RASHTRASANT TUKDOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
SECOND YEAR BACHELOR OF ENGINEERING (B.TECH) DEGREE COURSE - SEMESTER IV (C.B.C.S)
BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : DISCRETE MATHEMATICS AND GRAPH THEORY
Subject Code: BTCSEAIML401T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Prerequisite(S): Applied Mathematics- I and II

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.

Course Outcomes:

CO1	apply graph theory models of data structures and state machines to solve problems of connectivity and constraint satisfaction.
CO 2	Gain an introduction into how mathematical models for engineering are designed, analyzed and implemented in industry and organizations
CO 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.
CO 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.

CO 5	Apply knowledge of mathematics, physics and modern computing tools to scientific and engineering problems. Apply their knowledge in life-long learning.

SYLLABUS

UNIT - 1

Set Theory, Relations and Functions

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

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

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

UNIT - 4

Graph Theory

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

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

TEXTBOOKS

T1	Discrete Mathematical Structures (PHI) by Kolman, Busby & Ross PHI.

T2	Discrete Mathematical Structures with Applications to Computer Science (TMH), Tremblay and Manohar.
T3	Fuzzy Sets Uncertainty and Information, George, J. Klir, Tina A. Folger.

REFERENCE BOOKS

R1	Discrete Mathematics for Computer Scientists & Mathematicians, J. Mott, A. Kandel, T. Baker.
R2	Discrete Mathematics, S. Lipschutz.
R3	Neural network and Fuzzy systems (PHI), Bart Kosko.

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BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : DATA STRUCTURES AND PROGRAM DESIGN
Subject Code: BTCSEAIML402T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3+1	4	30	70	100

Prerequisite(S): Computational Skills, Object Oriented Programming
Course Objectives:

1	To introduce a fundamental concept of data structures and to emphasize the importance of data structures in developing & implementing efficient algorithms.
2	To implement data structures algorithms by using C/C++ language
3	To select an appropriate data structure to solve real world problem and compare alternative implementations of data structures with respect to performance.
4	To acquire knowledge on Searching and Sorting Techniques

Course Outcomes:

CO1	Analyze the complexity of algorithms & sorting techniques
CO 2	Apply the concept of stacks & queues to solve real world problems.
CO 3	Describe and implement Linked List operations.
CO 4	Demonstrate different methods for traversing trees.
CO 5	Utilize the concepts of graphs to build solution. Design & implement searching techniques and hashing function.

SYLLABUS
UNIT - 1
Introduction to algorithm: General Concepts of Data Structures, Types of Data Structures with its properties and operations, Time and Space Analysis of Algorithms, Big Oh, theta and omega

notations, Average, Best and Worst Case Analysis. Sorting and Searching Techniques: Selection Sort, Insertion Sort, Heap Sort, Shell, Linear and Binary Search.

UNIT - 2

Stack & Queue: Representation of Stack & queue using array and linked list, , Application of stacks, Conversion from infix to post fix and pre-fix expressions, Evaluation of postfix expression using stacks, Multiple stacks, Circular queues and Priority Queues

UNIT - 3

List: Representation of ordered list using array and operation on it, Linked Lists, Simply linked list, Implementation of linked list using static and dynamic memory allocation, operations on linked list, polynomial representations using linked list, circular linked list, doubly linked list.

UNIT - 4

Trees: General and binary trees, Representations and traversals of tree, Threaded Binary Trees, Binary search trees, Applications, The concept of balancing and its advantages, B-Trees, B+ Trees, AVL Trees.

UNIT - 5

Graphs and digraphs: Representations of Graph, Matrix Representation of Graph, List Representation of Graph, Directed Graphs, Breadth and depth first searches, spanning trees. Hashing: hash tables, hash functions, Collision resolution, overflow handling, Applications

TEXTBOOKS

1. Classical Data Structure, D. Samanta, Prentice Hall of India
2. Data Structures using C, Aaron M. Tanenbaum, Pearson Education
3. Data Structures using C, Seymour Lipschutz, Tata McGraw Hill

REFERENCE BOOKS

1. Ellis Horowitz, Sartaj Sahani, Susan Anderson- Freed, Fundamentals of Data Structure in C, Second Edition, University Press.
2. An Introduction to Data Structures an Applications, Jean Paul Trembley, Paul G. Sorenson, Tata McGraw Hill Publication
3. Data Structures using C and C++, Y. Langman, Pearson Education
4. Algorithms in a Nutshell, George H & Garry, O'reilly publication
5. Data Structures & Algorithm using Python, Rance D. Necaise, John Wiley Publication

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BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : DATA STRUCTURES AND PROGRAM DESIGN LAB
Subject Code: BTCSEAIML402P

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
2	1	25	25	50

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

Practical List :-
Minimum 10 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

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BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : DATABASE MANAGEMENT SYSTEMS
Subject Code: BTCSEAIML403T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Prerequisite(S): NIL
Course Objectives:

1	To understand general idea of database management systems.
2	To develop skills to design databases using data modeling and design techniques.
3	To develop skills to implement real life applications which involve database handling.
4	Demonstrate an understanding of career opportunities in subject area of designing, storage techniques, data handling and managing techniques.

Course Outcomes:

CO1	Understand basic database concepts and data modeling techniques used in database design.
CO 2	Study the concept of functional dependency and Perform the calculus with Design database by using different normalization technique.
CO 3	Study query processing and Perform optimization on query processing.
CO 4	Understand the concept of transaction processing and different recovery technique used in RDBMS.
CO 5	Study and Implement advanced databases which are used real time system.

SYLLABUS

UNIT - 1

Introduction to database systems: Approaches to building a database, Three-tier architecture of a database, Challenges in building a DBMS, DBMS Architecture, Various components of a DBMS, Types of Data models

UNIT - 2

Relational Data Model: Concept of relations, Schema-instance distinction, Keys, referential integrity and foreign keys, Relational algebra operators, Tuple relation calculus, Domain relational calculus. Physical and logical hierarchy: Concept of index, B-trees, hash index, function index, bitmap index. Concepts of Functional dependency, Normalization (1NF, 2NF, 3NF, BCNF, etc).

UNIT - 3

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

UNIT - 4

Transaction: Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation.

UNIT - 5

Recovery System and advanced databases: failure classification, recovery and atomicity, log based recovery, checkpoints, buffer management, advanced recovery techniques. Introduction to Web databases, distributed databases, data warehousing and data mining, Data Security, NOSQL databases.

TEXT/Reference BOOKS

1. Database System Concepts by Avi Silberschatz , Henry F. Korth , S. Sudarshan, Tata McGraw
2. Hill, Fifth Edition 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
4. Database Management Systems - by Raghu Ramakrishnan and Johannes Gehrke, Tata McGraw Hill Publication, Third Edition.
5. Introduction to Database Management Systems by Kahate

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BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : DATABASE MANAGEMENT SYSTEMS LAB
Subject Code: BTCSEAIML403P

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
2	1	25	25	50

Minimum 10 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

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COURSE - SEMESTER IV (C.B.C.S)

BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : COMPUTER NETWORK
Subject Code: BTCSEAIML404T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3	3	30	70	100

Prerequisite(S): NIL
Course Objectives:

1	To study the banic taxonomy and teminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
2	To study the fundamentals and basics ofPhysical layer, and writ apply tbetn in real time applications.
3	To study data link layer concepts, design issues, and protocols.
4	To Gain core knowledge of Network layer routing protocols and IP addressing.
5	To study pro to-process communication and Congestion control mechanism.
6	To study about domain name. Application layer and network management.

Course Outcomes:

CO1	Describe the functions of each layer in OSI model along with basic networking concepts.
CO2	Explain physical layer functionality and its working along with transmission media with real time applications.
CO3	Describe the functions of data link layer and explain the protocols used in data link
CO4	Classify the routing protocols and analyze how to map IP addresses. Identify the issues related to transport layer. congestion control.
CO5	Describe Quality of Service, DNS, Application layer protocols & Network security issues.

Syllabus:

Unit I:

Introduction to Data Communication, Network, Protocols & standards and standards organizations, Data Flow (Simplex, Half Duplex and Full Duplex mode), Network Criteria, Type of Connection, physical Topology, Categories of Network (LAN, MAN, WAN , PAN), Study of OSI reference model and TCP/IP Model.

Unit II:

Physical Layer and Media: Analog and Digital Data, Analog and Digital Signals, TRANSMISSION MODES: Serial and Parallel transmission, Asynchronous and Synchronous, Multiplexing and Demultiplexing. COMMUNICATION MEDIA: Guided and Unguided Media.

Unit III:

Data Link Layer: Types of errors, framing (character and bit stuffing), Protocols: for noiseless channels(Simplex, stop and wait), for Noisy channels(Stop and Wait ARQ, Go back-N ARQ, Selective repeat ARQ), Point-to-Point (PPP) and protocols.

Unit IV:

Multiple Access Protocol: Random Access, Control Access and Channelization
Network Layer: IPv4 Addresses, IP addressing Methods with subnetting and supernetting, Routing Protocols: Distance Vector, Link State, Path Vector, OSPF.

Unit V:

Transport Layer: Duties of transport layer, Process-to-process delivery, Congestion control: Data Traffic, Congestion control Category (Open loop, closed loop).
Quality of Service: Introduction to QoS, Techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm. Application Layer: Domain Name System, Functions of Network management system Voice over IP, Firewall.

TEXT BOOKS:

1. B. A. Forouzan - "Data Communication and Networking(3rd Ed.)" - TMH
2. A.S. Tanenbaum- "Computer Network (4th Ed.)" -Pearson Education/PHI
3. W. Stallings - "Data and Computer Communications(8th Ed.)" - PHI/Pearson Education

REFERENCE BOOKS:

1. Kurose and Rose -"Computer Networking - A top down approach featuring the internet" - Pearson Education
2. Introduction to Data Communications and Networking by Wayne Tomasi-Pearson Edition
3. Comer - "Internetworking with TCP/IP, vol. 1,2,3(4th Ed.)" - Pearson Education/PHI.

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BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : THEORY OF COMPUTATION
Subject Code: BTCSEAIML405T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3+1	4	30	70	100

Prerequisite(S): NIL

Course Objectives:

1	To discuss the Chomsky classification of formal language with discussion on grammar and automata for regular, context-free, context sensitive and unrestricted language.
2	Understand the basic properties of Turing machines and computing with Turing machines.
3	To discuss the notion of decidability.
4	To compute Ackerman function and analyze recursively and non-recursively enumerable language

Course Outcomes:

CO1	Design finite automata and its minimization along with Moore and Mealy machines.
CO 2	Apply regular expression and create grammar for the same.
CO 3	Deal with context free grammar and various normal forms of CFGs.
CO 4	Create Push Down Automata for the given CFG and inter-conversion of the same.
CO 5	Create Turning Machine for the grammar and Deal with Recursive and Recursively Enumerable Languages.

SYLLABUS

UNIT - 1

Finite Automata (FA): Basic Terminology and Definitions, Chomsky hierarchy, Deterministic Finite Automata , language of a DFA. Nondeterministic Finite Automata, Equivalence of Deterministic and Non-deterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.

UNIT - 2

Regular Grammars (RG): Definition, regular grammars and FA, Conversion. Proving languages to be non-regular, Pumping lemma, applications, Closure properties of regular languages.Regular Expressions (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions, Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions.

UNIT - 3

Context Free Grammar (CFG): Definition, Parse Tress, Derivation Trees, Rightmost and Leftmost derivations of Strings and Conversions. Ambiguity in CFGs, Minimization of CFGs, Normal forms for CFG, Pumping Lemma for CFLs.

UNIT - 4

Push down Automata (PDA):Definition, Model, Non-determinism, acceptance by two methods and their equivalence, conversion of PDA to CFG, CFG to PDAs, closure and decision properties of CFLs.

UNIT - 5

Turing Machines (TM) : Formal definition and behavior, Languages of a TM, TM as acceptor, TM as transducers, Variations of TM, Linear Bounded Automata, TM as computer of function. Properties of recursive and recursively enumerable languages, Recursively enumerable set, Undesirability, Decidability and solvability, Post correspondence Problem, Primitive recursive functions, Ackerman function

TEXT BOOKS/ Reference Books

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory Languages and Computation, 3rd edition, Pearson Education.

2. Michael Sipser, Introduction to the Theory of Computation, 3rd edition, Cengage Learning

3. Peter Linz,An Introduction to Formal Languages and Automata, 5th Edition, Malloy, Inc

4. Vivek Kulkarni, Theory of Computation, Oxford University Press, ISBN-13: 978-0-19-808458-

5. Theory of Computation - O.G. Kakde ,University Science Press.

6. K. L. P Mishra, N. Chandrashekaran , Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

7. John C Martin, Introduction to languages and the Theory of Computation, TMH

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COURSE - SEMESTER IV (C.B.C.S)

BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject : ARTIFICIAL INTELLIGENCE
Subject Code: BTCSEAIML406T

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
3	4	30	70	100

Prerequisite(S): NIL
Course Objectives:

1	To understand basic concept and task domain in AI
2	To identify and learn search techniques for given problem statement to find out its solutions.
3	To know different learning techniques.

Course Outcomes:

CO1	Explain key components of artificial intelligence (AI) , describe production system and problem solving, Applying knowledge to formulate problem as a state space representation.
CO 2	Classify artificial intelligence search techniques, define, analyze search heuristics, explain knowledge representation, Problem Reduction, and Constraint satisfaction (BL:
CO 3	Explain representation of knowledge along with its issues, design First order logic, Predicate Logic, resolution, Semantic Nets, Frames, and Scripts.
CO 4	Describe uncertainty while solving problem statement, Explain Bayesian networks and Fuzzy Logic.
CO 5	Understand and list various learning methods & models in real world and Describe formal learning theory in artificial intelligence. (BL: 1, 2) Describe fundamental of Knowledge acquisition, Expert Systems, Automated Reasoning and understanding Natural language basics.

SYLLABUS
UNIT - 1

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 - 2

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

UNIT - 3

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 - 4

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 - 5

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

Expert Systems: Fundamental blocks, Knowledge Engineering, Knowledge Acquisition, Knowledge Based Systems, Automated Reasoning, Understanding Natural language.

TEXT /Reference BOOKS

1. E.Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, 2008.

2. Artificial intelligence and soft computing for beginners by Anandita Das Bhattachargee, Shroff Publishers

3. Artificial Intelligence – A Practical Approach : Patterson , Tata McGraw Hill, 3rd Edition

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

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SECOND YEAR BACHELOR OF ENGINEERING (B.TECH) DEGREE
COURSE - SEMESTER IV (C.B.C.S)

BRANCH - COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

Subject: Professional Skill Lab-II
Subject Code: BTCSEAI&ML407P

Load (Th+Tu)	Credits (Th+Tu)	College Assessment Marks	University Evaluation	Total Marks
2	1	25	25	50

Prerequisite(S): NIL
CourseObjectives:

1	To be able to understand microcontrollers
2	To understand the infrastructure of Raspberry Pi and Arduino
3	To understand data and information processing techniques.
4	To understand to Design a program to solve the problems.

Course Outcomes:

CO1	Raspberry Pi and Arduino hardware/software
CO2	Commands in Raspberry Pi and Arduino
CO3	Basic operations of handling data
CO4	Code to perform string and numeric operations on given user input

Practical List:
This is a sample list of Experiments, minimum 8 experiments are to be performed covering the entire syllabus. At least two experiments should be beyond syllabi based on learning of syllabi (Apply)

1. Study Rasberry Pi and its component
2. Study Arduino and its component
3. Learn how to install Rasberry Pi
4. Learn configuration settings of Rasberry Pi
5. Start Raspberry Pi and learn the basics of editor and Raspberry Pi infrastructure

6. Start Raspberry Pi and try various Linux commands in command terminal window , Such as: ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping etc.
7. Write a code to do LED blinking using Rasberry Pi .
8. Write a code in Java to do accessing of microcontrollers.
9. Write a code in Java to do accessing of microcontrollers.
10. Mini-Project