:

1	To understand different Asymptotic notations
2	To have an appreciation of different mathematical principles of algorithm analysis
3	To understand and apply various algorithm design strategies
4	To understand various complexity classes like P,NP complete and NP hard

Course Outcomes:

At the end of this course students are able to:

CO1	Compare different types of Aymptotic notations and find time complexity in terms of asymptotic notations
CO2	Implement Divide and conquer strategy
CO3	Implement Dynamic programming strategy
CO4	Implement Backtracking strategy
CO5	Identify differentiate between Various types of Complexity classes

Syllabus:

UNIT I: Mathematical Foundations, summation of arithmetic and geometric series,n,n2, bounding summations using integration , analysing control structures, worst case and average case analysis, Asymptotic notations, sorting algorithm such as Insertion sort ,recursive function and recurrence relations, solution of recurrence relations using technique of characteristics equation, Amortised analysis	**[07 Hours]**
UNIT II: Divide and conquer basic strategy: Binary search, quick sort, merge sort, heap sort, Greedy method: Basic strategy, Fractional Knapsack problem, application to job sequencing with deadlines problems, minimum cost spanning trees, single source shortest path.	**[07 Hours]**
UNIT III: Dynamic Programming: Basic strategy, multistage graphs, all pairs shortest path, single source shortest path, travelling salesman problem, Longest common sequence,0/1 Knapsack problem.	**[07Hours]**
UNIT IV: Basic Traversal and Search Techniques: Breadth first search, Depth first search, Backtracking: Basic strategy, N-Queen's problem, graph coloring, Hamiltonian cycles.	**[08 Hours]**
UNIT V NP-hard, NP-complete Problems: Basic concepts, Non-deterministic algorithms, NP-hard and NP-complete, Cook's theorem, decision and optimization problems, Polynomial reduction.	**[07Hours]**

Textbooks:

1. Computer Algorithms By Horowitz, Sahani, Rajsekharam, Galgotia Publications Pvt.
2. Introduction to Algorithms by Thomas H. Cormen et. al. Prentice Hall of India.
3. Fundamentals of Algorithm, Brassard Bratley, Prentice Hall of India.

Reference books:

1. The Design and Analysis of Algorithms By Alfred V. Aho, John E. Hopcraft, Jeffrey D. Ullman, Pearson Publication

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Design and Analysis of Algorithms (Lab) Subject Code : BTECH_AI&DS-502P

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 hrs/Week (Practical)	1	25	25	50

Course Objectives:

1	To learn the importance of designing an algorithm in an effective way by considering space and time complexity
2	To learn graph search algorithms.
3	To study network flow and linear programming problems
4	To learn the dynamic programming design techniques.
5	To develop recursive backtracking algorithms.

Course Outcome:

At the end of this course students will be able to:

CO1	Calculate the time complexity of algorithm.
CO2	Sort the given numbers using various sorting algorithms.
CO3	Develop programs for the problems using Divide and Conquer and greedy methods.
CO4	Develop programs for the problems using Dynamic programming.
CO5	Students will be able to write programs for the problems using Backtracking.

Expected experiments to be performed (Not limited to):

1. To perform operation count for a given pseudo code
2. To perform search methods.
3. To find Time complexity of an algorithm.
4. To find Space complexity of an algorithm.
5. To find HCF and LCM of two numbers
6. Code and analyses to find median element in an array of integers.
7. Code and analyse to find majority element in an array of integers.
8. Code and analyse to sort an array of integers using merge sort
9. Code and analyse to sort an array of integers using quick sort
10. To implement maximum and minimum problem using divide and conquer strategy
11. To implement binary search using divide and conquer strategy
12. To implement program of Heap Sort.
13. WAP and analyze for minimum spanning tree using Kruskal algorithm.
14. WAP and analyze it for minimum spanning tree using Prim's algorithm.
15. WAP to implement matrix chain multiplication
16. Code to find the shortest path in graph using Dijkstra's algorithm.
17. Code to find the shortest path using Bellman-Ford algorithm.
18. To implement LCS problem using Dynamic Programming.
19. To implement matrix chain multiplication problem using dynamic programming.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Machine Learning Techniques　　　　Subject Code: BTECH_AI&DS-503T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3.00	30	70	100

Prerequisite(s): Artificial Intelligence

Course Objectives:

1.	To enable the Students with basic knowledge on Machine Learning Techniques.
2.	To develop skills of applying Machine Learning Techniques for solving real world problems.

Course Outcomes:

At the end of this course students are able to:

CO1	Understand basics of Machine Learning Techniques.
CO2	Understand different types of Regression Techniques.
CO3	Be capable of applying classification techniques.
CO4	Apply unsupervised machine learning techniques.
CO5	Apply & evaluate the machine learning techniques to real world problems.

Syllabus:

UNIT I: Introduction to Machine Learning Human learning & it's types, Machine learning and it's types (Supervised ,unsupervised reinforcement),well-posed learning problems, Applications of Machine learning, issues in machine learning. Types of data: Numerical and categorical data, data issues and remediation.	**[08 Hours]**
UNIT I: Introduction to Machine Learning Human learning & it's types, Machine learning and it's types (Supervised ,unsupervised reinforcement),well-posed learning problems, Applications of Machine learning, issues in machine learning. Types of data: Numerical and categorical data, data issues and remediation.	**[08 Hours]**
UNIT I: Introduction to Machine Learning Human learning & it's types, Machine learning and it's types (Supervised,unsupervised reinforcement),well-posed learning problems, Applications of Machine learning, issues in machine learning. Types of data: Numerical and categorical data, data issues and remediation.	**[08 Hours]**
UNIT II: Supervised Learning: Regression Data pre-processing: Dimensionally reduction, feature subset selection, Types of regression: Multiple linear regression, Polynomial regression model.	**[07Hours]**
UNIT III: Supervised Learning: Classification Logistic regression, K-nearest neighbour (KNN),Naive Bayes Decision trees, Support vector machine, Recommendation Systems : Content based and collaborative techniques.	**[07Hours]**
UNIT IV: Unsupervised Learning: Introduction Clustering, K-means clustering, Apriori algorithm and association rule, anomaly detection algorithm, Hierarchial clustering , K-Medoids.	**[07Hours]**
UNIT V: Trends and applications in Machine learning Ensemble learning, Bagging, randomization, Boosting, Applications of Machine learning: Image recognition, speech recognition, Prediction recommendation: email spam and malware filtering, virtual personal assistant, online fraud detection.	**[07Hours]**

Textbooks:

1. Machine Learning by Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das
2. Introduction to Machine Learning by Dr. Nilesh Shelke, Dr. Narendra. V. Choudhary, Dr. Gopal Sakarkar, Das Ganu Publications, ISBN-978-93-84336-63-9
3. Machine Learning by Tom Mitchell, Mc.Graw Publications

Reference books:

1. Python Machine Learning Dr Randal S. Olson

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Internet of Things and its Application Subject Code : BTECH_AI&DS-504T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Prerequisite(s):

Course Objectives:

1	To understand the concepts of Internet of Things and can able to build IoT application

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the concepts of Internet of Things.
CO2	Understand the concept of AI for IoT.
CO3	Analyse IoT protocols for sensor network.
CO4	Analyse IoT application using Ardunio and Raspbrrypi Programming
CO5	Design IoT Application in different domain and analyse its performance.

Syllabus:

UNIT I: **Introduction to IoT:** Defining IoT, the characteristics of IoT, Physical Design of IoT, Logical Design of IoT, Functional blocks of IoT and Communication Models and APIs sensing actuation, IoT tools	**[07 Hours]**
UNIT II: **Aritificial Intelligence for IoT:** Machine to machine communication, IoT reference model, verticals, big data and IoT, introduction to tensorflow and keras	**[07Hours]**
UNIT III: **Aspects of Communication using IoT protocols:** WSN protocol, SCADA and RFID, 6low, COAP protocol, Sensor deployment and Node discovery, Data aggregation and dissemination	**[07Hours]**
UNIT IV: Interopratibility in IoT, introduction to Arduino programming: Part I, Part II, intergration of sensors and actuators with Arduino, introduction to Raspberrypi, implementation of IoT with Raspberrypi, introduction to SDN for IoT.	**[08Hours]**
UNIT V: **Domain specific IoT applications:** AI for industrial IoT, AI for smart cities IoT, Home automation, Surveillance applications, Other IoT applications, Sensor based application through embedded system.	**[07Hours]**
Textbooks: 1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach" Waltenegus Dargie, 2. Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice". 3. Amita Kapoor,"Hands on Artificial Intelligence for IoT". 4. Beginning C for Arduino, 2nd Edition, Jack Purdum. 5. Programming Auduino: Gettting started with sketch, Simon Monk, 2nd Edition.	
Reference books: 1. Introduction to IoT, by Sudip Misra 1st Edition 2020, Cambridge University press. 2. IoT Architecture, Implementation and Security, 1st Edition Mayur Ramgir, Pearson Publication.	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER:V (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Internet of Things -Lab Subject Code : BTECH_AI&DS-504P

Sr. No.	Practical List
1	To study Arduino Uno IoT Kit with ATMega 328 Microcontroller
2	Design a sketch for running of LEDs
3	Design a sketch to monitor state of switch by establishing serial communication between Arduino and computer
4	Design a sketch to read analog value of potentiometer by establishing serial communication between arduino and computer.
5	Design a sketch for blinking LEDs without using delay.
6	Design a sketch to develop switch based binary LED counter. Also observe output on serial monitor.
7	Design a sketch to create a simple digital clock using LCD display.
8	Design a sketch to make use of EEPROM to control devices (LED).
9	To log data of temperature sensor over internet and analysis it.
10	Advance Practical: Study and setup of ESP -32 board
11	Interfacing Raspberry Pi with RFID.
12	Controlling Raspberry Pi with WhatsApp
13	Setting up Wireless Access Point using Raspberry Pi
14	Fingerprint Sensor interfacing with Raspberry Pi
15	Raspberry Pi GPS Module Interfacing
16	IoT based Web Controlled Home Automation using Raspberry Pi
17	Visitor Monitoring with Raspberry Pi and Pi Camera

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject : NoSQL (Elective - I) Subject Code : BTECH_AI&DS-505.1T

Load Th	Credits Th	College Assessment Marks	University Evaluation	TotalMarks
3	3	30	70	100

Prerequisite(s): DBMS

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the different types of NoSQL Databases
CO2	Compare and contrast RDBMS with different NoSQL databases.
CO3	Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases
CO4	Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases
CO5	Apply Nosql development tools on different types of NoSQL Databases.

Syllabus:

UNIT I: Overview and History of NoSQL Databases: Definition of the Four Types of NoSQL Database, Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points, Key-Value and Document Data Models.	**[07 Hours]**
UNIT II: collection, Basic CRUD operations, Capped collection.	**[07 Hours]**
UNIT III: MongoDB: Inserting document from java script file, Inserting document from JSON file, Difference between JSON and Java script object, Nested documents ,Arrays in documents, JSON and BSON ,ObjectID in MongoDB database, Aggregation, Projection queries, creating indexes, backup and restore.	**[08 Hours]**
UNIT IV Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Overview of Cassandra, Key Features of Cassandra, Architecture of Cassandra, Replication and sharding, MapReduce on databases.	**[08 Hours]**
UNIT V Column- oriented NoSQL databases using Apache HBASE, , Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.	**[07 Hours]**
Textbooks: 1. Sandalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019. 2. Dan Sullivan, NoSQL, for Mere Mortals, Pearson Edition-1, 2015	
Reference books: 1. NoSQL with mongoDB in 24hrs by Brad Dayley Pearson Education, Edition-1, 2015.	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCEAND DATA SCIENCE

Subject: Information Security (Elective - I) Subject Code: BTECH_AI&DS-505.2T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Prerequisite(s):

Course Objectives:

1	Learn Fundamentals of Information Security. Security threats its services and counter measures
2	Acquire background of Hash Function Authentication, Firewall. digital Signature
3	To Understand cloud and IoT Security and Vulnerability in existing system

Course Outcomes:

At the end of this course students are able to:

CO1	Recall the fundamental concepts of Information security
CO2	Analyze Security problems in computer system and mobile networks
CO3	Explain standard security algorithm for cryptography
CO4	Learn software vulnerability. electronic payment and its application
CO5	To design cloud computing security services using IoT

Syllabus:

UNIT I: Introduction to Information Security: Security Design principles, attacks, vulnerability, security Goals and services, threats.	**[07 Hours]**
UNIT II: Cryptography: Introduction to Cryptography Substitution and Transposition Techniques, SDES, AES, RSA. Authentication: Hash Functions and Message Authentication Algorithms, Digital signature.	**[07 Hours]**
UNIT III: Cyber Security: Fundamentals of Cyber security Penetration security Malware, Worms Viruses, Spyware, Mobile Protection. Prevention Software: Firewall and VPN	**[07 Hours]**
UNIT IV: Software vulnerability: Phishing, Buffer Overflow, Cross Site Scripting(XSS), Electronic Payment Types, Enabling technology, Smart Cards, Smart Phones, Card Holder, Payment Types, Present E-Transaction Attacks.	**[08 Hours]**
UNIT V Cloud and IoT Security, Concepts and Approaches, Introduction to IoT, IoT Security.	**[07 Hours]**
Textbooks: 1. William Stallings, "Cryptography And Network Security Principle And Practices" Pearson Publication, 2013. 2. Bernard Menezes, "Network Security and Cryptography", Cenage learning, 2010.	
Reference books: 1. William Stallings, "Computer Security Principle And Practices" Pearson Publication, 2020	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: V(C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCEAND DATA SCIENCE

Subject: Wireless Communication Technologies (Elective - I)   Subject Code: BTECH_AI&DS-505.3T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Course Objective:

1	To understand the basic concepts in cellular communication
2	To understand the characteristics of wireless channels.
3	To know the Impact of digital modulation techniques in fading
4	To get exposed to diversity techniques in wireless communication.
5	To acquire knowledge in multicarrier systems

Course Outcome:

CO1	To be able to design solutions for cellular communication
CO2	To be able to compute the capacity of wireless channels
CO3	To be able to analyze the performance of the digital modulation techniques in fading channels.
CO4	To apply various diversity techniques in wireless communication.
CO5	To design multicarrier systems in wireless communication

Syllabus:

UNIT I CELLULAR CONCEPTS Frequency Reuse – Channel Assignment Strategies – Hand off Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring-Repeaters for Range Extension-Microcell Zone Concept.	[07 Hours]
UNIT II THE WIRELESS CHANNEL Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.	[07 Hours]
UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS Performance of flat fading and frequency selective fading – Impact on digital modulation techniques –- Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference	[07 Hours]
UNIT IV DIVERSITY TECHNIQUES Realization of Independent Fading Paths – Receiver Diversity – Selection Combing – Threshold Combing – Maximal-Ratio Combing – Equal - Gain Combing – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.	[07 Hours]
UNIT V MULTICARRIER MODULATION Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.	[07 Hours]

Text Books:

1. Theodore.S. Rappaport. "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2009.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Wiley Series in Telecommunications, Cambridge University Press, 2005.

References:

1. Keith Q. T. Zhang, " Wireless Communications: Principles, Theory and Methodology" John Wiley & Sons, 1st Edition, 2016.
2. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House,2004.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCEAND DATA SCIENCE

Subject: ARM Processor & its Essentials (Elective - I)   Subject Code: BTECH_AI&DS-505.4T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Course Objective:

1	To teach the architecture of 8 bit RISC processor
2	To teach the architecture and programming of 16 bit RISC processor
3	To teach the implementation of DSP in ARM processor
4	To discuss on memory management in RISC processor
5	To teach the application development with ARM processor

Course Outcome:

CO1	To be able to understand architecture , addressing modes of AVR Microcontroller
CO2	To be able to programme 8 bit RISC processor
CO3	To be able to design applications using ARM processor
CO4	To be able to understand memory protection Management.
CO5	To apply various diversity techniques to design with ARM controllers

Syllabus:

UNTI I AVR MICROCONTROLLER ARCHITECTURE Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing	**[07 HOURS]**
UNIT II ARM ARCHITECTURE AND PROGRAMMING Arcon RISC Machine – Architectural Inheritance – Core & Architectures, The ARM Programmer's model -Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors. Instruction set – Thumb instruction set – Instruction cycle timings	**[07 HOURS]**
UNIT III ARM APPLICATION DEVELOPMENT Introduction to DSP on ARM –FIR Filter – IIR Filter – Discrete Fourier transform – Exception Handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Example: Standalone - Embedded Operating Systems – Fundamental Components - Example Simplelittle Operating System	**[08 HOURS]**
UNIT IV MEMORY PROTECTION AND MANAGEMENT Protected Regions-Initializing MPU, Cache and Write Buffer-MPU to MMU-Virtual MemoryPage Tables-TLB-Domain and Memory Access Permission-Fast Context Switch Extension.	**[07 HOURS]**
UNIT V DESIGN WITH ARM MICROCONTROLLERS Assembler Rules and Directives- Simple ASM/C programs- Hamming Code- Division-Negation- Simple Loops –Look up table- Block copy- subroutines.	**[07 HOURS]**

TEXTBOOKS

1. Steve Furber, 'ARM system on chip architecture', Addision Wesley
2. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield 'ARM System Developer's Guide Designing and Optimizing System Software', Elsevier 2007.
3. Trevor Martin, 'The Insider's Guide To The Philips ARM7-Based Microcontrollers, An Engineer's Introduction To The LPC2100 Series' Hitex (UK) Ltd.,

REFERENCES:

1. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001 5. William Hohl, ' ARM Assebly Language' Fundamentals and Techniques.
2. ARM Architecture Reference Manual 6. LPC213x User Manual

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Professional Skills-III- LAB Subject Code : BTECH_AI&DS-506P

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 hrs/Week (Practical)	1	25	25	50

Course Objectives:

The interactive experiments in this lab will give the students an opportunity for learning and better understanding of the basic concepts and constructs of Data Mining AND/OR Machine Learning as well as advanced methodology concepts

Expected experiments to be performed Based on Data Mining AND/OR Machine Learning Syllabus.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE
SEMESTER: V (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCEAND DATA SCIENCE

Subject: Effective Technical Communication Subject Code: BTECH_AI&DS-507T

Course Objective:

1.	At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/SNAP/GMAT/GATE etc.) to pursue masters degree. They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently.

Course Outcome: By the end of the course, students will be able to

CO1	Acquire knowledge of structure of language.
CO2	Be able to face competitive exams and the interview process and can become employable
CO3	Develop business writing skills
CO4	Become familiar with technology enabled communication and can develop technical and scientific writing skills.

Syllabus:

Unit 1: Functional Grammar:
Common errors, Transformation of Sentences- Change the Voice, Change the Narration, Simple, Compound Complex sentences, Use of Phrases, Idioms & Proverbs.

Unit II. English for Competitive Exams & Interview Techniques:
Word building, English words /phrases derived from other languages, Prefixes and Suffixes, Synonyms/Antonyms, Technical Jargons, Verbal Analogies, Give one word for, Types & Techniques of Interview.

Unit III. Formal Correspondence
Business Letters, (Enquiry, Quotation, Order, Complaint), Job applications and Resume Writing, e-mail etiquette, Writing Memorandum, Circulars, notices, Analytical comprehension

Unit IV. Technical & Scientific Writing:
Features of Technical Writing, Technical Report writing (Accident, Feasibility, Trouble, Progress), Writing Scientific Projects, Writing Manuals, Writing Project Proposals, Writing Research papers.

Text and Reference Books:

1. Effective technical Communication by Barun K. Mitra, Oxford University Press.
2. Technical Communication-Principles and Practice by Meenakshi Raman & Sharma, Oxford University Press, 2011
3. Functional English for Technical Students by Dr. Pratibha Mahato and Dr. Dora Thompson, Himalaya Publishing House.
4. How to Prepare a Research Proposal: Guidelines for Funding and Dissertations in the Social and Behavioral Sciences by Krathwohl & R David.
5. Technical Writing- Process and Product by Sharon J. Gerson & Steven M. Gerson, 3rd edition, Pearson Education Asia, 2000
6. Developing Communication skills by Krishna Mohan & Meera Banerjee

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOFY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Deep Learning** Subject Code: BTECH_AIDS-601T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs.(Theory)	3	30	70	100

Prerequisite(s): Artificial Intelligence

Course Objectives:

1.	To understand the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data.
2.	To apply Deep Learning Techniques to various engineering and social applications.

Course Outcomes:

At the end of this course students are able to:

1.	Understand the fundamentals of Deep Learning.
2.	Gain knowledge of the different modalitites of Deep Learning currently used.
3.	Gain knowledge about state-of the art models and other important works in recent years.
4.	Learn the skills to develop Deep Learning based AI systems. (use of multiple packages etc.)
5.	Develop applications of deep learning for Data Science.

Syllabus:

UNIT I: Issues and challenges in machine learning, difference between machine learning and deep learning, understanding biological neuron and artificial neuron, types of activaion functions, architecture of neural network, learning process in ANN.	[06 Hours]
Unit II: McCulloch Pitts Neuron, thresholding logic, perceptrons, perceptron learning algorithm , multilayer perceptrons (MLPs), representation power of MLPs, signoid neurons, gradient descent.	**[07 Hours]**
Unit III: Feedforward Neural Networks, Back propogation Gradient Descent(GD), Momentum Based GD, Nesterov ACcelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Weighted intialization in neural network, Eigen values and Eigen vectors.	**[08 Hours]**
UNIT IV Basic concept of Computer Vision: Image formation, image representation, linear filtering, Image in frequency domain, Image sampling, image processing and feature extraction, correlation, convolution, edge detection: canny edge detector	**[07 Hours]**
UNIT V Convolutional Neural Networks: Popular CNN architecture, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet object detection, Introduction to Recurrent Neural Network (RNN), advantages, disadvantages and its application.	[08 Hours]
Text books: 1. Deep Learning by Amit Kumar Das first edition 2021 Pearson education. 2. Deep Learning, an MIT press book, Ian goodfellow and yoshua Bengio and aaron cournville http://www.deeplearningbook.org 3. Daniel Jurafsky, James H. Martin "Speech and language processing: An introduction to natuarral language processimg, computatonal linguistics and spech recognition, 2/e, prentice hall,2008	
Reference books: 1. Multiple view geametry in computer vision by Richard HEartley and Andrew Zisserman. 2. Deep learning by Ian Goodfellow and Yoshua bengio and Aaron courville http ://www.deeplearningbook.org/ computer vision, a modern approach by Fosyth and Ponce.	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: **Deep Learning Lab** Subject Code: BTECH_AIDS-601P

Load Th	Credits Th	College Assessment Marks	University Evaluation	TotalMarks
2 Hrs.(Theory)	1	25	25	50

Prerequisite(s): Advanced Python and Basic understanding of machine learning concepts.

Course Objectives:

1.	To understand dataset and pre-processing to build neural network models
2.	To identify the problems, choose relevant deep learning algorithms and analyze the results for respective applications.

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the fundamentals of Deep Learning.
CO2	Gain knowledge of the different modalities of Deep Learning currently used.
CO3	Choose appropriate data preprocessing techniques to build neural network models.
CO4	Build neural network models using deep learning algorithms-CNN and RNN to solve real world problems.

Name of Experiments / Case Studies

1. To study various type of activation functions.
2. To perform and implement perceptron model.
3. To perform and implement Multilayer Perceptron.
4. To perform and implement Feedforward Neural Network for diabetic datasets.
5. To perform and implement Back propagation Neural Network.
6. To perform and implement Convolution Neural Network for Diabetic datasets.
7. To write a program in Python to generate edge features for any same image:
8. To perform and implement RNN.
9. To build a model for any image classification e.x. Covid-19 or CT Scan Image classification.
10. Implementation and analysis by any Deep Neural network algorithm for Character recognition.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Computer Communication Network Subject Code: BTECH_AI&DS-602T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite(s): Computer Network

Course Objectives:

1	To explain the basics concept of Computer communication network
2	To explain the Computer Network Layer
3	To explain IP addressing scheme
4	To explain network process
5	To make selection of IEEE standards

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the various physical components as well as different network topologies and transmission media for the computer communication.
CO2	Analyse various error detection and correction methods.
CO3	Understand the switching techniques and routing algorithms.
CO4	Understand the importance of Transport layer to establish computer communication.
CO5	Compare different application layer protocols and able to understand the network security concept.

Syllabus:

UNIT I: Introduction to Computer networks and Physical Layer Introduction to Networks, Components, Types of connections, Topologies ,Protocols and standards, ISO/OSI model and TCP/IP model, Transmission media, Coaxial cable, Fibre optics, Modems RS232 interfacing, sequencing, Uses of Computer network.	**[08 Hours]**
UNIT II: Data Link Layer Error-Detection and correction, Parity, LRC, CRC, Hamming code, Flow Control and error control, Sliding window protocol, Stop and wait, Go back-N,ARQ-Selective repeat ARQ,HDLC-,LAN Medium access sublayer Channel allocation in LAN's and MAN's Network using CSMA,CDMA/CD.	**[07 Hours]**
UNIT III: Network Layer Internetworks - Circuit Switching, Datagram Switching& Virtual circuit switching, IP addressing methods, Network Layer Design issues, IP addressing,IPv4,IPv6,Routing algorithms, shortest path routing, Flooding, Flow based routing, Distance vector routing, Link state routing.	**[08 Hours]**
UNIT IV: Transport Layer Transport Layer-Process to process delivery, Connection oriented & Connectionless Transport, UDP, TCP, Congestion control.	**[07 Hours]**
UNIT V: Application Layer Application Layer Protocols: DNS, SMTP, SNMP, FTP, HTTP & WWW Security: Cryptography, user authentication, security protocol in internet, Firewalls, IEEE 802.11 & Cellular telephony	**[06 Hours]**
Textbooks: 1. Behrouz A.Forouzan , " Data Communications and Networking", 4th Edition , Tata McGraw Hill 2. Andrew Tenenbaum, "Computer Networks",4th Edition, Pearson Education.	
Reference books: 1. Behrouz A.Forouzan ,"TCP/IP protocol Suit",3rd Edition, Tata McGraw Hill Publications. 2. Stevens, "TCP/IP illustrated Volume -I & II", Pearson education. 3. Feibel Werner, " Encyclopaedia of networking" Pearson education. 4. Frank J.Derfler," Practical Networking",2nd edition, QUE international Publishing. 5. Nurul Sarkar, "Computer Networking & Hardware concepts", Information Science Publisher, USA	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Digital System Design using Verilog Subject Code: BTECH_AI&DS-603T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objectives:

1	Interpret different modeling styles.
2	Analyse working of various digital circuits.
3	Synthesize various digital circuits using FPGA.
4	Implement Combinational system.

Course Outcomes:

At the end of this course students are able to:

CO1	Understand the digital system designs skills using Verilog HDL.
CO2	Understand Gate level modeling.
CO3	Design Behavioral modeling and loop constructs.
CO4	Understand synthesis of digital and sequential sub systems.
CO5	Design and implement complete digital systems using Verilog HDL and demonstrate the innovation skills.

Syllabus:

UNIT I: Introduction to Verilog: Verilog as HDL, Levels of design Description, Concurrency, Simulation and Synthesis, Functional Verification , System Tasks, Programming Language Interface(PLI), Module, Simulation and Synthesis Tools, Test Benches. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White space characters, Comments, Numbers , Strings, Logic Values, Strengths, DAta Types, Scalars and Vectors, Parameters, Operators.	**[06 Hours]**
Unit II: Gate Level Modeling and Gate Primitive, Module structure, other GATE primitives. Illustrative Examples, Tri-State Gates.Arrays of Instances of Primitives , Design of Flip-flops with Gate Primitives, DElays, Strength and Contention Resolution, Net Types, Design of Basic Circuits, Modeling at Data Flow Level Introduction, Continous assignment structures, DElays and continuous, Assignments ,Assignment to vectors, Operators.	**[08 Hours]**
Unit III: Behavioral Modeling Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Behavioral modeling of Flip Flops and latches, Assignments with Delays, Wait construct, Multiple Always Blocks, Blocking and Non blocking Assignments, The case statement, if and if-else constructs, Assign-de-assign construct, repeat construct, for loop, The disable construct, while loop, forever loop, Parallel blocks, Force-release, construct, Event.	**[08 Hours]**
UNIT IV Synthesis of Digital Sub-systems: Synthesis of Combinational Sub-systems: Introduction to Synthesis, Synthesis of Combinational Logic, Synthesis of Sequential Logic with latches, Synthesis of Three-state Devices and Bus Interfaces, Synthesis of Sequential Sub-systems: Synthesis of Seqeuntial Logic with Flip-Flops, Syntheisis of Explicit State Machines, Registered Logic, State Encoding, Synthesis of Implicit State Machines, Registers and Counters.	**[06 Hours]**
UNIT V System Implementation and User-Defined Primitives: Introduction of Programmable Logic Array (PLA), Programmable Array Logic(PAL), Programmability of PLDs, Complex PLDs (CPLDs), Field Programmable GAte Arrays, The role of FPGAs in the ASIC Market, FPGA Technologies, Verilog-Based Design Flows for FPGAs and ASICs, Comparison of design implementation using CPLDs, FPGA and ASIC.	**[08 Hours]**

Text books:

1. Verilog HDL- A guide to design Digital design and synthesis by Samir Palnitkar (Pearson).
2. Design Through Verilog HDL by T.R. Padmanabhan, WILEY INDIA.
3. Verilog HDL Primer 3rd Edition by Bhasker. J., Bsp.
4. Digital Design: with an Introduction to the Verilog HDL by Moris Meno.

Reference books:

1. Advanced Digital Design with the Verilog HDL by Michael D. Ciletti.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: DSD(LAB) Subject Code: BTECH_AI&DS-603P

Load P	Credits P	College Assessment Marks	University Evaluation	Total Marks
2 Hrs	1	25	25	50

1.	Realization of a Boolean function Design and simulate the Verilog code to realize three and fourvariable Boolean functions
2.	Design of decoder and encoder Design and simulate the Verilog code for the followingcombinational circuits a) 3 to 8 Decoder b) 8 to 3 Encoder (With priority and without priority)
3.	Design of multiplexer and de multiplexer Design and simulate the Verilog code for the followingcombinational circuits a) Multiplexer b) De-multiplexer
4.	Design of code converters Design and simulate the Verilog code for the following combinational circuits a) 4- Bit binary to gray code converter b) 4- Bit gray to binary code converter c) Comparator
5.	Full adder and full subtractor design modeling Write a Verilog code to describe the functions of a full Adderand subtractor Using three modeling styles
6.	Design of 8-bit Arithmetic logic unit Design a model to implement 8-bit ALU functionality
7.	Verilog model for flip flops Write Verilog codes for the flip-flops - SR, D, JK, T
8.	Design of counters Write a Verilog code for the following counters a) Binary counter b) BCD counter (Synchronous reset and asynchronous reset)
9.	Verilog code for universal shift register Design and simulate the Verilog code for universal shift register
10.	Verilog code for carry look ahead adder Design and simulate the Verilog code for carry look ahead adder
11.	Verilog code to detect a sequence Write a Verilog code to detect the sequence 1010101
12.	Chess clock controller FSM using Verilog Design a traffic light controller using Verilog

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Web and Social Media Analytics (Elective II) Subject Code: BTECH_AI&DS-604.1T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite(s): Knowledge of Social Media Management

Course Objectives:

1	Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics.
2	Identify and select key performance indicators to accurately measure the success of social media efforts.
3	Analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools.
4	Develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively.

Course Outcomes:

At the end of the course students will be able to:

CO1	Be able to understand social media, web and social media analytics, and their potential Impact.
CO2	Be able to understand usability, user experience, and customer experience.
CO3	Be able to understand usability metrics, web and social media metrics.
CO4	Be able to design and conduct usability studies.
CO5	Be able to use various data sources and collect data relating to the metrics and key Performance indicators.

Syllabus:

UNIT – I: Introduction Web and social media (Web sites, web apps, mobile apps and social media)Usability, user experience, customer experience, customer sentiments, web marketing,conversion rates, ROI, brand reputation, competitive advantages Web analytics and a Web analytics 2.0 framework (click stream, multiple outcomes analysis, experimentation and testing, voice of customer, competitive intelligence,Insights).	[8 Hours]
UNIT – II: Background Data (Structured data, unstructured data, metadata, Big Data and Linked Data)Lab testing and experiment design (selecting participants, within-subjects or between subjects study, counterbalancing, independent and dependent variable: A/B testing,multivariate testing, controlled experiments) Data analysis basics (types of data, metrics and data, descriptive statistics, comparing means, correlations, nonparametric tests, presenting data graphically)	[7 Hours]
UNIT – III Measuring user experience Usability metrics (performance metrics, issues-based metrics, self-reported metrics), Planning and performing a usability study (study goals, user goals, metrics andevaluation methods, participants, data collection, data analysis) Typical types of usability studies and their corresponding metrics (comparing alternative designs, comparing with competition, completing a task or transaction, evaluating theimpact of subtle changes)	[7 Hours]
UNIT – IV: Web metrics and web analytics PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical issues; HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; On-site web analytics, off-site web analytics, the goal-signal-metric process.	[7 Hours]
UNIT – V : Social media analytics Social media analytics (what and why) Social media KPIs (reach and engagement) Performing social media analytics (business goal, KPIs, data gathering, analysis, measure and feedback) Data analysis language and tools Ready-made tools for Web and social media analytics (Key Google Analytics metrics,dashboard, social reports) Statistical programming language (R).	[7 Hours]
TEXT BOOKS: 1. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons; Pap/Cdr edition (27 Oct 2009) 2. Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann; 1 edition (28 April 2008) 3. Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons (16 April 2010) 4. Brian Clifton, Advanced Web Metrics with Google Analytics, John Wiley & Sons; 3rd Edition edition (30 Mar 2012)	
REFERENCE BOOKS: 1. Social Media & Web Analytics by Aditya Kumar by R. Narain & Co. 2. Social Media and Web Analytics by Vishnuprasad Nagadevara 3. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics By: Marshall Sponder	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Blockchain and cyber security (Elective II) Subject Code: BTECH_AI&DS-604.2T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite(s): Network Security

Course Objectives:

1	To learn fundamentals of Cyber Security.
2	Obtain knowledge about technologies of Blockchain.
3	To learn different models and their application.

Course Outcomes:

At the end of this course students are able to:

CO1	To understand fundamentals of Cyber Security and Blockchain Technology
CO2	To learn models of Blockchain.
CO3	Analyze and demonstrate ethereum.
CO4	Analyze and demostrate Hyperledger fabric.

Syllabus:

UNIT I: Introduction to Cyber Security:Private and Public Key Cryptography, RSA algorithms, Hash Functions SHA-256, SHA-512 algorithms, and Digital signatures, Message Authentication HMAC, MD5	**[07 Hours]**
Unit II: Digital Cash, Bitcoin Blockchain -Wallet -Why Nakamoto came up with Block chain in crypto currency-Merkley Tree, transaction veriability, Double spending, Bitcoin challenges and solutions.	[07Hours]
Unit III: Models EGARAY, RLA model, proof of work, proof of state, Consensus Algorithm in Blockchain Byzantine General Problems.	[08Hours]
UNIT IV: Smart Contract Tools and Hands-on -Ethereum Virtual Machine(EVM), wallets, introduction to solidity, attacks on smart contracts.	**[07Hours]**
UNIT V Introduction to HyperLedger fabric, mechanism in permissioned Blockchain, application of Blockchain in Cyber Security, limitation of Blockchain as a technology.	**[07Hours]**
Textbooks: 1. S.Shukla, M.Dhawan, S.Sharma, S.Venkateshan Blockchain technology: cryptocurrency and applications, Oxford University Press 2019. **2.** Arvind Narayanan, Joseph Bonneau, Edverd Felten, Andrew Miller and Steaven GoldFeder, Bitcoin and Cryptocurrency technologies: A comprehensive introduction, Priceton University Press 2016.	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Intelligent sensor and Instrumentation (Elective II)   Subject Code: BTECH_AI&DS-604.3T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite: Digital Electronics

Course Objective

1	Study the concepts of intelligent sensor and instrumentation
2	Learn the various technics to measure the physical quantity using smart sensor
3	Introduce the concepts of data acquisition and applications of smart sensor

Couse Outcome

CO1	To be able to understand and analyse Classification & selection of sensors
CO2	To be able to compute and measure various physical quantity using transducers
CO3	To be able to analyze the performance of the virtual instrumentation
CO4	To apply various diversity techniques in data acquisition methods
CO5	To design various application using smart sensor

Syllabus:

Unit- I: Sensors & Transducer: Definition, Classification &selection of sensors, Measurement of displacement usingPotentiometer, LVDT & Optical Encoder, Measurement of force usingstrain gauge, Measurement of pressure using LVDT based diaphragm& piezoelectric sensor.	[07 Hours]
Unit-II: Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement ofposition using Hall effect sensors, Proximity sensors: Inductive &Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic& Capacitive.	[08 Hours]
Unit -III: Virtual Instrumentation: Graphical programmingtechniques, Data types, Advantage of Virtual Instrumentationtechniques, Concept of WHILE & FOR loops, Arrays, Clusters &graphs, Structures: Case, Sequence & Formula nodes, Need ofsoftware based instruments for industrial automation.	[07 Hours]
Unit-IV: Data Acquisition Methods: Basic block diagram, Analogand Digital IO, Counters, Timers, Types of ADC: successiveapproximation and sigma-delta, Types of DAC: Weighted Resistor andR-2R Ladder type, Use of Data Sockets for NetworkedCommunication.	[07 Hours]
Unit V: Intelligent Sensors: General Structure of smart sensors &its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensor: Automatic robot control & automobile engine control.	[07 Hours]
Text Books: 1. DVS Murty, Transducers and Instrumentation, PHI 2nd Edition2013 2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013. 3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & ProcessControl, 2nd ED / Instrument Society of America, 1994. 4. Gary Johnson / LabVIEW Graphical Programing II Edition /McGraw Hill 1997.	
Reference Books: 1. Arun K. Ghosh, Introduction to measurements andInstrumentation, PHI, 4th Edition 2012. 2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation& Measurement Techniques, PHI – [illegible] 3. Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition2012, Oxford University Press.	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Robotics and Intelligent System(Elective II)   Subject Code: BTECH_AI&DS-604.4T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite: Artificial Intelligence

Course Objective:

1	Study the concepts of Artificial Intelligence.
2	Learn the methods of solving problems using Artificial Intelligence.
3	Introduce the concepts of Expert Systems and Machine learning.

Course Outcome:

At the end the course the Student will be able to:

CO1	Identify problems that are amenable to solution by AI methods.
CO2	Identify appropriate AI methods to solve a given problem.
CO3	Formalize a given problem in the language/framework of different AI methods.
CO4	Summarize the learning methods adopted in AI
CO5	Design and perform an empirical evaluation of different algorithms on a problem formalization. 6. Illustrate the applications of AI in Robotic Applications.

Syllabus:

Unit 1: In oducti n History, s ate of t art. Need for AI in Robotics. Thinking and acting humanly, intelligen agents, s ructure of agents.	[07 Hours]
Unit 2: Pr blem S lving Solving roble by searching –Informed search and exploration–Constraint satisfacti pro ms– Adversarial search, knowledge and reasoning–knowledg repres ntation – first order logic	[07 Hours]
Unit3: Pla ning Planning ith for ard and backward State space search – Partial order planning – Plannin graph Planning with propositional logic – Planning and acting in real worl	[07 Hours]
Unit 4: R asoning Uncertain y – Pr babilistic reasoning–Filtering and prediction–Hidden Markov models–K lman filters– Dynamic Bayesian Networks, Speech recognition, making d cision Forms of learning – Knowledge in learning – Statistical learning ethod -reinforcement learning, communication, perceiving and acting, Pr babilis ic language processing, and perception.	[08 Hours]
Unit 5: I In Robotics (7 hrs) Robotic perception, localization, mapping-configur space, planning uncertain movements, dynamics and control of moveme Eth d risks of artificial intelligence in robotics.	[07 Hours]

Text Boo s:

1. Stuart Russ , Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Educatio India, 016.
2. Negn itsky, , "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: AddisonW sley, 02.

Referenc Book :

1. David Jeffer , "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishin Comp ny, 1992.
2. Robin urph Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 20 9. 3. ncis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
4. Huimi u, X   u, "Artificial Intelligence and Robotics", Springer, 2017.
5. Micha Bra   Gerhardt, Davidson, "Robotics and Artificial Intelligence", Springer, 2012.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Open Elective-I- Current Trends and Technologies Subject Code: BTECH_AI&DS-605.1T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objective

1	Gain fundamental knowledge of electronic communication.
2	Understand the technologies in Internet, eTechnologies & e-Learning
3	Learn the basics of Green Computing and its implementation in industries
4	Develop the understanding of concepts in Social Media

Course Outcome:

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

CO1	Use the basics of internet for deployment of various servers and recourses
CO2	Design and implement technologies for e-Commerce and e-Learning.
CO3	Choose appropriate implementation of Green Computing.
CO4	Make use of Social Networking properly and securely.

Syllabus:

UNIT I: Fundamentals of Communications: Types of communication- Wired, wireless, mobile, Modes of transmission: Simplex, Half Duplex, Full Duplex, Multiplexing techniques, History and evolution of wireless and mobile systems, Transition and characteristics of 1G, 2G, 3G, 4G, Spectrum, regulation and frequency allocation	[07 Hours]
UNIT II: Fundamentals of INTERNET: History, Internet working, Connections, Internet services, The World Wide Web, Tools for the WWW, Web servers, Web browsers, Web page makers and editors, Plug-ins and delivery vehicles	[07 Hours]
UNIT III: e-Technologies: Electronic Commerce: Framework, Media Convergence of Applications, Consumer, Applications, Organization Applications, Electronic Payment Systems: Digital Token, Smart Cards, Credit Cards, Risks in Electronic Payment System, Designing Electronic Payment Systems, Electronic Data Interchange (EDI): Concepts, Applications, (Legal, Security and Privacy) issues, EDI and Electronic Commerce, Standardization and EDI, EDI Software, Implementation, EDI Envelope for Message Transport, Internet-Based EDI	[07 Hours]
UNIT IV: Green Computing: Introduction, Why....Green Computing? Approaches to Green Computing: Virtualization, Power Management, Power supply, Storage, Video Card, Display, IT Equipment, Recycling, Remote Conferencing & Telecommuting Strategies, Product longevity, Resource allocation, Terminal servers, Operating system support, How to Implement? Industrial implementation of Green Computing- Blackle, Fit-PC, Zonbu computer, Sunray thin client	[08 Hours]
UNIT V: Social Networking: Definition, Overview of Social Networking Sites, Types of Social Networking Sites: General purpose, Niche, Advantages of Social Networking Sites, Drawbacks of Social Networking Sites, Features and Need of Social Networking, Security Issues with Social Networking Sites, Case Studies	[07 Hours]
Text Books: 1. Impact of E-Business Technologies on Public and Private Organizations, OzlemBak, Nola Stair 2. Mobile Computing, Tomasz Imielinski Henry F. Korth 3. Broadband Communications technology, Byeong Gi Lee, Minho Kang, Jonghee Lee	
References: 1. Introduction to Broadband communication systems, Cajetan M. Akujuobi, Matthew, N. O. Sadiku 2. E-Learning Tools and Technologies, William Hortan, Katherine Hortan Wiley	

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Open Elective-I- INDUSTRY 4.0 — Subject Code: BTECH_AI&DS-605T-2

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objective:

1	Able to learn an introduction to Industry 4.0 (or the Industrial Internet)
2	Will able to understand its applications in the business world.
3	Will able to understand Business Model and Reference Architecture in Industry
4	Will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

Course Outcome:

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

CO1	Students will be Understand the basics of IoT and basics of Industry 4.0.
CO2	Students will be Understand Business Model and Reference Architecture
CO3	Students will be able to understand the different Business issues in Industry 4.0 and how to solve them.
CO4	Students will be able to understand the need of Security and Fog Computing and applications of IioT.

Syllabus:

UNIT I: Introduction to Industry 4.0: History, Concept, The Journey so far: Developments in USA, Europe, China and other countries, The Fourth Revolution, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Globalization and Emerging Issues.	[07 Hours]
UNIT II: Basics of Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Life-cycle Management, Augmented Reality and Virtual Reality, Introduction to Artificial Intelligence, Big Data and Advanced Analysis, Cyber-Security in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems.	[07 Hours]
UNIT III: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.	[07 Hours]
UNIT IV: Security and Fog Computing: Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT, Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications)	[08 Hours]
UNIT V: Industrial IoT- Application domain: Milk Processing and Packaging Industries, Manufacturing Industries, Virtual Reality Lab, Steel Technology Lab, Facility Management, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Facility Management.	[07 Hours]

TEXTBOOKS:

1. Industry 4.0: The Industrial Internet of Things , Alasdair Gilchrist, Apress
2. Industrial Internet of Things: Cyber manufacturing Systems, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Springer

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FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Professional Skills-IV   Subject Code: BTECH_AI&DS-606P

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 hrs/Week (Practical)	1	25	25	50

Course Objectives:

The interactive experiments in this lab will give the students an opportunity for learning and better understanding of the basic concepts and constructs of Cyber security/ Block Chain/ Web and social media analytics as well as advanced methodology concepts

Expected experiments to be performed Based on Cyber security/ Block Chain/ Web and social media analytics.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: Intellectual Property Rights

Subject Code: BTECH_AI&DS-607T

Course Objectives:

1. To introduce fundamental aspects of Intellectual property Rights
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

Course Outcome: At the end of this course students will be able to

CO1.	Understand fundamental aspects of Intellectual property Rights
CO2.	Apply knowledge on patents, patent regime in India and abroad and registration aspects
CO3.	Be able of getting copyrights and its related rights and registration aspects
CO4.	Be able of getting trademarks and registration aspects
CO5.	Apply knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

Syllabus:

UNIT 1:

Overview of Intellectual Property:Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT 2:

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT 3:

Copyrights -Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT 4:

Trademarks - Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT 5:

Other forms of IP -

Design: Design meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI): Geographical indication meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection

Plant Variety Protection: Plant variety protection meaning and benefit sharing and farmers' rights – Procedure for registration, effect of registration and term of protection

Layout Design Protection Layout Design protection meaning – Procedure for registration, effect of registration and term of protection

Text books:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference books:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
2. resources:
3. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
4. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf

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SEMESTER: VI (C.B.C.S.)
BRANCH: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Subject: MiniProject/ Internship　　　　Subject Code: BTECH_AI&DS-608P

Load	Credits Th	College Assessment Marks	University Evaluation	Total Marks
2 Hrs.(Theory)	1	25	25	50