CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Kokapet(Village), Gandipet, Hyderabad, Telangana-500075. www.cbit.ac.in

ISO Certified 9001:2015

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 44 years

SCHEME OF INSTRUCTION AND SYLLABI

of

B.E. III to IV SEMESTERS

FOUR YEAR DEGREE COURSE

in

B.E. – INFORMATION TECHNOLOGY

(AICTE Model Curriculum with effect from AY 2023-24)

R-22 Regulation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Autonomous Institution under UGC), Affiliated to Osmania University,
Accredited by NBA and NAAC-UGC,
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

In line with AICTE Model Curriculum with effect from AY 2023-24

B.E. (INFORMATION TECHNOLOGY)

SEMESTER – III

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22ITC01	Digital Logic and Computer Architecture	3	-	-	3	40	60	3
2	22CSC05	Data Structures	3	-	-	3	40	60	3
3	22CSC32	Discrete Mathematics	3	-	-	3	40	60	3
4	22ITC02	Java Programming	3	-	-	3	40	60	3
5	22CSC15	Operating systems	3	-	-	3	40	60	3
6	22EGM01	Indian Constitution and Fundamental Principles	2	-	-	2	-	50	NC
PRACTICALS									
7	22CSC31	Data Structures Lab	-	-	2	3	50	50	1
8	22ITC03	Java Programming Lab	-	-	2	3	50	50	1
9	22ITC04	Operating Systems Lab	-	-	2	3	50	50	1
10	22ITC05	IT Workshop	-	-	2	3	50	-	1
11	22ITI01	MOOCs/Training/ Internship	2-3 Weeks / 90 Hours				50	-	2
TOTAL			17	0	8	-	450	500	21
Clock Hours per Week: 25									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

With effect from the AY 2023-24

22ITC01 DIGITAL LOGIC AND COMPUTER ARCHITECTURE

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1 Familiarize with logic gates, combinational and Sequential logic circuits.
2 Provide understanding of Digital Counters, registers and Data representation.
3 Present the operation of the Central Processing Unit.
4 Facilitate the techniques that computers use to communicate with input and output devices.
5 Introduce the concept of memory hierarchy and memory management.

Course Outcomes:

On Successful completion of this course, student will be able to:

1 Apply Boolean algebra for simplification and learn representation of data using numbers.
2 Understand fundamentals of combinational & sequential logic gates, registers and counters.
3 Infer the architecture and functionality of the central processing unit.
4 Explore the techniques that computers use to communicate with I/O devices for data transfer.
5 Comprehend memory hierarchy, cache memory and virtual memory.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	1	0	0	0	1	0	0	1	2	0	3
CO2	2	1	1	0	1	0	0	0	0	0	0	1	1	0	3
CO3	2	2	1	0	0	0	0	0	0	0	2	2	0	0	3
CO4	2	1	0	0	0	0	0	0	0	0	0	2	0	0	3
CO5	2	2	1	0	0	0	1	0	1	0	2	2	1	0	3

UNIT–I

Data Representation: Number Systems, Octal and Hexadecimal Numbers, Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers, Fixed–Point Representation, and Floating –Point Representation.

Digital Logic Circuits : Digital Computers, Logic Gates, Boolean Algebra, Map simplification, Product –of-sums Simplification, Don't –Care Conditions.

UNIT–II

Combinational Circuits: Decoders, Encoders, Multiplexers, Half-Adder, Full–Adders, **Flip-Flops:** SR, D, JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

Registers: Register with Parallel load, Bidirectional Shift Register with Parallel load, 4-bit Synchronous Binary Counter.

UNIT–III

Central Processing Unit: General register Organization, Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions, and Zero-Address Instructions. Addressing Modes: Data Transfer and Manipulation, Program Control, Multi core Processors and their Performance.3354

UNIT–IV

Input-Output Organization: Peripheral Devices: ASCII Alphanumeric Characters, Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, First-In- First-Out Buffer, Modes of Transfer: Interrupt-Initiated I/O, Priority Interrupt: Daisy Chaining, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access (DMA): DMA Controller.

UNIT–V

Memory Organization: Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, Solid State Drive, Associative Memory: Hardware Organization, Read and Write Operations, Cache Memory: Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table.

Text Book:

1. M.Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education. 2016.

Suggested Reading:

1 Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", 2nd Edition, McGraw Hill, 2009.

2 ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill, 1995.

3 William Stallings, "Computer Organization and Achitecture", 8th Edition,PHI.2010

4 Carl Hamachar, Vranesic, Zaky, "Computer Organization", 5th Edition, McGraw Hill.2002.

Web Resources:

1. https://nptel.ac.in/courses/117106114Week1%20Slides1.1Introduction.pdf
2. https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ ECE545_lecture1_digital_logic_review.ppt
3. http://www.nptelvideos.in/2012/11/computer-organization.html

22CSC05 **DATA STRUCTURES**

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisite: Basic knowledge of programming language such as python

Course Objectives:

1. Study various linear and non-linear data structures.
2. Understand the performance of operations on data structures.
3. Explore various searching and sorting techniques.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the basic concepts and types of data structures.
2. Analyze various linear and nonlinear data structures.
3. Identify the applications of stacks, queues, trees and graphs.
4. Identify the significance of balanced search trees, graphs and hashing.
5. Evaluate various searching and sorting techniques.
6. Use appropriate data structures to design efficient algorithms.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	1	2	3
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO6	3	3	1	-	-	-	-	-	-	-	-	-	-	2	-

UNIT-I

Introduction: Data structures, Classification of data structures, Abstract Data Types, Analysis of Algorithms

Recursion: Examples illustrating Recursion (Factorial, Binary Search), Analyzing Recursive Algorithms.

Sorting: Quick sort, Merge Sort, Selection Sort, Radix sort, Comparing Sorting Algorithms.

UNIT–II

Stacks: Stack ADT, Applications of stack, Array based stack implementation**.**

Queues: Queue ADT, applications of queues, Array based queue implementation, Double Ended Queues, Circular queues.

UNIT-III

Linked Lists: Introduction, Linked lists, Representation of linked list, types of linked list, singly linked lists, implementing stack with a singly linked list and Queue, Circular linked lists, doubly linked lists, Applications of linked lists.

UNIT-IV

Trees: General Trees, Binary Trees, Implementing Trees, Tree traversals.

Search Trees: Binary Search Trees, Balanced search trees- AVL trees, B- trees.

Priority queue and Heaps: Priority queue ADT, Priority queue applications, Heap trees, implementing a priority queue with a Heap, Heap Sort.

UNIT-V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals.

Hashing: Introduction, Hash Functions-Modulo, Middle of Square, Folding, Collision Resolution Techniques-Separate Chaining, Open addressing,- Linear Probing, Quadratic Probing, Double Hashing.

Text Books:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structure and Algorithms in Python", Wiley, 2021.
2. Narasimha karumanchi, "Data Structures and Algorithms Made Easy", Career Monk Publications, 2020
3. S. Sahni and Susan Anderson-Freed, "Fundamentals of Data structures in C", E. Horowitz, Universities Press, 2nd Edition.
4. ReemaThareja, "Data Structures using C", Oxford University Press.

Suggested Reading:

1. D. S. Kushwaha and A K. Misra, "Data structures A Programming Approach with C", PHI.
2. Seymour Lipschutz, "Data Structures with C", Schaums Outlines, Kindle Edition
3. Kenneth A. Lambert, " Fundamentals of Python: Data Structures", Cengage Learning, 2018
4. D. Samantha, "Classic Data Structures", Prentice Hall India, 2nd Edition, 2013

Web Resources:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-#DS
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

With effect from the AY 2023-24

22CSC32 **DISCRETE MATHEMATICS**

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. Introduce Propositional and Predicate Logic
2. Introduce various proof techniques for validation of arguments.
3. Develop an understanding of counting, functions and relations.
4. Familiarize with fundamental notions and applicability of graph theory and algebraic systems

Course Outcomes:

On Successful completion of this course, students will be able to:

1. Describe rules of inference for Propositional and Predicate logic.
2. Demonstrate use of Set Theory, Venn Diagrams, and relations in Real-world scenarios.
3. Model solutions using Generating Functions and Recurrence Relations.
4. Determine the properties of graphs and trees to solve problems arising in computer science applications.
5. Distinguish between groups, semi groups and monoids in algebraic systems

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	-	-	-	-	2	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	-	-	-	1	1	2	3
CO3	2	3	1	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	3	1	-	-	-	-	-	-	1	2	2	2
CO5	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction to Propositional Calculus: Basic Connectives and Truth tables, Logical Equivalence: Laws of Logic, Logical Implication; Rules of Inference. **Predicates**: The Use of Quantifiers, Quantifiers, Definitions and the Proofs of Theorems

UNIT-II

Sets: Sets and Subsets, Operations on sets and the Laws of Set Theory, Counting and Venn Diagrams. **Relations**: Cartesian Products and Relations. Partial ordering relations, POSET, Hasse diagrams, Lattices as Partially Ordered Sets, Equivalence relations. Pigeon hole principle.

UNIT-III

Generating Functions: Generating Functions, Calculating Coefficient of generating functions.
Recurrence Relations: The First Order Linear Recurrence Relation, Second Order Linear. Homogeneous Recurrence relations with constant coefficients, Non Homogeneous Recurrence relations.

UNIT-IV

Introduction to Graphs: Graphs and their basic properties- degree, path, cycle, Sub graphs, Complements and Graph Isomorphism, Euler trails and circuits, Hamiltonian paths and cycles, planar graphs, Euler formula, Graph Coloring.

Trees: Definitions, Properties,Spanning Trees, **Minimum Spanning trees**: The Algorithms of Kruskal and Prim

UNIT-V

Algebraic Structures: Algebraic Systems, Examples and General Properties, Semi groups and Monoids. **Groups**: Definitions and Examples, Subgroups, Homomorphisms and cyclic groups

Text books:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", An Applied Introduction, 5th edition, Pearson Education, 2016. (latest edition)
2. Rosen, K. H. (2019). Discrete Mathematics and Its Applications. (8th Edition) ISBN10: 125967651X ISBN13: 9781259676512(latest edition)
3. J. P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", TATA Mc Graw-Hill Edition, 1995.

Suggested Reading:

1. Singh, S.B., Discrete Mathematics, Khanna Book Publishing Company, New Delhi. SBN: 9789382609407, 9789382609407 Edition: 3, 2019 (latest edition)
2. R. K. Bisht, H. S. Dhami, "Discrete Mathematics", Oxford University Press, Published in 2015.
3. David D. Railey, Kenny A. Hunt, "Computational Thinking for the Modern Problem Solving", CRC Press, 2014
4. Joe L. Mott, Abraham Kandel, Theodore P. Baker, "Discrete Mathematics for Computer Scientists & Mathematicians", 8th Edition, PHI, 1986

Web Resources:

1. https://nptel.ac.in/courses/111107058/
2. https://nptel-discrete-mathematics-5217

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22ITC02 **JAVA PROGRAMMING**

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. Deliver the Object oriented programming features and principles for code development.
2. Explore the reusability of the code, coupling and cohesion.
3. Handle the exceptions and multiple flow of the execution.
4. Understand the collection framework.
5. Develop the database applications.

Course Outcomes:

On Successful completion of this course, students will be able to:

1. Apply the concept of OOP to design, implement and execute programs.
2. Use the strings, interfaces, packages and inner classes for application development.
3. Apply the exception handling mechanisms and multithreading for the development.
4. Develop applications using collection framework.
5. Develop database applications using SQL package.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO2	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO5	2	2	3	2	3	1	-	1	2	1	2	2	2	3	3

UNIT-I

Introduction to Java: Procedural and object-oriented programming paradigms, Principles, Features, Basic structure a java program, Java Primitive Data Types, Basic Operators, Flow-control statements. Defining Classes, Adding Instance Fields and Methods, Object Creation, Constructors, Access Modifiers, Method Overloading and Constructor Overloading, Use of static and final keyword, Arrays, Strings and String Tokenizer.

UNIT-II

Inheritances and Packages: Types of Inheritance, super keyword, preventing inheritance, the Object class, method overriding and dynamic method dispatch, abstract classes and methods. Interfaces, Interfaces vs. Abstract classes, Inner classes and types, Packages, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT-III

Exception Handling and Threading: What are exceptions, Error vs. Exception, usage of try, catch, throw, throws and finally clauses.Multithreading in Java, Life cycle of Thread, how to create threads, Thread class in java, Thread priorities, Thread Synchronization. Introduction to Generics.

UNIT-IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Collection classes – Array List, Linked List, Hash Set, Tree Set, Hash Map, Tree Map, legacy and class, Iteration over Collections – Iterator and List Iterator, Enumeration interfaces, differentiate Comparable and Comparator interface, Introduction to Java 8 Features.

UNIT-V

Servlets,JSP and Databases: Introduction to Servlets , Servlet Life cycle, Request and Response methods-Servlet Collaboration. Servlet Config vs. Servlet Context, JSP, Databases: Connecting to Database - JDBC, Drivers, Connection, Statement and its types, Result set, CRUD operations.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.
3. Bruce W.perry "Java Servlet and JSP Cookbook", O'reilly Media Inc., 2004.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, "An Introduction to Object-Oriented Programming with Java", TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy "Programming with Java", TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I— Fundamentals", 8th Edition, Prentice Hall, 2008.
5. K Somasundaram "Introduction to Java Programming" , Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects ", 11th Edition., 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

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22CSC15 **OPERATING SYSTEMS**

Instruction	3L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Computer Architecture and Programming Fundamentals.

Course Objectives:

1. Understand the basic concepts and design of an operating system.
2. Interpret the structure and organization of the file system
3. Learn Inter Process Communication mechanisms and memory management approaches.
4. Explore cloud infrastructures and technologies.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the basics of Operating systems and its major components.
2. Illustrate the concepts related to process management.
3. Distinguish various memory management techniques.
4. Apply concepts of process synchronization and deadlocks to a given situation.
5. Evaluate various file allocation methods and Apply security as well as recovery features in the design Operating system.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-	-	2	3
CO 2	3	3	-	3	1	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	2	1	1	-	-	-	-	-	-	-	1	1	3
CO 4	3	3	1	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	3	2	3	1	-	-	-	-	-	-	-	1	2	3

UNIT–I

Introduction to Operating Systems: Computer System overview, Components of a computer system, functions of OS, Examples, different types of OS (RTOS vs. desktop vs. mobile etc.), OS distributions and versions.

OS architectures: Micro-kernel, Layered, Kernel Approaches and examples.

UNIT–II

Process management: Program vs. process, process states, Process Control Block (PCB), OS services and system calls (fork, wait, exec, getpid, getppid etc.), system calls vs. System programs, Process scheduling- Process context switching, Scheduling algorithms, scheduling criteria.

Inter Process Communication: Linux IPC Mechanisms, RPC, RPC exception handling, Security issues.

UNIT–III

Memory Management: Memory view of a process, Process memory usage requirements, virtual and physical memory related system calls (mmap, munmap, sbrk, mprotect). Address translation mechanisms --- static

mapping, segmentation, paging, page faults, page replacement algorithms, page sharing, read/write permissions, swapping.

Secondary Memory Management: Disk structure, disk scheduling, disk management, buffering, swap space management, RAID levels.

UNIT–IV

Concurrency and Synchronization: Introduction to threads, benefits, types and thread APIs, Synchronization, issues, hardware and software solutions for synchronization, Classical problems of synchronization.

Deadlocks: Introduction, necessary conditions for deadlock occurrence, RAG, deadlock handling mechanisms - prevention, avoidance and recovery.

UNIT-V

File Systems: File concepts, file types, allocation and organization methods, file handling system calls, File system metadata, directory structure, caching optimizations File Systems case study.

OS Security: Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

Text Books:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. Maurice J. Bach, "Design of the UNIX Operating System", Pearson Education India; 1st Edition, 2015.
3. Ekta Walia Khanna ,"Operating System Concepts", Publishing House; 2nd Edition,2019.
4. Dhananjay Dhamdhare, "Operating Systems-A Concept Based Approach", 3rd Edition, McGraw Hill Education, 2017.

Suggested Reading:

1. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX® Environment" Pearson Education India; 3rd Edition, 2013.

Online Resources:

1. Remzi H. Arpaci-Dusseau and Andrea C. , "Three Easy Pieces", Arpaci-Dusseau Arpaci-Dusseau Books, LLC https://pages.cs.wisc.edu/~remzi/OSTEP/ (online version)
2. Frans Kaashoek, Robert Morris, and Russ Cox, Xv6, a simple Unix-like teaching operating system [T4-R] https://github.com/mit-pdos/xv6-riscv (RISC-V version) [T4-X] https://github.com/mit-pdos/xv6-public (x86 version)

22EGM01 INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(BE/BTech - Common to all branches)

Instruction	2 Hours per week
Duration of End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	-
Credits	No Credits

Course Objectives

1. Understand the history of framing of the Indian Constitution.
2. Aware of Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of the Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

Course Outcomes

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

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to the federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	1	1	1	-	-	-	1	-	-
CO2	-	-	2	-	-	3	2	2	1	-	-	-	1	1	-
CO3	-	-	1	-	-	1	1	-	-	-	-	-		-	3
CO4	-	-	1	-	-	1	1	-	-	-	-	-	1	-	-
CO5	-	-	2	-	-	3	2	1	1	-	-	-	1	-	2

UNIT-I

Constitutional History and Framing of Indian Constitution

East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

UNIT-II

Fundamental Rights, Duties and Directive Principles of State Policy

The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

UNIT-III

Union Government and its Administration

Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

UNIT-IV

Union Legislature and Judiciary

Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

UNIT-V

Local Self Governments

Rural Local Governments: ZillaParishad- CEO and functions of ZillaParishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

Text Books:

1. **Indian Government & Politics**, Ed Prof V RavindraSastry, Telugu Akademy, 2nd edition, 2018.
2. **Indian Constitution at Work,** NCERT, First edition 2006, Reprinted in 2022.

Suggested Reading:

1. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. Granville Austin, The Indian Constitution: the Cornerstone of a Nation, OUP, 2nd Edition 1999
4. M.V. Pylee, India's Constitution, S. Chand Publishing, 16th Edition, 2017
5. Rajeev Bhargava (ed), Politics and Ethics of the Indian Constitution, OUP, 2008

Web Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

With effect from the AY 2023-24

22CSC31 **DATA STRUCTURES LAB**

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Pre-requisites: Any Programming Language

Course Objectives:

1. Understand the basic concepts of data structures and abstract data types.
2. Explore linear and non-linear data structures.
3. Study various searching, sorting and hashing techniques.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Implement the abstract data type.
2. Implement linear data structures such as stacks, queues using array and linked list.
3. Implement non-linear data structures such as trees, graphs.
4. Evaluate various sorting techniques.
5. Analyze various algorithms of linear and nonlinear data structures.
6. Choose or create appropriate data structures to solve real world problems.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	2	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	1	1	2
CO5	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	2	3	1	-	-	-	-	-	-	-	-	-	-	-	-

LIST OF EXPERIMENTS

1. Implementation of Quick Sort, Merge Sort, Selection Sort.
2. Implementing stack using array.
3. Conversion of Infix Expression to Postfix expression.
4. Implement the algorithm for Evaluation of Postfix.
5. Implementing Queue using array
6. Implementation of Insert, Delete and display operations on Single Linked List.
7. Implementation of Stack and Queue using linked list.
8. Implementation of Insert, Delete and display operations on doubly Linked List.
9. Implementation of Binary Search Tree operations.
10. Implementation of Heap Sort

Text Books:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020

With effect from the AY 2023-24

22ITC03 **JAVA PROGRAMMING LAB**

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Deliver the basic principles of OOP.
2. Explore the object-orientation process in creating classes, object, etc.,
3. Demonstrate the inheritances and polymorphism.
4. Handle the exceptions in runtime and multithreading.
5. Develop the database applications.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Practice the basics of OOPs to develop java applications.
2. Use the inheritance and interfaces for application development.
3. Apply the exception handling and multithreading to handle multiple flows of execution.
4. Develop applications using collection framework.
5. Apply the SQL concepts for application development.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO2	3	3	3	2	2	1	-	1	2	2	2	3	2	2	2
CO3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO5	3	3	3	2	3	1	-	1	2	2	2	3	2	3	3

LIST OF EXPERIMENTS

1. Implement the program(s) to handle the various data types, operators, expressions, control-flow, and strings.
2. Develop a java program(s) for dynamic method dispatch and constructor.
3. Develop a java program(s) to deal with different types of inheritances and interfaces.
4. Implement the program(s) to demonstrate the packages.
5. Develop a java program(s) to handle user defined exceptions with multiple catch blocks.
6. Implement program(s) to demonstrate Multithreading and thread synchronization.
7. Implement the collection framework classes with Iterator/ListIterator/Enum Interface.
8. Develop a java program(s) to implement the features of JDK8.
9. Implement a java program(s) to implement the concept of Servlets and JSP.
10. Create a web application to implement CRUD operations using Servlets, JSP and Databases.

Text Books:

1. Herbert Schildt, “Java: The Complete Reference”, 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram “Advanced Programming in Java2” Jaico Publishing House, 2008.
3. Bruce W.perry “Java Servlet and JSP Cookbook”, O’reilly Media Inc., 2004.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, “Programming in Java”, Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, “An Introduction to Object-Oriented Programming with Java”, TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy “Programming with Java”, TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, ”Core Java, Volume I— Fundamentals”, 8th Edition, Prentice Hall, 2008.
5. K Somasundaram “Introduction to Java Programming” , Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel “Java How to Program, Early Objects ”, 11th Edition., 2018.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

With effect from the AY 2023-24

22ITC04 **OPERATING SYSTEMS LAB**

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Familiarize with Unix commands and the command-line interface.
2. Understand shell scripting and its applications in automating tasks and managing system resources
3. Understand Process Creation and Inter-Process Communication using system calls.
4. Learn Process synchronization mechanisms and scheduling algorithms.
5. Learn various Page Replacement, deadlock detection, and Avoidance algorithms.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Use the command-line interface and basic Unix commands.
2. Develop shell scripts for simple tasks.
3. Demonstrate inter-process communication (IPC) using Pipes, Shared Memory, and Message queues.
4. Compare the performance of various CPU Scheduling Algorithms and demonstrate Process Synchronization using semaphores.
5. Analyze the performance of the various Page Replacement, Deadlock detection, and avoidance algorithms.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	0	0	0	1	0	0	0	3	0	1
CO2	2	1	1	1	2	0	0	0	0	0	0	0	3	1	1
CO3	2	2	1	2	3	0	0	0	1	0	0	0	1	0	0
CO4	2	3	2	2	3	0	0	0	1	0	0	0	1	0	2
CO5	3	3	0	1	3	1	0	0	1	0	0	0	1	0	2

LIST OF EXPERIMENTS

1. Exploring the Unix commands for
   a) **Files** (ls, cd, mkdir, rmdir, cp, mv, rm, cat, cmp, diff, wc, chmod, chown, compress, uncompress, more, less, head, tail, cut, paste)
   b) **Process** (ps, kill, top, nice, fork system call)
   c) **Networking** (ping, ifconfig, netstat, route, ssh, scp, ping)

2. Developing shell scripts for the following.
   a) System resources Monitoring b) User accounts Creation

3. Demonstration of the following IPC mechanisms.
   a) Pipes b) Shared Memory c) Message Passing.

4. Implementation of the following CPU Scheduling Algorithm:
   a) FCFS b) SJF c) SRTF d) Round Robin

5. Implementation of the solution for Producer-Consumer Problem.

6. Implementation of the solution for Dining Philosophers Problem.

7. Implementation of the solution for Reader-Writers Problem.

8. Implementation of Banker's algorithm for Deadlock Avoidance.

9. Implementation of Deadlock Detection algorithm using Resource Allocation Graph.

10. Implementation of the following Page Replacement Algorithms.
    a) FIFO b) LRU c) OPTIMAL

Text Books:

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons publications, 2018.
2. Sumitabha Das, "UNIX: Concepts and Applications" Tata McGraw Hill Education (India) Private Limited; 4th edition, 2017.
3. W. Richard. Stevens (2005), Advanced Programming in the UNIX Environment, 3rd edition, Pearson Education, New Delhi, India.

Suggested Reading:

1. William Stallings, "Operating Systems", Fifth Edition, Pearson Education, 2005.
2. A.Tanenbaum, "Modern Operating Systems", 4th Edition, Pearson Education, 2015.
3. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg, Thomson Asia, 2005.

Web Resources:

1. https://www.cse.iitb.ac.in/~mythili/os/
2. https://profile.iiita.ac.in/bibhas.ghoshal/teaching_os_lab.html

22ITC05 **IT WORKSHOP**

Instruction	2 Hours per week
Semester End Examination	-
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Introduce the basic components of a computer, assembling and disassembling a PC. Installation procedure of Operating Systems.
2. Facilitate knowledge on Internet Services, awareness of cyber hygiene, protecting the personal computer.
3. Impart knowledge on Latex and Ms -word.
4. Provide knowledge on how to create interactive presentations using PowerPoint.
5. Familiarize with the concepts of Ms-Excel.

Course Outcomes:

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

1. Identify the basic components of a computer, gain knowledge on assembling and disassembling a PC and OS installations.
2. Inspect internet connectivity issues, secure a computer from cyber threats.
3. Make use of Latex and Ms-word for creating effective documents.
4. Create effective presentations using Ms-PowerPoint.
5. Create, Organize and analyze data within an Excel spreadsheet.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	2	1	-	-	1	1	2	3	3	2
CO2	2	1	2	1	1	2	1	-	1	1	1	2	3	3	2
CO3	2	2	2	1	1	2	1	3	3	1	1	2	2	3	3
CO4	2	2	2	2	3	-	1	-	-	3	2	2	1	-	3
CO5	2	2	2	2	3	-	1	-	3	3	2	2	1	-	3

LIST OF EXPERIMENTS

PC HARDWARE:

Task 1: Identification of the peripherals of a computer, block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices , Introduction to Memory and Storage Devices , I/O Port, Device Drivers.

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

INTERNET & WORLD WIDE WEB:

Task1 : Web Browser usage and advanced settings like LAN, proxy, content, privacy, security, cookies, extensions/plugins, Antivirus installation, configuring a firewall, blocking pop-ups, Google search techniques (text based, voice based), alexa website traffic statistics, Email creation and usage, google hangout/skype/gotomeeting video conferencing, archive.org for accessing archived resources on the web, Creating a Digital Profile on LinkedIn, Twitter, Github.

Task2 :Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of LaTeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of LaTeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using LaTeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2:Using LaTeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both LaTeX and Word.

Task 3:Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic PowerPoint presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1:Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2 :Calculating GPA - .Features to be covered:- Cell Referencing, Formulae in excel – average, standard deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

Text Books:

1. Peter Norton,Introduction to Computers, McGraw Hill Education, 7th edition,2017
2. Comdex Information Technology course tool kit Vikas Gupta, WILEY Dreamtech
3. The Complete Computer upgrade and repair book, 3rd edition Cheryl A Schmidt, WILEY Dreamtech

Suggested Reading:

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. PC Hardware - A Handbook – Kate J. Chase PHI (Microsoft)
3. LaTeX Companion – Leslie Lamport, PHI/Pearson.
4. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
5. IT Essentials PC Hardware and Software Labs and Study Guide Third Edition by Patrick Regan – CISCO Press, Pearson Education.

Web Resources:

1. https://www.overleaf.com/learn

22ITI01 **MOOCs/Training/Internship**

Instruction/Demonstration/Training	2-3 Weeks/90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	–
Mid Term Evaluation	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences

MOOCs/Training/Internship Objectives:
This MOOCs/Training/Internship aims to:

1.
2.
3.

MOOCs/Training/Internship Outcomes:
Upon completion of this MOOCs/Training/Internship, students will be able to:

1.
2.
3.
4.
5.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

In line with AICTE Model Curriculum with effect from AY 2023-24

B.E. (INFORMATION TECHNOLOGY)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC15	Probability and Queuing Theory	3	1	-	3	40	60	4
2	22ECC40	DC Circuits, Sensors and Transducers	3	-	-	3	40	60	3
3	22CSC11	Database Management Systems	3	-	-	3	40	60	3
4	22CSC14	Design and Analysis of Algorithms	3	-	-	3	40	60	3
5		Professional Elective – I	3	-	-	3	40	60	3
6	22MBC01	Engineering Economics & Accountancy	3	-	-	3	40	60	3
7	22CEM01	Environmental Science	2	-	-	2	-	50	NC
PRACTICALS									
8	22CSC33	Database Management Systems Lab	-	-	2	3	50	50	1
9	22ITC06	Design and Analysis of Algorithms Lab	-	-	2	3	50	50	1
10	22ITC07	Mini Project – I	-	-	2	3	50	-	1
TOTAL			**20**	**1**	**6**	**-**	**390**	**510**	**22**
Clock Hours per Week: 27									

L: Lecture **D: Drawing** **CIE: Continuous Internal Evaluation**

T: Tutorial **P: Practical/Project Seminar/Dissertation** **SEE: Semester End Examination**

Professional Elective-1		
S.No.	**Course Code**	**Course Name**
1.	22ITE01	Data Mining
2.	22ITE02	Digital Image Processing
3.	22ITE03	Fundamentals of Cryptography
4.	22ITE04	Mobile Application Development
5.	22ADE01	Data Analysis and Visualization

With effect from the AY 2023-24

22MTC15 PROBABILITY AND QUEUEING THEORY

Instruction	3L-1T- Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	4

Course Objectives:

1. Able to learn and Analyzing data in Linear and Non-Linear form.
2. Able to fit the random data using statistical averages.
3. Able to interpret the continuous probability function .
4. Understand the data using the testing of Hypothesis.
5. Able to learn the Queuing models.

Course Outcomes:

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

1. Apply the principle of Least Squares approximating for estimating the value.
2. Analyzing the Random data using Statistical averages.
3. Analyze the Random phenomenon using probability distributions.
4. Distinguishing the data using different methods of hypothesis testing.
5. Analyze the Queue model for the probabilistic nature.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	1	1	1	2
CO3	2	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO4	2	2	1	1	-	-	-	-	-	-	-	1	-	-	-
CO5	2	2	1	1	-	-	-	-	-	-	-	1	1	1	2

UNIT-I: Curve Fitting

Measures of Central Tendency, Measures of Dispersion, Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, coefficient of correlation, limits of correlation coefficient. Linear Regression, Regression coefficients, Properties of Regression Coefficients. Curve fitting by the Method of Least Squares, Fitting of Straight lines, Second degree parabola and Growth curve

($y = ae^{bx}$, $y = ax^{b} and y = ab^{x}$).

UNIT-II: Random variables

Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, properties of variance and co-variance. Moments (Moments about the mean and moments about a point).

UNIT-III: Probability Distributions

Poisson distribution, Mean and variance, MGF and Cumulates(without proof)of the Poisson distribution, Recurrence formula for the probabilities of Poisson distribution, Fitting of Poisson distribution, Normal distribution, Characteristics of normal distribution and Normal probability Curve, MGF and CGF of Normal distribution, Mean and variance ,Areas under normal curve. Exponential distribution, MGF, CGF, Mean and variance.

UNIT-IV: Tests of Hypothesis

Parameter and Statistic, Tests of significance, tests of significance for large samples. Tests of significance for single proportion, and difference of proportions. Tests of significance for single mean and difference of means. Small sample test, t-test for single mean and differences of Means. F-test for equality of two population variances. Chi-Square test of goodness of fit and test of independent of attributes, ANOVA (One way classification).

UNIT-V: Queueing Theory

Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem- Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models- Measures of the (M/M/1):($\infty/FIFO$) $model$-Characteristic of Finite Capacity,Single Server Poisson Queue Model III (M/M/1):($N/FCFS$) Model.

Text Books:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. T Veerarajan, Probability, Statistics and Random Processes, 2nd Edition, Tata McGraw-Hill.

Suggested Reading:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.

22ECC40 DC CIRCUITS, SENSORS AND TRANSDUCERS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisite: Concepts of Semiconductor Physics and Applied Physics.

Course Objectives:

1. Describe semiconductor device's principles and understand the characteristics of junction diode and transistors.
2. Understand working principles of Sensors, and Transducers.
3. Understand Interfacing of various modules of sensors with myRIO.

Course Outcomes:

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

1. Develop devices like rectifiers, filters, regulators, etc.
2. Develop the robot using the relevant sensors
3. Evaluate the performance of actuators in practical applications
4. Acquire the data from various sensors and transducers with the help of myRIO
5. Analyze usage of sensors/transducer for the development of real-time applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	3	2	3	2	3	2	-	-	-
CO2	3	3	3	2	1	2	3	2	3	2	3	2	-	-	-
CO3	3	2	3	2	3	3	3	2	3	2	3	2	-	-	-
CO4	3	3	3	3	3	3	3	2	3	2	3	2	-	2	2
CO5	3	3	3	3	3	3	3	2	3	2	3	2	-	2	2

UNIT- I

Devices: Concepts of semiconductors, V-I Characteristics of P-N Junction diode, current equation. Characteristics of Zener Diodes, Special diodes: LED, Photo Diode

Applications: Zener Diode as a voltage regulator, Half Wave Rectifier and Full Wave Rectifier

UNIT- II

Sensors: Definition, classification of sensors

Proximity Sensors: Principle, Inductive and Capacitive proximity sensors and its Applications

Velocity, motion, force sensors: Tachogenerator, Optical encoders, Strain Gauge as force Sensor, Fluid pressure: Tactile sensors, **Flow Sensors:**Ultrasonic and laser, **Level Sensors:** Ultrasonic and Capacitive

Temperature and light sensors: Resistance Temperature detectors, Photo Diodes, Applications of Photo **Diodes.**

UNIT- III

Transducers: Definition, classification of Transducers

Mechanical Transducers: Displacement-to-Pressure, Seismic Displacement Transducers Passive Electrical Transducers: LVDT, Resistor Moisture Transducer

Active Electrical Transducers: Hall Effect Transducer, Piezoelectric transducer

UNIT- IV

Actuators: Introduction, Types of actuators in IOT, Real life examples of actuators in IOT

ROBOT Sensors: sensors in robot – Touch sensors; **Camera Systems in Machine :** Camera Technology, History in Brief, Machine Vision versus closed Circuit Television (CCTV).

Collision Avoidance sensors: Principle, Laser, LED.

UNIT-V

Hardware/software platforms: Introduction to LabVIEW, Data Acquisition System: hardware Overview of my RIO, Converting Raw Data Values to a Voltage.

Sensors Interfacing with my RIO: Introduction, Pin configuration, diagrams of thermistor, photo cell, hall effect, IR Range Finder, Bluetooth, Temperature Sensors.

Text Books:

1. Robert L.Boylestad, Louis Nashelsky, "Electronic Devices and Circuits Theory", Pearson Education, 9th edition, LPE, Reprinted, 2006.
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. Roland Siegwart&Illah R. Nourbakhsh, "Introduction to autonomous mobile robots", Prentice Hall of India, 2004
4. Ed Doering, NI myRIO Project Essentials Guide, Feb.2016

Suggested Reading:

1. Anindya Nag, Subhas Chandra Mukhopadhyay, JurgenKosel ,Printed Flexible Sensors: Fabrication, Characterization and Implementation, Springer International Publishing, Year: 2019, ISBN: 978-3-030-13764-9,978-3-030-13765-6
2. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
3. User guide and specifications NI myRIO-1900.

With effect from the AY 2023-24

22CSC11 DATABASE MANAGEMENT SYSTEMS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Discrete mathematics of computer science, Programming and Data Structures.

Course Objectives:

1. Familiarize students with fundamental concepts of database management. These concepts include aspects of database design, database languages and database-system implementation.
2. Understand about data storage techniques and indexing.
3. Impart knowledge in transaction management, concurrency control techniques and recovery procedures.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Design database schema for an application using RDBMS concepts.
2. Write SQL queries for tasks of various complexities.
3. Build applications using database system as backend.
4. Understand internal working of a DBMS including data storage, indexing, query processing, transaction processing, concurrency control and recovery mechanisms.
5. Analyze non-relational and parallel/distributed data management systems with a focus on scalability.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	-	-	-	-	-	-	1	1	1	2
CO2	2	3	2	2	3	-	-	-	-	-	-	1	2	2	2
CO3	2	1	2	1	3	-	-	-	-	-	-	-	-	-	-
CO4	2	1	1	-	-	-	-	-	-	-	-	-	1	-	2
CO5	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction: Motivation, Introduction to Data Models (Relational, Semi structured, ER).
Relational Data Bases: Relational Data Model, Relational Algebra, Relational Calculus.

UNIT-II

SQL + Interaction with Database: SQL Data Types, Basic Structure of SQL Queries, Modification of the Database, Set Operations, Aggregate Functions, Data-Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Index Definition in SQL.
Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Subqueries, Views) . Programming in a standard language and interfacing with a DB backend.

UNIT-III

Big Data : Key-value Stores and Semi structured Data, using JSON and MongoDB, or other combinations
Database Design : Introduction to ER model, Mapping from ER to relational model, Functional Dependencies, Normalization.

UNIT-IV

Physical Design: Overview of Physical Storage (Hard Disks, Flash/SSD/RAM), sequential vs random I/O, Reliability via RAID, Storage Organization (Records, Pages and Files), Database Buffers, Database Metadata, Indexing, B+-Trees.

UNIT-V

Query Processing and Optimization: Query Processing, External sort, Joins using nested loops, indexed nested loops.

Overview of Query Optimization: Equivalent expressions, and concept of cost based optimization.

Transaction Processing: Concept of transactions and schedules, ACID properties, Conflict-serializability, **Concurrency control:** locks, 2PL, Strict 2PL, optional: isolation levels, Recovery using undo and redo logs.

Text Books:

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill. Indian Edition released 2021
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Pubs, 2017
3. Lemahieu, Broucke and Baesens, "Principles of Database Management", Cambridge University Press, 2018
4. RP Mahapatra, "Database Management Systems", Khanna Publishing House, 2020.
5. Krishnan, "Database Management Systems", McGraw Hill.

Suggested Reading:

1. MySQL Explained: Your Step By Step Guide to Database Design, Andrew Comeau,23-NOV-2015
2. Pro SQL Server 2008 Relational Database Design and Implementation (Expert's Voice in SQL Server) 1st Edition

Web Resources:

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html.
2. https://www.oracle.com/news/connect/json-database-semistructured-sql.html

22CSC14 DESIGN AND ANALYSIS OF ALGORITHMS

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Basics of Data structures and algorithms.

Course Objectives:

1. Provide an introduction to formalisms to understand, analyze and denote time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.
3. Provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Analyze performance of algorithms using asymptotic notations.
2. Demonstrate familiarity with major algorithms and importance of algorithm design techniques.
3. Apply algorithm design techniques of different problems.
4. Analyze the efficiency of the algorithms
5. Understand limits of efficient computation with help of complexity classes.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	-	-	1	1	2
CO2	3	3	2	-	1	-	-	-	1	-	1	1	-	-	2
CO3	3	2	2	2	2	-	-	-	1	-	1	-	1	-	2
CO4	3	3	2	2	2	-	1	-	1	-	-	-	-	-	-
CO5	3	2	2	2	2	1	1	-	1	-	-	-	1	1	2

UNIT-I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds–best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method. **Analysis of recursive algorithms through recurrence relations**: Substitution method, Recursion tree method and Masters‟ theorem, Randomized Quicksort.

UNIT-II

Greedy Algorithms: The general method, Knapsack Problem, Huffman Codes, Job scheduling with deadlines. **Dynamic Programming:** The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix chain multiplication, Longest Common subsequence, Optimal Binary search tree.

UNIT-III

Backtracking: The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound:** The general method, FIFO branch and bound, LC branch and bound, 0/1 Knapsack Problem, Travelling Salesperson problem

UNIT-IV

Graph Algorithms: Applications of DFS: Bi-Connected components, strongly connected components, topological sorting. **Shortest Path Algorithms:** Dijkstra‟s, Bellman-Ford, Floyd-Warshall and Johnson‟s algorithms**. Minimum Spanning Tree Algorithms:** Prim‟s and Kruskal‟s.

UNIT-V

Theory of NP-Completeness: Polynomial time, Polynomial time verification, P, NP, NP-hard and NP-Complete classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, vertex-cover and Subset Sum Problem.

Text Books:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, MIT Press/McGraw-Hill, 3rd Edition, 2009.
2. E. Horowitz, sartajsahni and sanguthevarRajasekaran, “Fundamentals of Computer Algorithms”, Universities Press, 2008.

Suggested Reading:

1. Michael T Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis”, and Internet Examples, Wiley Second Edition.

Web Resources:

1 https://nptel.ac.in/courses/106101060/

22MBC01 ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1 Demonstrate the importance of Managerial Economics in Decision Making.
2 Explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3 Understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Apply fundamental knowledge of Managerial Economics Concepts and Tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make the best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	3	1	1	1	1	1	1	1	-	-	1	2	3
CO 2	2	2	2	2	-	1	1	1	-	1	-	1	1	1	2
CO 3	1	2	1	2	2	-	2	1	-	1	-	-	-	-	-
CO 4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	-
CO 5	1	3	1	2	1	1	2	-	-	1	2	1	-	-	-

UNIT-I

Introduction to Managerial Economics: Introduction to Economics and Its Evolution - Managerial Economics - Its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic Concepts of Managerial Economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equi-Marginal Principle, Contribution, Negotiation Principle.

UNIT-II

Demand and Supply Analysis:Demand Analysis - Concept of Demand, Determinants, Law of Demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple Numerical Problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III

Production and Cost Analysis:Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input - Output Relations; Laws of Returns. Cost Analysis: Cost Concepts – Types of Costs, Cost - Output Relationship – Short Run and Long Run; Market Structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition. Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger Accounts, Trial Balance Concept and preparation of Final Accounts with Simple Adjustments.

UNIT-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and Sources of raising Finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical Problems.

Text Books:

1. Mehta P.L.,"Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

Suggested Readings:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018.

22CEM01 **ENVIRONMENTAL SCIENCE**

Instruction	2 Hours per week
Duration of End Examination	2 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	-
Credits	No Credits

Course Objectives:

1. To figure out a more sustainable way of living.
2. Understanding the behaviour exhibited by organisms under some natural conditions.
3. Educating and making people aware of different environmental issues and problems.
4. Using natural resources in an effective manner without actually causing any harm to the environment.
5. Exposing students to how science and the scientific method address environment systems and issues.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Identify the natural resources and realize the importance of water, food, forest, mineral, energy, land resources and effects of over utilization.
2. Understand the concept of ecosystems and realize the importance of interlinking food chains.
3. Contribute to the conservation of bio-diversity.
4. Suggest suitable remedial measures for the problems of environmental pollution and contribute for the framing of legislation for protection of the environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	3	-	-	-	-	1	1	1	-
CO2	1	-	-	-	-	-	2	1	-	-	-	1	-	-	
CO3	1	-	-	-	-	-	2	1	-	-	-	1	-	-	-
CO4	1	-	-	-	-	1	2	1	-	-	-	1	-	-	-
CO5	1	-	-	-	-	1	2	1	-	-	-	1	2	3	-

UNIT-I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT–III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT–IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT–V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006

22CSC33 DATABASE MANAGEMENT SYSTEMS LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Become familiar with the concepts of structured query language.
2. Understand about programming language / structured query language (PL/SQL).
3. Become familiar with generation of form and open database connectivity.
4. Add constraints on Databases implement DCL, TCL and advanced SQL commands.
5. Develop programs using cursors, triggers, exceptions, procedures and functions in PL/SQL.

Course Outcomes:

On Successful completion of the course, students will be able to

1. Outline the built-in functions of SQL and apply these functions to write simple and complex queries using SQL operators.
2. Demonstrate Queries to Retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, Save point commands, SQL Plus Reports and formulate the Queries for Creating, Dropping and Altering Tables, Views, constraints.
4. Develop queries using Joins, Sub-Queries and Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update, Creating Password and Security features.
5. Demonstrate the usage of data types , Bind and Substitution Variables , Anchored, Declarations, Assignment Operation and PL/SQL code using Control Structures .
6. Develop PL/SQL code using Cursors, Exception, Composite Data Types and Procedures, Functions and Packages.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	-	-	2	-	1	3	2	2	2
CO2	3	3	2	3	3	-	-	-	2	-	1	3	1	2	3
CO3	3	2	2	2	3	-	-	-	2	-	1	1	-	-	-
CO4	3	1	1	1	-	-	-	-	2	-	1	-	-	-	-
CO5	3	1	1	1	-	-	-	-	2	-	1	-	1	1	2
CO6	3	1	-	1	-	-	-	-	1	-	1	-	-	-	-

LIST OF EXPERIMENTS

SQL:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using operators in SQL.
3. Queries to Retrieve and Change Data: Select, Insert, Delete and Update.
4. Queries using Group By, Order By and Having Clauses.
5. Queries on Controlling Data: Commit, Rollback and Save point.
6. Queries to Build Report in SQL *PLUS.
7. Queries for Creating, Dropping and Altering Tables, Views and Constraints.

8. Queries on Joins and Correlated Sub-Queries.
9. Queries on Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update,
10. Creating Password and Security features.
11. Querying in NoSql

PL/SQL:

1. Write a PL/SQL code using Basic Variable, Anchored Declarations and Usage of Assignment Operation.
2. Write a PL/SQL code Bind and Substitution Variables, Printing in PL/SQL.
3. Write a PL/SQL block using SQL and Control Structures in PL/SQL.
4. Write a PL/SQL code using Cursors, Exception and Composite Data Types.
5. Write a PL/SQL code using Procedures, Functions and Packages.

Note: The creation of a sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

Text Books:

1. "Oracle: The complete Reference", by Oracle Press, BOB bryla, 2013.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.
3. Rick FVanderLans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007.

Suggested Reading:

1. "The Language of SQL (Learning)" by Larry Rockoff
2. MongoDB Fundamentals: A hands-on guide to using MongoDB and Atlas in the real world

Web Resources:

1. https://www.mongodb.com/docs/manual/tutorial/query-documents/
2. https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html

22ITC06 DESIGN AND ANALYSIS OF ALGORITHMS LAB

Instruction	2 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Introduce Divide and conquer algorithmic strategy.
2. Familiarize with the Greedy Paradigm.
3. Introduce Dynamic programming algorithms.
4. Gain knowledge of connected and disconnected components.
5. Introduce Backtracking technique.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Implement Divide and Conquer Strategy.
2. Build solutions using Greedy technique.
3. Apply Dynamic programming technique to solve problems.
4. Determine connected and biconnected components from a Graph.
5. Design solutions using Backtracking technique.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	0	0	0	0	0	0	2	2	3	3
CO2	3	3	2	2	1	0	0	0	0	0	0	2	2	3	3
CO3	3	3	2	2	1	0	0	0	0	0	2	2	2	0	3
CO4	3	3	2	2	1	0	0	0	0	0	0	2	2	0	3
CO5	3	3	2	2	1	0	0	0	0	0	0	2	2	3	3

LIST OF EXPERIMENTS

1. Demonstrate the Divide and Conquer technique to determine the maximum and minimum elements from any given list of elements.
2. Implement Merge sort algorithm for sorting a list of integers in ascending order.
3. Implement greedy algorithm for job sequencing with deadlines.
4. Implement Prim's and Kruskal's algorithms to generate minimum cost spanning tree.
5. Implement Dijkstra's algorithm for the Single source shortest path problem.
6. Implement Dynamic Programming technique for the 0/1 Knapsack problem.
7. Implement Dynamic Programming technique for the Optimal Binary Search Tree Problem.
8. Implement an algorithm to determine whether any given graph has connected components or not, and identify any articulation points that may be present.
9. Implement backtracking algorithm for the N-queens problem.

10. Implement backtracking algorithm for the given graph problems.
    A. Hamiltonian Cycle problem.
    B. Graph Coloring problem.

Text Books:

1. Ellis Horowitz, SartajSahani, SanguthevarRajasekaran, "Fundamentals of Computer Algorithm", 2nd Edition, Universities Press, 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India Private Limited, 2006.

Suggested Reading:

1. Levitin A, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2008.
2. Goodrich M.T.,R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
3. Base Sara, Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999.

Web Resources:

1. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. http://nptel.ac.in/courses/ 106101060
4. http://www.facweb.iitkgp.ernet.in/~sourav/daa.html

With effect from the AY 2023-24

22ITC07 **MINI PROJECT – I**

Instruction	2 Hours per week
Duration of End Examination	-
Semester End Examination	-
Continuous Internal Evaluation	50 Marks
Credits	1

Course Objectives:

1. Enable student learning by doing.
2. Develop capability to analyze and solve real world problems.
3. Inculcate innovative ideas of the students.
4. Impart team building and management skills among students.
5. Instill writing and presentation skills for completing the project.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Interpret Literature with the purpose of formulating a project proposal.
2. Plan, Analyze, Design and implement a project.
3. Find the solution of an identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver a presentation before the departmental Committee.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	2	1	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	1	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	-	2	3	3	3	3	3
CO4	2	2	2	3	3	3	3	2	3	3	2	3	2	3	3
CO5	1	2	1	2	3	3	-	-	2	3	-	-	-	3	-

The Students are required to choose a topic for a mini project related to the courses of the current semester or previous semester. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

SCHEDULE

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Design, Implementation and Testing of the Project	7 weeks
4.	Documentation and Project Presentation	4 weeks

Guidelines for the Award of Marks

S No	Description	Max. Marks
1.	Weekly Assessment	20
2.	PPT Preparation	5
3.	Presentation	10
4.	Question and Answers	5
5.	Report Preparation	10

Final Mini Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Mini Project for that class.

With effect from the AY 2023-24

22ITE01 **DATA MINING**

(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. Introduce the concepts of Data Mining.
2. Familiarize different kinds of data and various preprocessing techniques, Data warehouse fundamentals.
3. Study different frequent pattern discovery methods and classification basics.
4. Learn various advanced classification methods and Prediction.
5. Introduce the concepts of cluster analysis and outlier detection.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the concepts and issues of data mining.
2. Apply preprocessing techniques, build multidimensional data models and perform OLAP operations.
3. Build association rules through various frequent pattern discovery methods and Understand classification concepts.
4. Analyze and evaluate various models for classification and prediction.
5. Illustrate Clustering and Outlier detection techniques.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	2	-	-	-	-	1	1	1	3	3	2
CO2	2	2	2	2	-	-	-	-	-	1	-	1	3	3	2
CO3	3	3	2	2	2	-	1	-	-	-	1	1	3	3	2
CO4	3	3	2	3	2	-	1	-	-	-	1	1	3	3	2
CO5	2	2	1	2	1	-	1	-	-	-	1	1	2	3	3

UNIT-I

Introduction: Data mining, Kinds of data, Kinds of pattern, Major issues in data mining**.**

Getting to know your data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity.

UNIT–II

Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Data Warehousing and Online Analytical Processing: Data Warehouse - Basic Concepts, Data Warehouse Modeling - Data Cube and OLAP, Data Warehouse Design and Usage: A Business Analysis Framework for Data Warehouse Design, Data Warehouse Design Process, Data Warehouse Usage for Information Processing.

UNIT-III

Mining Frequent Patterns, Associations and correlations: Basic Concepts, Frequent Item Set Mining Methods, Interesting patterns, Pattern Evaluation Methods.

Advanced Pattern Mining: Pattern Mining in Multilevel and Multidimensional Space.

Classification: Basic Concepts, Decision Tree Induction**.**

UNIT-IV

Classification and Prediction: Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Introducing Ensemble Methods, Bagging, Boosting, Random Forests, Improving Classification Accuracy of Class Imbalanced Data, Prediction.

Advanced Methods: Bayesian Belief Networks, Classification by Back propagation, Support Vector Machines, Lazy Learners (or Learning from Your Neighbors), Classifier Accuracy.

UNIT-V

Cluster Analysis: Basic Concepts and Methods: Cluster Analysis, Partitioning Methods, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, DBSCAN, Evaluation of Clustering, Clustering graph and network data.

Outlier Detection: Outliers and Outlier Analysis, Outlier Detection Methods, Statistical Approaches, Proximity- Based Approaches.

Text Book:

1. Han J, Kamber M, Jian P, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2012.

Suggested Reading:

1. Pang-Ning Tan, Michael Steinback, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2008.
2. M. Humphires, M.Hawkins, M.Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.
3. Anahory, Murray, "Data Warehousing in the Real World", Pearson Education, 2008.
4. Kargupta, Joshi, et al, "Data Mining: Next Generation Challenges and Future Directions", Prentice Hall of India Pvt. Ltd, 2007

Web Resource:

1. https://hanj.cs.illinois.edu/bk3/
2. https://www.kdnuggets.com/
3. http://archive.ics.uci.edu/ml/index.ph

With effect from the AY 2023-24

22ITE02 **DIGITAL IMAGE PROCESSING**
(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1 Introduce the fundamental concepts and applications of digital image processing.
2 Impart knowledge on the image processing concepts: intensity transformations, spatial filtering, smoothing, and sharpening both in spatial and frequency domain.
3 Familiarize the image analysis concepts: morphological image processing, image segmentation, image representation and description, and object recognition.
4 Introduce colour image processing techniques.
5 Understand various image compression methods.

Course Outcomes:

On Successful completion of this course, student will be able to:

1 Illuminate the fundamental concepts and applications of digital image processing techniques.
2 Demonstrate intensity transformations, spatial filtering, smoothing and sharpening in both spatial and frequency domains, image restoration concepts.
3 Demonstrate image restoration and morphological image processing methods.
4 Apply object recognition techniques by using image segmentation and image representation & description methods.
5 Illustrate the various colour models and Application of image compression methods.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	1	-	-	-	-	1	2	3	3
CO2	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3
CO3	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3
CO4	2	1	1	2	1	-	1	-	-	-	-	1	2	3	3
CO5	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3

UNIT-I

Introduction: Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Some Basic Relationships between Pixels; **Intensity Transformations:** Some Basic Intensity Transformation Functions, Histogram Processing - Histogram Equalization, Histogram Matching (Specification)

UNIT-II

Spatial Filtering: Fundamentals of Spatial Filtering, Smoothing Spatial Filters; Sharpening Spatial Filters; **Filtering in the Frequency Domain**: The 2-D Discrete Fourier Transform and its inverse; The Basics of Filtering in the Frequency Domain; Image Smoothing Using Frequency Domain Filters - Ideal, Butterworth

and Gaussian Low pass Filters; Image Sharpening Using Frequency Domain Filters - Ideal, Butterworth and Gaussian High pass Filters.

UNIT-III

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models; Restoration in the Presence of Noise Only—Spatial Filtering; Periodic Noise Reduction by Frequency Domain Filtering; Estimating the Degradation Function; Inverse Filtering; Minimum Mean Square Error (Wiener) Filtering; **Morphological Image Processing**: Preliminaries; Erosion and Dilation; Opening and Closing, The Hit or Miss Transform

UNIT-IV

Image Segmentation: Fundamentals; Points, Line and Edge Detection, Thresholding; Segmentation by Region Growing, Region Splitting and Merging

Feature Extraction: Boundary Pre-processing, Boundary Feature Descriptors, Some Simple Region Descriptors.

Image Pattern Classification: Patterns and Pattern Classes, Pattern Classification by Prototype Matching

UNIT- V

Colour Image Processing: Colour Fundamentals; Colour Models, Pseudo Colour Image Processing, Basics of full Colour Image Processing;

Image Compression: Fundamentals, Huffman Coding, Arithmetic Coding, LZW Coding

Text Book:

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2020.

Suggested Reading:

1. Vipula Singh, ―Digital Image Processing with MatLab and lab View‖, Elsevier.
2. Thomas B. Moeslund, ―Introduction to Video and Image Processing: Building Real Systems and Applications‖, Springer, 2012.
3. Milan Sonka, Vaclav Halvac and Roger Boyle, ―Image Processing, Analysis, and Machine Vision‖, 2nd Edition, Thomson Learning Publishers.
4. Kenneth R.Castleman, ―Digital Image Processing‖, Pearson Education, 2006.

Web Resource:

1 www.imageprocessingplace.com
2 https://in.mathworks.com/discovery/digital-image-processing.html
3 https://imagemagick.org/
4 https://nptel.ac.in/courses/117105079/

With effect from the AY 2023-24

22ITE03 **FUNDAMENTALS OF CRYPTOGRAPHY**

(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. Introduce fundamental concepts of computer security and cryptography.
2. Familiarize with the concepts of number theory, block ciphers.
3. Provide knowledge on asymmetric key cryptography and hash functions.
4. Acquaint with message authentication codes and digital signatures.
5. Impart knowledge on key distribution and user authentication.

Course Outcomes:

On successful completion of this course, students will be able to:

1. Demonstrate the key security concepts, security attacks and cryptography techniques.
2. Understand and apply various concepts of number theory in symmetric encryption algorithms.
3. Interpret operations of asymmetric key cryptography models and secure hash functions.
4. Make use of the concepts of message authentication codes and digital signatures in real time applications.
5. Understand concepts related to key distribution, user authentication.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	3	1	1	1	0	1	1	2	3	3
CO2	2	3	3	2	1	3	1	1	1	1	1	1	2	3	3
CO3	2	3	3	2	1	3	1	1	1	1	1	1	2	3	3
CO4	2	3	3	2	1	3	1	1	1	1	1	1	2	3	3
CO5	2	3	3	2	1	3	1	1	1	1	1	1	2	3	3

UNIT-I

Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security.

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT-II

Introduction to Number Theory: Divisibility and Division Algorithm, Euclidean algorithm, Modular arithmetic, Prime Numbers, Fermat's theorem and Euler's theorem, Discrete Logarithms.

Bloc Ciphers and Data Encryption Standard: Traditional Block Cipher Structure, the Data Encryption Standard, DES Example, the Strength of DES, Block Cipher Design Principles, Multiple Encryption, Triple DES

Advanced Encryption Standard: Finite Field Arithmetic, AES Structure, AES Transformation functions, AES Key Expansion, AES Example, AES Implementation.

UNIT-III

Asymmetric Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman key exchange,Homomorphicencryption,Onion routing.

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm,SHA-512 Logic.

UNIT-IV

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions HMAC, Security of HMAC.

Digital Signatures: Digital Signature**,** ElGamal Digital Signature Scheme**,** NIST Digital Signature Algorithm.

UNIT-V

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure.

User Authentication: Kerberos, Federated Identity Management.

Text Book:

1. William Stallings, “Cryptography and Network Security Principles and Practice”,Pearson Education, Seventh Edition,2017.

Suggested Reading:

1. V.K.Jain, “Cryptography and Network Security”, First Edition, Khanna Book Publishing,2013.
2. Behrouz A Forouzan, "Cryptography and Network Security", Second Edition, Tata McGraw Hill, 2010.

Web Resources:

1. Foundations of Cryptography, https://nptel.ac.in/courses/106/106/106106221/
2. Cryptography and Network Security, https://nptel.ac.in/courses/106/105/106105162/

With effect from the AY 2023-24

22ITE04 **MOBILE APPLICATION DEVELOPMENT**

(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

1. Introduce the Kotlin Programming Language for Mobile Application Development.
2. Demonstrate the development of basic mobile applications on android operating system.
3. Implement the design using specific mobile development frameworks.
4. Demonstrate the Location based services in mobile application design.
5. Demonstrate their ability to deploy mobile applications in the marketplace for distribution.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Understand the benefits of using Kotlin for Mobile application development.
2. Design user interface for mobile applications.
3. Use Intent, Broadcast receivers and Internet services in Android App.
4. Use multimedia, camera and Location based services in Android App.
5. Apply best practices to implement databases and publish apps on Playstore.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	1	2	-	2	-	-	-	1	-	-	2	3	-
CO2	-	2	1	2	-	2	-	-	-	-	-	-	1	3	-
CO3	-	2	1	2	-	2	-	-	-	-	-	-	2	3	3
CO4	-	2	1	2	-	2	-	-	-	-	-	-	2	3	-
CO5	-	2	2	2	3	2	-	-	3	-	-	1	2	3	3

UNIT-I

Introduction to Kotlin - Basic expressions - Control flow statements - null safety – Functions- passing functions as arguments - simple lambdas. Object oriented programming in Kotlin - Classes and Objects – Constructors - Visibility modifiers - Subclasses and Inheritance – Interfaces - Data classes - Singleton class – Pairs- Triples.

UNIT-II

Introduction to Android Architecture: History - Features and Android Architecture – Android SDK Tools - Application Components - User Interface Design - Views - View Groups – Layouts - Event Handling – Listeners – Adapters – Menus - Action Bars – Android Localization.

UNIT-III

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS. Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity. Notifications – Creating and Displaying notifications, Displaying Toasts.

UNIT-IV

Camera –Playing audio/video - Media recording - Sensors - Listening to sensor readings – Bluetooth - Android Communications – GPS - Working with Location Manager, Working with Google Maps extensions - Maps via intent - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location.

UNIT-V

Content Providers – Uri - CRUD access –Browser – CallLog – Contacts – Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases - Deploying Android Application to the World.

Text Books:

1. Reto Meier, “Professional Android 4 Development”, John Wiley and Sons, 2012.
2. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015.

Suggested Reading:

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Wei-Meng Lee, Beginning Android 4 Application Development, 4th Edition, Wiley India (Wrox), 2013.

Web Resources:

1. https://developer.android.com
2. http://www.androidcentral.com/apps
3. https://www.opensesame.com/c/android-app-development-beginners-training-course

22ADE01 **DATA ANALYSIS AND VISUALIZATION**

(Professional Elective – I)

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. Introduce the Numpy library in Python to support storage and operations on large multi-dimensional arrays and matrices.
2. Introduce large collection of mathematical functions to operate on multidimensional sequential data structures.
3. Demonstrate the functionality of the Pandas library in Python for open source data analysis and manipulation
4. Demonstrate Data Aggregation, Grouping and Time Series analysis with Pandas.
5. Introduce the Matplotlib library in Python for resting static, animated and interactive visualizations.

Course Outcomes:

On Successful completion of this course, student will be able to:

1. Use Numpy library utilities for various numerical operations.
2. Apply pandas library functions for handling data frames
3. Perform various preprocessing operations on datasets using Pandas Series and DataFrame objects.
4. Analyze the given dataset and derive conclusions using inferential statistics.
5. Apply 2-D and 3-D plotting techniques on datasets using matplotlib and seaborn.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	3	-	-	2
CO2	3	2	-	1	1	-	-	-	-	-	-	3	-	-	2
CO3	3	1	-	3	1	-	-	-	-	1	-	3	3	3	3
CO4	3	2	1	3	1	-	-	-	-	3	-	3	3	3	3
CO5	2	2	-	2	1	-	-	-	-	3	-	3	2	-	2

UNIT-I

Introduction to Numpy: Data types in Python - Fixed type arrays, creating arrays, array indexing, array slicing, reshaping arrays, array concatenation and splitting, Universal Functions, Aggregations, Broadcasting rules, Comparisons, Boolean Arrays, Masks Fancy Indexing, Fast Sorting using np.sort and np.argsort, partial sorting Creating Structured Arrays, Compound types and Record Arrays.

UNIT- II

Introduction to Pandas: Series Object, DataFrame Object, Data Indexing and Selecting for Series and DataFrames, Universal Functions for Index Preservation, Index Alignment and Operations between Series and DataFrames, Handling missing data, operating on Null values, Hierarchical Indexing.

UNIT-III

Combining Datasets: Concat, Append, Merge and Joins, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance functions - query() and eval()

UNIT-IV

Inferential Statistics - Normal distribution, Poisson distribution, Bernoulli distribution, z-score, p-score, One-tailed and two-tailed, Type 1 and Type-2 errors, Confidence interval, Correlation, Z-test vs T-test, F-distribution, Chi-square distribution, the chi-square test of independence, ANOVA, data mining, titanic survivors dataset analysis

UNIT-V

Visualization with Matplotlib : Simple Line plots, Scatter plots, Visualizing errors, Density and Contour plots, Histograms, Binnings, Multiple subplots, Three-dimensional plotting with Matplotlib, Geographic data with Basemap, Visualization with Seaborn.

Text Books:

1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly Media, 2016.
2. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.

Web Resources:

1. https://www.coursera.org/learn/python-data-analysis?specialization=data-science-python
2. https://www.coursera.org/learn/python-plotting