CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of III Semester of B.E. - Artificial Intelligence and Data Science as per AICTE Model Curriculum with effect from 2021-22

DEPARTMENT OF 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	20ECC34	DC Circuits, Sensors and Transducers	3	-	3	40	60	3
2	20MTC09	Probability and Statistics	3/1	-	3	40	60	4
3	20ITC08	Database Management Systems	3	-	3	40	60	3
4	20ADC01	Java Programming	3	-	3	40	60	3
5	20ITC05	Digital Logic and Computer Architecture	3	-	3	40	60	3
6	20EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	NC
7	20EGM02	Indian Traditional Knowledge	2	-	2	-	50	NC
PRACTICALS								
8	20ITC10	DBMS Lab	-	2	3	50	50	1
9	20ADC02	Java Programming Lab	-	2	3	50	50	1
10	20ADC03	Artificial Intelligence & Machine Learning Tools, Techniques and Applications	-	2	3	50	50	1
11	20ITC12	Mini Project - I	-	2	-	50	-	1
12	20ADI01	MOOCs/Training/Internship	2-3 Weeks/ 90 Hours		-	-	-	2
TOTAL			**20**	**8**		**400**	**550**	**22**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

20ECC34 **DC CIRCUITS, SENSORS AND TRANSDUCERS**

BE (AI&DS)

Instruction	3 L Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of Semiconductor Physics and Applied Physics.

Course Objectives:

1. Understand DC circuit theory for sensors and transducers.
2. Describe semiconductor device's principles and understand the characteristics of junction diode and transistors.
3. Understand working principles of Oscillators, Sensors, and Transducers.
4. Understand Interfacing of various modules of DAQ with myDAQ and myRIO

Course Outcomes:

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

1. Understand about the basics of lower power systems, DC circuits.
2. Use semiconductor devices in making circuits like rectifiers, filters, regulators, etc.
3. Design transistorized circuits of amplifiers and oscillators
4. Acquire the data from various sensors and transducers with the help of DAQ.
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	1	-	1
CO2	3	3	3	2	1	2	3	2	3	2	3	2	-	-	1
CO3	3	2	3	2	3	3	3	2	3	2	3	2	-	1	1
CO4	3	3	3	3	3	3	3	2	3	2	3	2	1	1	1
CO5	3	3	3	3	3	3	3	2	3	2	3	2	2	2	1

UNIT-I

DC Circuit theory: Basic DC theory, Voltage and Current relationship, Power in Electronics and its calculation, Types of Current - Direct Current (DC) and Alternating Current (AC), DC Voltage, Conventional Current Flow vs. Electron Flow. Measurement of DC current and power in a circuit, Parallel and Series circuits, Batteries and alternative sources of energies.

UNIT-II

Introduction to semiconductor: Characteristics of P-N Junction diode, current equation. Characteristics of Zener Diode

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

Introduction to Transistors: Classification, Bipolar Junction Transistors Configurations.

UNIT-III

Feedback Circuits: Principles of Negative Feedback Amplifiers, Advantages, Types, Topologies of negative feedback, Outline the Effect of negative feedback on Gain, Input Impedance and Output Impedance; Principle of Oscillator, Operation of LC Type- Hartley, Colpitts; RC phase shift Oscillator.

Op-Amps Circuits: Basic Principle, Ideal and practical Characteristics and Applications: Summer, Integrator, and Differentiator.

UNIT-IV

Sensors: Definition, classification of sensors

Proximity Sensors: Eddy current proximity sensors and its Applications, Inductive proximity switch and its Applications

Velocity, motion, force and pressure sensors: Tachogenerator, Optical encoders, Strain Gauge as force Sensor, Fluid pressure: Tactile sensors
Temperature and light sensors: Resistance Temperature detectors, Photo Diodes, Applications of Photo Diodes.

UNIT-V
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
Data Acquisition methods: myDAQ, MyRIO-1900 Architecture, myDAQ Interfacing: Interfacing LED's, Seven segment display, temperature sensors, IR Sensors, Range Finder sensors, Motors, motor driver interfaces, Thermistors, Buzzers.

Text Books:
1. John Bird, Electrical Circuit Theory and Technology, Fifth Edition, 2014.
2. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuits Theory", Pearson Education, 9th edition, LPE, Reprinted, 2006.
3. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
4. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
5. Ed Doering, NI myRIO Project Essentials Guide, Feb.2016

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

20MTC09 **PROBABILITY AND STATISTICS**

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. Able to learn and Analyzing data in Linear and Non-Linear form.
2. Able to fit the hypothetical data using probability distribution.
3. Understand the data using the testing of Hypothesis.
4. Able to Analyzing time series data using trend analysis.
5. Able to formulate and get the solution of real world problem.

Course Outcomes:

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

1. Use the principle of Least Squares approximating for estimating the value.
2. Use the basic probability for fitting the Random phenomenon.
3. Analyzing data using different methods of hypothesis testing.
4. Use the Moving Averages Methods for trend analysis.
5. Analyze the random phenomena of real world data.

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	-	1	1
CO2	2	2	-	-	-	-	-	-	1	-	-	1	-	1	1
CO3	2	2	-	-	-	-	-	-	1	-	-	1	-	1	1
CO4	2	2	2	-	-	-	-	-	1	-	-	1	-	1	1
CO5	2	2	2	-	-	-	-	-	1	-	-	1	-	1	1

UNIT-I: Curve Fitting

Measures of Central Tendency, Measures of Dispersion, Moments (Moments about the mean and moments about a point). Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. 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: Discrete Probability Distribution

Basic Probability, 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. Poisson distribution, MGF and Cumulates of the Poisson distribution, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution).

UNIT-III: Continuous Probability Distribution

Normal distribution, Characteristics of normal distribution and Normal probability Curve, MGF and CGF of Normal distribution, Areas under normal curve. Uniform distribution, moment generating function, mean and variance of uniform distribution. Gamma distribution, MGF, CGF, Mean and Variance of Gamma distribution. Exponential distribution, MGF, CGF, Mean and Variance of Exponential distribution.

UNIT-IV: Large and Small Sample Tests

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. Tests of significance of differences of standard deviations. 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.

UNIT-V: Time Series Analysis and Analysis of Variance

One way classification-Assumptions for ANOVA Test-ANOVA for fixed effect model-Two way classification-ANOVA for fixed effect model-Components of Time series-Measurement of Trend- Method of semi Averages-Moving Averages Method (3 Years and 5 Years).

Text Books:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. S.C.Gupta, V.K.Kapoor, "Fundamentals of **Applied** Statistics", Sultan Chand and Sons, 2014.

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.

20ITC08 **DATABASE MANAGEMENT SYSTEMS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the fundamental concepts and the role of a database system in an organization
2. To acquire knowledge on Data base design models, constraints and notations.
3. To familiarize with querying databases using SQL.
4. To acquaint with design and implementation issues of a database system.
5. To discuss the concepts of database security, concurrency and recoverability.

Course Outcomes:

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

1. Understand the purpose of database systems and design any domain specific database using E-R model.
2. Design and implement a database using Relational data model, formulate Relational algebra expressions. Use SQL for efficient data retrieval queries.
3. Access databases from high level languages, define triggers and apply normalization.
4. Understand the concepts of database transactions, locking protocols, concurrency control, backup and recovery.
5. Efficiently organize and manage data using indexing and hashing.

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	1	1	-	-	-	1	1	1	1	3	-	2
CO2	2	1	2	1	2	-	-	-	-	-	1	-	2	-	2
CO3	2	1	2	2	1	-	-	-	-	-	-	-	2	-	2
CO4	2	1	1	1	1	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	1	1	-	-	-	-	-	-	1	3	-	2

UNIT-I

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Design, Database Engine, Database and Application Architecture, Database Users and Administrators and History of Database Systems.

Database Design Using the E-R Model: Overview of the Design Process, The Entity- Relationship Model, Complex Attributes, Mapping Cardinalities, Primary Key, Removing Redundant Attributes in Entity Sets, Reducing E-R Diagrams to Relational Schemas, Extended E-R Features and Entity-Relationship Design Issues,

UNIT-II

Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages and The Relational Algebra.

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database.

Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Index Definition in SQL and Authorization.

UNIT-III

Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers, Recursive Queries, Advanced Aggregation Features.

Relational Database Design: Features of Good Relational Designs, Decomposition using Functional Dependencies, Normal Forms, Functional-Dependency Theory, Algorithms for Decomposition Using Functional Dependencies, More Normal Forms, Atomic Domains and First Normal Form, Database-Design

Process.

UNIT-IV

Transactions: Transaction Concept, a Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity.

Concurrency Control: Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols and Validation-Based Protocols.

UNIT-V

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management and ARIES.

Indexing and Hashing: Basic Concepts, Ordered Indices, B+ -Tree Index Files, Hash Indices, Multiple-Key Access, Creation of Indices and Bitmap Indices.

Text Book:

1. Abraham Silberschatz, Henry F Korth, S. Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill International Edition, 2020.

Suggested Reading:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", 6th Ed, Add-Wes, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Ed, Mc GH Intl 2014.
3. Rick F Vander Lans, "Introduction to SQL", 4th Ed, Pearson Education, 2007.
4. Benjamin Rosenzweig, Elena Silvestrova, "Oracle PL/SQL by Example", 5th Ed, Pearson Ed, 2015.

Web Resources:

1. http://db-book.com/
2. https://www.tutorialspoint.com/dbms/
3. https://www.w3schools.in/dbms/
4. http://www.oracle-dba-online.com/sql/oracle_sql_tutorial.htm.
5. http://www.tutorialspoint.com/plsq

20ADC01 **JAVA PROGRAMMING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To acquaint with Exception handling mechanisms and Multithreading.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize with the concept of Regular Expressions and new features introduced in java Version 8

Course Outcomes:

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

1. Understand object-oriented concepts.
2. Create Java applications using best OOP practices e.g. Inheritance, interfaces, packages, and inner classes.
3. Implement the concepts of Exception Handling and Multi-threading.
4. Develop applications using Collections framework and handle files.
5. Use Regular expression and java 8 concepts in 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	1	-	1	-	-	-	1	-	-	1	2	3	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	3	-
CO3	2	2	1	-	-	-	-	-	-	-	2	2	2	3	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	3	3
CO5	2	1	-	-	-	-	-	-	1	-	-	2	2	3	3

UNIT-I

Introduction to Java: Objects, Classes, structure a java program, difference between jdk and jre, Java Primitive Types, Basic Operators, Conditional and Logical statements. Defining Classes: Adding Instance Fields and Methods, Constructors, Access Modifiers (Visibility Modes), Object Creation Examples, Method Overloading and Constructor Overloading, Use of static and final keywords, Objects as parameters, Difference between local variable and instance field, importance of Object class.

UNIT–II

Inheritance, Interfaces and Packages in Java: Defining super / sub classes, Abstract classes, Method overriding, Interfaces and new features in latest version. Packages: Defining, Creating and Accessing a Package, importing packages.

Arrays, Strings in Java: How to create and define arrays, Introduction to java. util. Array class, Difference between String &String Buffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives, Autoboxing and unboxing

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT–III

Exception Handling in Java: What are exceptions, Error vs. Exception, usage of try, catch, throw throws and finally clauses, writing your own exception classes, Difference between checked vs. unchecked Exceptions.

Generics: Need of Generics concept, Generic classes, bounded types, Generic methods and interfaces.

Multithreading in Java: The java Thread Model, How to create threads, Thread class in java, Thread priorities, Inter thread communication, Thread synchronization

UNIT–IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Commonly used Collection classes – ArrayList, LinkedList, HashSet, TreeSet, HashMap, TreeMap, legacy and class, Iteration over Collections – Iterator and ListIterator, Enumeration interfaces, differentiate Comparable and Comparator

File Handling: Stream classes, Reader and Writer classes, File and Directory class, How to read user input from keyboard.

UNIT-V

Regular Expression : Introduction, Application areas of Regular Expression, Pattern class**,** Matcher class, Important methods of Matcher class, Character classes, Predefined character classes, Quantifiers, Pattern class split() method, String class split() method.

Java 8 new Features: Collections and Java Stream, Functional Interfaces in Java 8 Stream, Converting Java Stream to Collection or Array, Java Stream Intermediate Operations, Terminal Operations, Functional Interfaces, Lambda Expressions.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 11th Ed, Tata McGraw Hill Publications, 2020.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I-Fundamentals", 8th Ed, Prentice Hall, 2008.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", OUP, 2nd Ed, 2014.
2. C.Thomas Wu, "An Introduction to Object-Oriented Programming with Java", Tata Mc GH, 4th Ed, 2010.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2
3. https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-092-introduction-to-programming-in-java-january-iap-2010/ lecture-notes/

20ITC05 DIGITAL LOGIC AND COMPUTER ARCHITECTURE

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with logic gates, combinational and Sequential logic circuits.
2. To provide understanding of Data representation.
3. To present the operation of the Central Processing Unit.
4. To facilitate with the techniques that computers use to communicate with input and output devices.
5. To introduce the concept of memory hierarchy and memory management.

Course Outcomes:

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

1. Understand simplification of logic gates, fundamentals of combinational and sequential logic gates.
2. Design of registers, counters and representation of data using numbers.
3. Understand the architecture and functionality of central processing unit.
4. Discuss 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	-	1	-	-	-	1	-	-	1	2	-	3
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	-	3
CO3	2	2	1	-	-	-	-	-	-	-	2	2	-	-	3
CO4	2	1	-	-	-	-	-	-	-	-	-	2	-	-	3
CO5	2	2	1	-	-	-	1	-	1	-	2	2	1	-	3

UNIT-I

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean Algebra, Map simplification, Product –of-sums Simplification, Don't –Care Conditions, Combinational Circuits, Half-Adder, Full–Adder, Flip-Flops: SR, D , JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

UNIT-II

Digital Components: Integrated circuits, Decoders. Encoders, Multiplexers

Registers: Register with Parallel load, Shift Register, Counters.

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

UNIT-III

Central Processing Unit: Computer Registers, General register Organization, Instruction Cycle, Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions,Zero-AddressInstructions,RISCInstructions,AddressingModes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC):CISC Characteristics, RISC Characteristics, Multicore Processors and their Performance.

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-OutBuffer,ModesofTransfer:Interrupt-InitiatedI/O, Priority Interrupt:

Daisy Chaining Priority, 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 and Linear Tape Open Technology, Associative Memory: Hardware Organization, MatchLogic,ReadandWriteOperations,CacheMemory:AssociativeMapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table, Page Replacement.

Text Books:

1. M.MorrisMano,"ComputerSystemArchitecture",3rdEdition,Pearson Education, 2016.
2. John L. Hennessy, David A. Patterson Morgan Kaufman, "Computer Architecture - A Quantitative Approach", 5th edition,, Elsevier,2012
3. William Stallings, "Computer Organization and Architecture", 9th edition, Pearson Education, 2013

Suggested Reading:

1. Stephen Brown, ZvonkoVranesic,"FundamentalsofDigitalLogicwithVHDLdesign",2nd Edition, McGrawHill,2009.
2. ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, TataMcGrawHill,1995.
3. William Stallings, "Computer Organization and Architecture", 8thEdition, PHI.
4. CarlHamachar,Vranesic,Zaky,"ComputerOrganization",5thEdition, McGraw Hill.

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

20EGM01 **INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES**

(BE/ B.Tech. III/IV Semester - Common to all branches)

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
Credits	No Credits

Course Objectives:

The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectual's constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Course Outcomes:

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

1. Understand the making of the Indian Constitution, its features and learn the importance of Directive Principles of State Policy.
2. Identify the difference between Right to Equality and Right to Freedom and know the relevance of Fundamental Duties.
3. Analyze the structuring of the Indian Union, distribution of powers between the Union and the States, and the role and position of President in Union Government.
4. Distinguish between the LokSabha and RajyaSabha in law making process while appreciating the importance of Judiciary in interpretation of law and protection of citizens' rights.
5. Differentiate between the Municipalities and Panchayats in their functioning and know 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	-	-	-	-	-	-
CO2	-	-	-	-	-	1	1	1	1	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	1	1	-	-	-	-	1	-	-
CO5	-	-	-	-	-	1	1	1	1	-	-	-	1	-	-

UNIT-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

UNIT-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - Right to Equality, Right to Freedom under Article 19, Right to Life and Personal Liberty Under Article 21.
Fundamental Duties - the legal status.

UNIT-III

Union Government and its Administration - Structure of the Indian Union, Federalism: distribution of legislative and financial powers between the Union and the States.
Parliamentary form of government in India: Union Executive-President's power, role and position.
Emergency Provisions: National, Constitutional and Financial Emergencies.

UNIT-IV

Union **Legislature and Judiciary:** Union Legislature-Parliament: LokSabha and RajyaSabha, functions of Parliament and Parliamentary Committees.

Union Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism

UNIT-V

Local Self Government - District's Administration Head (Collector): Role and Importance.

Municipalities: Introduction, Chairman/Mayor and Role of Elected Representatives, Commissioner of Municipality/Municipal Corporation.

Panchayati Raj: Zilla Panchayat-Elected Representatives and their roles, CEO of Zilla Panchayat: Position and Role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed. Prof V Ravindra Sastry, Telugu Academy, 2nd Edition, 2018.
2. Indian Constitution at Work, NCERT, First edition 2006, Reprinted- January 2020.

Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Web Resource:

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

20EGM02 **INDIAN TRADITIONAL KNOWELDGE**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	-

Prerequisite: Knowledge on Indian Culture

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes:

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

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

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	-	--	-	-	-	-	-	-	-
CO2	-	1	1	-	-	1	1	1	-	-	-	-	1	-	-
CO3	-	1	-	-	-	-	-	--	-	1	-	-		-	-
CO4	1	1	1	-	-	1	-	--	-	-	-	-	1	-	-
CO5	1	1	1	1	-	-	-	--	-	-	-	1	1	-	-

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient, medieval and modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, Introduction to Mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health

Essential Readings:

1. Kapil Kapoor, **Text and Interpretation: The Indian Tradition,** ISBN: 81246033375, 2005
2. Samskrita Bharati, **Science in Samskrit**, ISBN-13: 978-8187276333, 2007
3. Satya Prakash, **Founders of sciences in Ancient Indi**a, Govindram Hasan and, ISBN-10: 8170770009, 1989
4. Brajendranath Seal, **The Positive Sciences of the Ancient Hindus**, Motilal Banarasi dass, ISBN-10: 8120809254, 1915.
5. KanchaIlaiah, Turning the Pot, Tilling the Land: Dignity of Labour in Our Times

Suggested Reading:

1. Swami Vivekananda, Caste, Culture and Socialism, Advaita Ashrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, Religion and Culture, Advaita Ashrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn, ISBN: 978-0143426158, 2016
5. Swami Vivekananda, The East and the West, AdvaitaAshrama, Kolkata 9788185301860
6. Srivastava R.N., Studies in Languages and Linguistics, Kalinga Publications ISBN-13: 978-8185163475
7. SubhashKak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama, IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. S. Narain, Examinations in ancient India, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020
12. Shashi Tharoor, The Hindu Way
13. Amartya Sen, Argumentative Indian

SWAYAM / NPTEL:

History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
Language and Society - https://nptel.ac.in/courses/109/106/109106091/
Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

20ITC10 DATABASE MANAGEMENT SYSTEMS LAB

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce the basic commands of SQL.
2. To familiarize with query writing.
3. To impart knowledge on triggers, procedures and triggers.
4. To introduce exception handling in PL/SQL.
5. To familiarize with design and development of database applications

Course Outcomes:

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

1. Design and implement database schemas by enforcing integrity constraints.
2. Use SQL for database administration, data manipulation and retrieval.
3. Develop PL/SQL programs and use cursors for the databases.
4. Design triggers for database validation.
5. Handle Exceptions in PL/SQL programs.

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	2	-	-	-	3	1	1	-	3	-	2
CO2	1	1	-	-	1	-	-	-	-	-	-	-	-	-	2
CO3	2	1	2	2	1	-	-	-	1	1	-	-	1	-	2
CO4	2	2	2	2	1	-	-	-	1	1	-	-	3	-	2
CO5	2	2	2	2	1	-	-	-	1	1	-	-	2	-	2

List of Programs

1. Creation of database (Exercising commands like DDL and DML)
   (Note: use constraints while creating tables).
2. Exercising Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING clause and Creation and dropping of Views.
3. Exercising Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION INTERSECT Constructs.
4. Exercising all types of Joins.
5. Demonstration of PL/SQL Blocks and Cursors.
6. Demonstration of Procedures and Functions.
7. Usage of Triggers (BEFORE and AFTER Triggers, Row and Statement level Triggers and INSTEAD OF Triggers).
8. Demonstrate Exception Handling by PL/SQL procedures for data validation.
9. Creation of Forms and Generation of SQL reports.
10. Creation of full-fledged database application spreading over to 3 sessions.

Text Books:

1. Rick F Vander Lans, "Introduction to SQL", 4th Edition, Pearson Education, 2007.
2. Benjamin Rosenzweig, Elena Silvestrova, "Oracle PL/SQL by Example", 5th Edition, Pearson Education, 2015.
3. Alan Beaulieu, "Learning SQL", 2nd Edition, O'Reilly, 2009.

Suggested Reading:

1. Albert Lulushi, “Oracle Forms Developer’s Handbook”, Pearson Education, 2006.

Web Resources:

1. http://www.oracle-dba-online.com/sql/oracle_sql_tutorial.htm
2. https://www.javatpoint.com/pl-sql-tutorial

20ADC02 **JAVA PROGRAMMING LAB**

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To gain the fundamental programming knowledge of OOPs.
2. To use Exception handling mechanisms in application development.
3. To provide the knowledge of generics and Collections Framework.
4. To understand the Java.io package
5. To provide the knowledge in Regular Expressions and Java 8 Streams

Course Outcomes:

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

1. Develop Java applications using the concepts of Inheritance, interfaces, packages and access control modifiers.
2. Implement the concepts of Exception Handling and Multithreading in java Applications
3. Read and write data using different Java I/O streams.
4. Develop applications using Collections framework.
5. Validate inputs using regular expression and apply the knowledge of Java 8 new features in 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	-	3	1	-	-	-	-	-	-	1	-	-	1	3	-
CO2	-	2	1	1	-	-	-	-	-	-	-	-	1	3	-
CO3	-	2	1	1	-	-	-	-	-	-	-	-	2	3	3
CO4	-	2	1	1	-	-	-	-	-	-	-	-	1	3	-
CO5	-	2	1	2	3	-	-	-	-	-	-	-	2	3	3

List of Programs

1. Program(s) to illustrate the concepts of constructor overloading, method overloading, static and final keywords usage.
2. Program(s) to illustrate the concepts of Inheritance, method overriding, super key word usage and Dynamic polymorphism.
3. Program(s) to illustrate concept of Abstract Class and Interface.
4. Program(s) to demonstrate String handling with String, String Buffer and String Tokenizer classes.
5. Program(s) to demonstrate various types of inner classes, Packages creation and usage.
6. Program(s) to demonstrate concept of exception handling and user defined exceptions.
7. Program(s) to demonstrate concept of Multithreading and Thread synchronization.
8. Program(s) using Generics, Collection framework classes and Interfaces.
9. Programs(s) on Comparator, Comparable interfaces to define Customized sorting order on collection objects
10. Program(s) to illustrate the usage of I/O streams.
11. Program(s) to demonstrate the use of Regular expressions
12. Program(s) on Java 8 stream concepts
13. Programs(s) on usage of java 8 function programming features.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 11th Ed, Tata McGraw Hill Publications, 2020.
2. Cay S. Horstmann, Gary Cornell: "Core Java, Vol I-Fundamentals",8thEd,PrenticeHall,2008.

Suggested Reading:

1. Sachin Malhotra, Saurabh Chaudhary: "Programming in Java" , Oxford University Press,2nd Ed,2014.
2. C.Thomas Wu, "An Introduction to Object-Oriented Programming with Java", Tata McGH 4th Ed, 2010.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/ lecture-notes/

20ADC03 ARTIFICIAL INTELLIGENCE & MACHINE LEARNING TOOLS, TECHNIQUES AND APPLICATIONS

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce fundamental concepts in AI
2. To demonstrate simple AI applications using Natural Language Processing, Audio engineering & Speech
3. To demonstrate simple AI applications using Computer Vision, pattern recognition and machine learning.
4. To present various modeling and formulation techniques to solve problems using AI techniques.
5. To introduce state-of-art AI tools and techniques to solve problems faced by Engineers in design and analysis.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Understand the importance of AI.
2. Understand concepts of Machine Learning algorithms and their limitations.
3. Develop Chatbots based on the requirements.
4. Analyse complex problems involving image processing, such as quality control, visual surveillance, multimodal human-machine interfaces, and image compression.
5. Understand the application of Reinforcement Learning.

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	-	2	-	2	-	3	2
CO2	-	2	-	1	-	-	1	1	-	2	-	2	-	3	2
CO3	1	3	2	2	3	-	1	1	-	1	-	2	3	3	3
CO4	3	3	2	3	3	-	1	1	-	1	-	3	3	3	3
CO5	1	1	1	1	-	-	1	1	-	2	-	2	-	3	3

List of Programs

1. **Overview of AI, AI project lifecycle**
    a. Design/Construct the workflow of a general AI project using draw.io
2. **Teachable Machine** - To introduce Machine Learning Models, Computer Vision, Natural Language Processing
    a. Train a Machine Learning model to recognise a Person or Object including gestures
    b. Train a Machine Learning model to recognise various sound bites
    c. Train a Machine Learning model to recognise speech
3. **AI with App Inventor** - To introduce Image Classification, Audio Classification, Facial Recognition, Reinforcement Learning(Markov Models)
    a. Develop an app to recognise objects using Image Classification
    b. Train a Machine Learning model to identify different facial expressions using webcam
    c. Develop an Expression Match app using the trained ML model for facial expressions
    d. Develop a Voice Authentication app that uses a trained audio model of the user using audio classification to recognise the user's voice to authenticate.
    e. Develop a Rock-Paper-Scissors game that uses Reinforcement Learning (Markov Models) to learn from the patterns in the user's game choices
4. **Amazon Lex** - To introduce Automatic Speech Recognition(Speech to Text), Natural Language Understanding(intent of text), Conversational AI agents
    a. Develop a conversational chatbot to automatically recognise speech, understand the intent of the user and generate a response accordingly using Amazon Lex

5. **Wolfram Technology Framework** - To introduce Supervised Learning(Classification, Prediction, Sequence Prediction), Unsupervised Learning(Feature Extraction, Clustering), Neural Networks, Model Deployment
    a. Design a program using the Wolfram Language to Classify Data(Numbers, Images, Colors) using automatic model selection.
    b. Design a program using the Wolfram Language to predict the price of a house from a housing prices dataset using Regression.
    c. Design a program using the Wolfram Language to demonstrate Vector Encoding based Feature Extraction and Clustering for a dog image dataset.
    d. Construct a neural network from an image dataset and explore the hidden layers along with their outputs using the Wolfram Language

Web Resources:

1. https://teachablemachine.withgoogle.com/v1/
2. https://appinventor.mit.edu/explore/ai-with-mit-app-inventor
3. https://aws.amazon.com/lex/
4. https://www.wolfram.com/wolfram-u/machine-learning-zero-to-AI-60-minutes/
5. https://www.coursera.org/learn/ai-for-everyone

20ITC12 **MINI PROJECT –I**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

Course Outcomes:

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

1. Interpret literature with the purpose of formulating a project proposal.
2. Plan, Analyse, Design and Implement a project.
3. Find the solution of 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 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 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 all the faculty handling Mini Project for that class.

20ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	60 Marks
Mid Term Evaluation	40 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.

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															
CO2															
CO3															
CO4															
CO5															

Refer Internship Policy Document

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of IV Semester of B.E. - Artificial Intelligence and Data Science as per AICTE Model Curriculum with effect from 2021-22

DEPARTMENT OF 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	20MTC10	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2	20ITC06	Discrete Mathematics and Applications	3	-	3	40	60	3
3	20ITC15	Design and Analysis of Algorithms	3	-	3	40	60	3
4	20ADC 04	Machine Learning	3	-	3	40	60	3
5		Professional Elective – I	3	-	3	40	60	3
6	20MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
7	20CEM01	Environmental Science	2	-	2	-	50	NC
PRACTICALS								
8	20MTC11	Stochastic Process and Queueing Theory Lab	-	2	3	50	50	1
9	20ITC17	Design and Analysis of Algorithms Lab	-	2	3	50	50	1
10	20ADC 05	Machine Learning Lab	-	2	3	50	50	1
11	20ITC18	Mini Project – II	-	2	-	50	-	1
TOTAL			**21**	**8**	-	**440**	**560**	**22**

L:Lecture **T: Tutorial** **P: Practical**
CIE – Continuous Internal Evaluation **SEE - Semester End Examination**

Professional Elective #1	Image Processing 20ITE01	Data Analysis and Visualization 20ADE01	Mobile Application Development with Android and Kotlin 20ITE02	Fundamentals of Cryptography 20ITE03	Theory of Automata 20ADE02

20MTC10 STOCHASTIC PROCESS AND QUEUEING THEORY

Instruction	3 L Hours per week
Duration of Semester End Examination	3Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Able to learn methods to solve bivariate probability functions.
2. Able to know characterizing the random process.
3. Able to identify the tools for interpretating the random process
4. Able to know the statistical techniques for random process
5. Able to analyse the queuing model's

Course outcomes: On successful completion of this course the students shall be able to

1. Estimate the marginal probabilities of statistical averages
2. Distinguish the random process of auto correlation and cross correlation
3. Characterize the random process of ensemble averages
4. Analyze the effect the thermal noise in the system
5. Analyze the queuing behavior of different queuing models.

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	-	-	-	-	1	1
CO2	2	2	-	-	-	-	-	-	1	-	-	-	-	1	1
CO3	2	2	-	-	-	-	-	-	1	-	-	-	1	1	1
CO4	2	2	2	-	-	-	-	-	1	-	-	-	1	1	1
CO5	2	2	2	-	1	-	-	-	1	-	-	-	1	1	1

UNIT-I: Two-Dimensional Random Variables

Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two-dimensional random variable.

UNIT-II: Random Processes

Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Processes, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t),Cross-Correlation Function and its Properties wide sense stationary process.

UNIT-III: Discrete Time Process

Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.

UNIT-IV: Applications of Random Process

Definition of Gaussian process, Properties, Bank Pass Process, Narrow-Bank Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markow process, Definition of a Markov chain.

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. "Probability Statistics and Random Processes" by T Veerarajan,2nd Edition Tata McGraw-Hill
2. "Fundamentals of Mathematical Statistics" by V.K. Kapoor & S.C. Gupta 11th revised Edition Sultan Chand & Sons

Suggested Reading:

1. "Stochastic Process and Queueing Theory" by Randolph Nelson 1995, Ist edition, Springer-verlag New York.

20ITC06 DISCRETE MATHEMATICS AND APPLICATIONS

Instruction	3Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce Propositional Logic, Proof strategy concepts and gain knowledge in Sets and Functions.
2. To acquire knowledge in Induction, Recursion and Number theory applications.
3. To gain knowledge in Counting, Permutations, Combinations and Solving recurrence relations.
4. To introduce basic concepts of graphs, digraphs and relations and their properties.
5. To familiarize with Algebraic Structures.

Course Outcomes:

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

1. Symbolize the given sentence using propositional logic and apply the onto and one-to-one functions between the sets.
2. Understand the mathematical induction and apply the modular arithmetic for cryptography and congruence applications.
3. Apply permutations and combinations to handle different types of objects, understand solving homogeneous and Non-homogeneous recurrence using generating functions.
4. Apply relations and graph concepts for basic problem solving.
5. Demonstrate Algebraic systems and their Properties.

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	3	1	2	3	-	-	1	1	1	3	3	3
CO2	3	3	2	3	1	2	-	-	-	1	-	1	3	3	3
CO3	3	3	3	3	1	2	2	-	-	1	1	1	3	3	3
CO4	3	3	2	3	1	2	3	-	-	1	-	1	3	3	3
CO5	3	3	2	3	-	2	-	-	-	1	-	1	3	3	3

UNIT-I

The Foundations: Logic and Proofs: Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy

Basic Structures: Sets, Functions, Sequences, Sums, and Matrices: Sets, Set Operations, Functions, Sequences and Summations, Cardinality of Sets, Matrices

UNIT-II

Number Theory and Cryptography: Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences, Applications of Congruences, Cryptography.

Induction and Recursion: Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms.

UNIT-III

Counting: The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations.

Advanced Counting Techniques: Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion–Exclusion,

Applications of Inclusion–Exclusion

UNIT-IV

Relations: Relations and Their Properties, *n*-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.

UNIT-V

Algebraic Structures: Algebraic Systems: Examples and General Properties, Semi groups and Monoids.

Groups: Definitions and Examples, Subgroups, Homomorphism's and cyclic groups.

Text Books:

1. Kenneth H Rosen, "Discrete Mathematics and its applications", 8th Edition, McGraw Hill, 2019.
2. R.K. Bishit, H.S. Dhami, "Discrete Mathematics", Oxford University Press, 2015.

Suggested Reading:

1. J.P. Trembly, R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", McGraw- Hill, 1997.
2. J. K. Sharma, "Discrete Mathematics", 2nd Edition, Macmillan, 2005.
3. Joel Mott, Abraham Kandel, T.P. Baker, "Discrete Mathematics for Computer Scientist &Mathematicians", 2nd Edition, Macmillan Prentice Hall.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs37/
2. https://www.coursera.org/learn/discrete-mathematics

20ITC15 **DESIGN AND ANALYSIS OF ALGORITHMS**

Instruction	3 Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To analyse the performance of various algorithms.
2. To illustrate different paradigms of problem solving.
3. To learn about various algorithm design techniques and illustrates them using a number of well-known problems and applications.
4. To familiarize graph traversal and search techniques.
5. To discuss NP hard and NP complete problems and their applications.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Analyze best, average and worst case complexities of algorithms and choose appropriate data structure for designing algorithm.
2. Develop solutions using Divide and Conquer, Greedy techniques.
3. Design algorithms using dynamic programming approach, apply traversal and search techniques.
4. Apply backtracking, branch and bound techniques to solve problems.
5. Identify P, NP, NP-Complete and NP-Hard classes to which an algorithm belongs and design a feasible solution.

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	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3
CO3	3	3	2	2	-	-	-	-	-	-	2	2	2	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	2	-	3
CO5	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3

UNIT-I

Introduction: Algorithm Specification, Performance analysis: Space Complexity, Time Complexity, Asymptotic Notation (O, Omega, Theta), Searching and Sorting techniques-Performance Measurement.

Elementary Data Structures: Complexity measures for the Data Structures - Stacks and Queues, Trees, Hashing/Dictionaries, Priority Queues, Sets and Disjoint Set Union.

UNIT-II

Divide and Conquer: The general method, Binary Search, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Optimal Storage on Tapes, Optimal Merge Patterns, Single Source Shortest Paths.

UNIT-III

Dynamic Programming: The General Method, Multistage graphs, All Pair Shortest Paths, Single Source Shortest Paths, Optimal Binary Search Trees, -/1 Knapsack, Reliability Design, The Traveling Salesperson Problem.

Traversal and Search Techniques: Breadth First Search and Traversal, Depth First Search and Traversal, Connected Components and Spanning Trees, Biconnected Components and DFS.

UNIT-IV

Backtracking: The General Method, 8-Queens Problem, Graph Colouring, Hamilton cycles, Knapsack

Problem.

Branch and Bounds: The Method: Least Cost (LC) Search, The 15 puzzle, FIFO Branch and Bound, LC Branch and Bound, -/1 Knapsack Problem, Traveling Salesperson Problem.

UNIT-V

NP-Hard and NP-Complete Problems: Basic Concepts: Non-Deterministic Algorithms, the Classes NP Hard and NP Complete. Cook's theorem, NP-Hard Graph Problems: Node Cover Decision Problem, Chromatic Number Decision Problem, Directed Hamiltonian Cycle, Traveling Salesperson Decision Problem, NP Hard Scheduling Problems: Job Shop Scheduling.

Text Books:

1. Ellis Horowitz, Sartaj Sahani, Sanguthevar Rajasekaran, "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. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithm", Pearson Education, 2000.
3. Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 2nd Edition, Pearson Education, 2014.

Web Resources:

1. http://nptel.ac.in/courses/106101060
2. http://nptel.ac.in/courses

20ADC04 **MACHINE LEARNING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce machine learning concepts and models.
2. To familiarize with tree models and unsupervised learning.
3. To impart knowledge of dimensionality reduction and clustering techniques.
4. To learn the concepts of rule based models and kernel methods
5. To introduce the concept of neural network and ensemble methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Understand basic concepts of machine learning models.
2. Apply tree models, perform classification and regression tasks.
3. Understand rule based learning and linear models.
4. Apply distance based and probabilistic models for clustering and classification of data.
5. Design and develop a neural network, use dimensionality reduction techniques, ensemble 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	3	2	1	3	-	-	-	-	-	1	-	-	-	3	3
CO2	3	2	1	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	2	1	3	1	-	-	-	-	-	-	-	-	3	3
CO4	3	2	1	3	1	-	-	-	-	-	-	-	2	3	3
CO5	3	2	1	3	1	-	-	-	-	-	-	-	2	3	3

UNIT-I

Introduction: What Is Machine Learning, Examples of Machine Learning Applications. **Machine learning Models**: Geometric Models, Logical Models, Probabilistic Models. **Features**: Feature types, Feature Construction and Transformation, Feature Selection.

UNIT-II

Binary Classification: Introduction to classification, Scoring and Ranking, Class probability Estimation.
Beyond Binary Classification: Multi Class Classification, Regression, Unsupervised and Descriptive Learning.
Tree Models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction.

UNIT-III

Rule Models: Learning ordered and unordered rule sets, Descriptive rule learning, First-order rule learning.
Linear Models: Least Squares method, Perceptron, Support Vector Machines, Soft Margin SVM, Kernel methods for non-Linearity.

UNIT-IV

Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, from kernels to distances. **Probabilistic Models:** the normal distribution and its geometric interpretations, Probabilistic models for categorical data, Discriminative learning by optimising conditional likelihood, Probabilistic models with hidden variables: Expectation-Maximisation.

UNIT- V

Model Ensembles: Bagging and random forests, Boosting, Bias, Variance and Margin. **Multilayer Perceptron:** Introduction, Neural Networks as a Paradigm for Parallel Processing, The Perceptron, Training a Perceptron, Learning Boolean Functions, Multilayer Perceptrons, MLP as a Universal Approximator, Back propagation Algorithm, Training Procedures, Tuning the Network Size, Bayesian View of Learning, Dimensionality Reduction, Learning Time.

Text Books:

1. Peter Flach "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2nd Edition, 2013.

Suggested Reading:

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer 1st Edition-2013

Web Resource:

1. https://www.coursera.org/specializations/machine-learning

20MBC01 ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

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

Course Outcomes:

Upon successful completion of the course the students 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 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
CO1	1	1	3	1	1	1	1	1	1	1	-	-	1	-	1
CO2	2	2	2	2	-	1	1	1	-	1	-	1	1	-	-
CO3	1	2	1	2	2	-	2	1	-	1	-	-	1	-	-
CO4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	-
CO5	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, Equimarginal 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; Internal and External Economies of Scale.

Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features, Price Output Determination under Perfect Competition, Monopoly and Monopolistic Competition; Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV: Accountancy

Book-keeping, Principles and Significance of Double Entry Book Keeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments. Ratio Analysis.

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, 11th Edition, 2013.

Suggested Reading:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2015.
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. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

20CEM01 ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
Credits	No Credits

Course Objectives:

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and affects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of 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	-	-
CO2	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO3	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO4	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
CO5	1	-	-	-	-	1	2	1	-	-	-	1	2	-	-

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

20MTC11 STOCHASTIC PROCESS AND QUEUEING THEORY (LAB)

Instruction	2 L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Able to learn methods to solve probability functions.
2. Able to know characterizing the random process.
3. Able to identify the tools for interpretating the random process
4. Able to know the statistical techniques for random process
5. Able to analyse the queueing models.

Course Outcomes:

On successful completion of this course the students shall be able to

1. Execute marginal probabilities of statistical averages.
2. Compute the auto correlation and cross correlation of random process.
3. Characterize the random process of ensemble averages.
4. Analyze the effect of the thermal noise in the system.
5. Analyze the queuing behavior of different queuing models.

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	2	-	-	-	-	-	-	-	-	-	1	-	1	1
CO2	1	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO3	1	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO5	1	2	-	-	-	-	-	-	-	-	-	1	-	1	1

List of Experiments

1. Find estimated and true mean of Uniform and Exponential distributed data.
2. Find density and distribution function of a function of random variable Y = 2X + 1. Where X is r.v.
3. Estimate the mean and variance of Y = 2X + 1, where X is a random variable.
4. Plot Joint density and distribution function of sum of two random variables.
5. Estimate the mean and variance of ar.v. Z = X+Y. Where X and Y are also random variables.
6. Calculate marginal distributions of X and Y. Also find the conditional distributions of Y for X=x, when joint PMF is given.
7. Calculate marginal distributions of X and Y. Also find the conditional distributions of Y for X=x, when joint PDF is given.
8. Execute the problems on discrete process.
9. Execute problems on Continuous random process
10. Execute a program on Gaussian process.
11. Execute single server Poisson queuing model

Text Books:

1. Scilab Textbook Companion for Probability and Statistics For Engineers And Scientists by S. M. Ross.
2. S. M. Ross, Probability And Statistics For Engineers And Scientists, Edition: 3, 2005 Elsevier, New Delhi. ISBN: 81-8147-730-8

20ITC17 DESIGN AND ANALYSIS OF ALGORITHMS LAB

Instruction	2 L Hours per Week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce Divide and Conquer algorithmic strategy.
2. To familiarize Greedy Algorithms.
3. To introduce Dynamic programming algorithms.
4. To gain knowledge of connected and biconnected components.
5. To introduce Backtracking technique.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Implement Divide and Conquer Algorithms.
2. Build solutions using Greedy technique.
3. Apply Dynamic programming algorithms to solve problems.
4. Implement connected and biconnected components algorithms.
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	-	-	-	-	-	-	2	2	3	3
CO2	3	3	2	2	1	-	-	-	-	-	-	2	2	3	3
CO3	3	3	2	2	1	-	-	-	-	-	2	2	2	-	3
CO4	3	3	2	2	1	-	-	-	-	-	-	2	2	-	3
CO5	3	3	2	2	1	-	-	-	-	-	-	2	2	3	3

List of Programs

1. Implement Binary Search Tree Operations.
2. Find Maximum and Minimum elements from a given list of elements using Divide and Conquer technique.
3. Implement Merge sort algorithm for sorting a list of integers in ascending order.
4. Implement greedy algorithm for job sequencing with deadlines.
5. Implement Prim's algorithm to generate minimum cost spanning tree.
6. Implement Kruskal's algorithm to generate minimum cost spanning tree.
7. Implement Dijkstra's algorithm for the Single source shortest path problem.
8. Implement Dynamic Programming algorithm for the -/1 Knapsack problem.
9. Implement Dynamic Programming algorithm for the Optimal Binary Search Tree Problem.
10. Check whether given graph having connected components or not.
11. To find articulation points of a given graph..
12. Implement backtracking algorithm for the N-queens problem.
13. Implement backtracking algorithm for the Hamiltonian Cycle problem.
14. Implement backtracking algorithm for the Graph Coloring problem.
15. Implement Least Cost Branch and Bound for the -/1 Knapsack problem

Note: All the programs can be implemented using Java Programming.

Text Books:

1. Ellis Horowitz, Sartaj Sahani, Sanguthevar Rajasekaran, "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

20ADC05 **MACHINE LEARNING LAB**

Instruction	2 L Hours per week
CIE	50 Marks
SEE	50 Marks
Credits	1

Course Objectives:

1. To introduce the concept of decision tree for supervised learning.
2. To familiarize with bayesian decision theory and probabilistic methods.
3. To impart knowledge of dimensionality reduction and clustering techniques.
4. To introduce the concept of neural network and SVM.
5. To familiarize with ensemble methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Build decision trees for classification.
2. Perform dimensionality reduction of a dataset.
3. Apply distance based models for clustering and classification of data.
4. Design and build neural networks.
5. Build solutions using SVM, ensemble 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	3	3	1	3	2	-	-	-	-	1	-	-	2	3	3
CO2	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	1	3	2	-	-	-	-	-	-	-	2	3	3
CO4	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3

List of Programs

1. Build a decision tree algorithm for classification on a given data set.
2. Implement naïve Bayesian classifier and Compute its accuracy on test data set.
3. Construct a Bayesian network using standard Heart Disease Data Set to diagnosis heart patients.
4. Implement Support Vector Machine for linear and nonlinear data.
5. Build a Neural Network by implementing the Back propagation algorithm.
6. Implement k-Nearest Neighbour algorithm to classify the iris data set.
7. Apply EM algorithm, k-Means algorithm to cluster a given data and compare the quality these clusters.
8. Implement Linear and Logistic Regression algorithms.
9. Implement Bagging and Boosting methods.
10. Implement Principle Component Analysis.

Note: Students are supposed to implement the algorithms in Java/Python/R.

Text Books:

1. Aurelien Geron,"Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, Second Edition 2019.
2. Peter Flach: Machine Learning: "The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.

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Suggested Reading:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013.

Datasets:

1. https://www.kaggle.com/datasets

2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

Web Resources:

1. https://www.coursera.org/specializations/machine-learning

20ITC18 **MINI PROJECT –II**

Instruction	2 L Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

Course Outcomes:

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

1. Interpret Literature with the purpose of formulating a project proposal.
2. Plan, Analyse, Design and Implement a project using SDLC model.
3. Find the solution of 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 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 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 all the faculty handling Mini Project for that class.

20ITE01 **DIGITALIMAGE PROCESSING**

(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the fundamental concepts and applications of digital image processing.
2. To impart knowledge on the image processing concepts: intensity transformations, spatial filtering, Smoothing and sharpening both in spatial and frequency domain.
2. To familiarize the image analysis concepts: morphological image processing, image segmentation, image representation and description, and object recognition.
3. To introduce colour image processing techniques.
4. To understand with various image compression methods.

Course Outcomes:

Upon successful completion of the course the students 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 Resources:

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/

20ADE01 **DATA ANALYSIS AND VISUALIZATION**

(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

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

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Efficiently store and manipulate dense data in arrays with Numpy
2. Apply high level mathematical functions to aggregate, broadcast, index and sort multidimensional arrays.
3. Create Series and DataFrame objects to operate on datasets.
4. Perform Data cleaning, transformation, merging, aggregation on datasets.
5. Apply 2-D and 3-D plotting techniques on datasets

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 - partitioning with K-nearest neighbors, 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

20ITE02 **MOBILE APPLICATION DEVELOPMENT WITH ANDROID AND KOTLIN**

(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the Kotlin Programming Language for Mobile Application Development
2. To demonstrate the development of basic mobile applications on android operating system
3. To demonstrate the Android Application Architecture
4. To introduce basic app design guidelines as well as styles, themes and material design
5. To demonstrate the publishing of a mobile app on Google Play

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the benefits of using Kotlin for Mobile application development
2. Understand the android project structure
3. Understand activity and fragment life cycles
4. Apply various styles, themes and material design to apps
5. Apply best practices to prepare and publish apps on Play store

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 enums, Pairs, Triples, Collections and Extensions in Kotlin

UNIT-II

Installing Android Studio, Android app project, deploying app on emulator or device, image resources and click handler, view layouts, adding libraries to module gradle file, layouts using XML and layout editor, app interactivity, ConstraintLayout, Data binding, Fragments, Navigation graphs, Navigational paths, Options menu, Safe Args plugin, External activity,

UNIT-III

Activity and Fragment life cycles, Android lifecycle library, configuration changes, Android App Architecture, Classes of Lifecycle, ViewModel and ViewModelFactory, LiveData and LiveData observers, Data binding with ViewModel and LiveData, LiveData Transformations

Room Persistence library, Coroutines, RecyclerView, Data binding with Recycler View, Retrofit library for web services, Moshi library for parsing JSON response, loading and displaying images from the internet, filtering data from the internet, Offline cache and repository, WorkManager, Background workers and periodic WorkerRequest

UNIT-IV

Basic App design, Styles and Themes, Material Design, best practices for app design Permissions, App

performance, Security, Handling user data, Compliance with personal data policies, logs, encryption of sensitive data, External storage, IP networking

UNIT-V

Firebase, Firebase analytics, Firebase notifications, Firebase database, App monetization, In-app purchases, Subscriptions, Advertising using Admob

Generate Signed APK, Preparing app for release, GooglePlay filters, Google Play developer console, Alpha and beta tests on Google Play, Pre-launch reports and Publishing

Text Books / Online Resources:

1. Android Development with Kotlin by Google
2. Android Development with Kotlin online videos

20ITE03 **FUNDAMENTALS OF CRYPTOGRAPHY**
(Professional Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce fundamental concepts of computer security and cryptography.
2. To familiarize with the concepts of block ciphers and symmetric encryption.
3. To provide knowledge on asymmetric key cryptography and key exchange.
4. To acquaint basic structure of cryptographic hash functions and message authentication codes.
5. To impart knowledge on digital signatures, key distribution, user authentication.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Demonstrate the key security concepts, security attacks and cryptography techniques.
2. Analyze block ciphers, symmetric encryption algorithms.
3. Describe the operations of asymmetric key cryptography and key exchange.
4. Comprehend cryptographic hash functions, message authentication codes.
5. Inspect the digital signature process, 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	-	1	1	2	-	2
CO2	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO3	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO4	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO5	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2

UNIT-I

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

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

UNIT-II

Block 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, ElGamal Cryptographic System, Elliptical Curve Arithmetic, Elliptical Curve Cryptography, pseudorandom number generation based on an Asymmetric cipher.

UNIT-IV

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.

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.

UNIT-V

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

20ADE02 **THEORY OF AUTOMATA**
(Professional Elective - I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:
1. To study abstract computing models: Finite Automata, Pushdown Automata and Turning Machines.
2. To introduce various grammars, formal languages and their relationships.
3. To learn about the relation among various grammars and recognizers for different formal languages.
4. To acquaint with mathematical methods to prove properties of languages, grammars and automata.
5. To familiarize with decidability and undecidability of computational problems.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Build Deterministic, Non deterministic Finite automata for Languages and show the acceptance of strings using Formal Machines.
2. Develop regular expressions and their equivalent finite automata for different languages.
3. Infer Context-free grammars for certain languages and Test for Closure Properties and Decision Properties of CFL's.
4. Construct pushdown automata for languages and analyse Equivalence of PDA's and CFG's.
5. Identify Recursively Enumerable Languages, Undecidable problems and Model Turing Machines for Simple Computational 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	1	2	2	-	1	-	-	-	-	1	-	-	2	-	2
CO2	2	2	1	-	-	-	-	-	-	1	-	-	-	-	2
CO3	2	2	1	-	-	-	-	-	-	1	-	-	1	-	2
CO4	1	2	1	-	1	-	-	-	-	1	-	-	2	-	2
CO5	2	2	2	-	1	-	-	-	-	1	-	-	2	-	2

UNIT-I
Introduction to Finite Automata, the Central Concepts of Automata Theory: Alphabets, Strings and Languages. Finite Automata: An Informal Picture of Finite Automata: The Ground Rules, the Protocol, Enabling the Automata to Ignore Actions, the Entire System as an Automaton. **Deterministic Finite Automata:** Definition of a DFA, Simpler Notations for DFA's, Extending the Transition Function to Strings, The Language of a DFA
Nondeterministic Finite Automata: Definition of NFA, The Extended Transition Function, The Language of an NFA, Equivalence of NFA and DFA, An Application: Text Search, Finite Automata with Epsilon-Transitions: Use of €-transitions, The formal notation for an €- NFA, €-closure, Extended Transitions and Languages for €- NFA's, Eliminating €-transitions.

UNIT-II
Regular Expression and languages: Regular Expressions: The Operators of Regular Expressions, Building Regular Expressions. Finite Automata and Regular Expression: From DFAs to Regular Expressions, Converting DFA 's to Regular Expressions by Eliminating States, Converting Regular Expressions to Automata, Applications of Regular Expressions, Algebraic Laws for Regular Expressions.
Properties of Regular Languages: Proving Languages not to be Regular: The pumping lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages: Testing Emptiness of Regular Languages, Testing Membership in a Regular Language. Equivalence and Minimization of Automata: Testing Equivalence of States, Testing Equivalence of Regular

Languages, Minimization of DFA's.

UNIT-III

Context Free Grammars and Languages: Context-Free Grammars: Definition of Context Free Grammars, Derivations using a Grammar, Leftmost and Rightmost Derivation, The language of a Grammar, Parse Trees: Constructing Parse Trees, The Yield of a Parse Tree, Applications of CFGs, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity From Grammars, Leftmost Derivations as way to Express Ambiguity, Inherent Ambiguity.

Properties of Context Free Languages: Normal Forms for Context-Free Grammars: Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Productions, Eliminating unit Productions, Chomsky Normal Form, Pumping Lemma for CFL 's: Statement of the Pumping Lemma, Applications of Pumping Lemma for CFL 's, Closure Properties of CFL 's, Decision Properties of CFL's: Testing Emptiness of CFL's, Testing Membership in a CFL's.

UNIT-IV

Pushdown Automata: Definition of pushdown automaton: The Formal Definition of PDA, Graphical Notation for PDA 's, Instantaneous Description of a PDA, The Language of a PDA: Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack, Equivalence of PDA 's and CFG's: From Grammars to PDA's, From PDA's to Grammars, Deterministic Pushdown Automata: Definition, Regular Languages and Deterministic PDA's.

UNIT-V

Introduction to Turing Machines: Problems that Computer Cannot Solve: The Turing Machine: Notation for the TM, Instantaneous Descriptions for TM 's, Transitions Diagrams, The Language of a TM, Turing Machines and Halting, Programming Techniques for Turing Machines: Storage in the State, Multiple Tracks, Subroutines. Extensions to the Basic Turing machine, Restricted Turing machines, Turing Machine and Computers: Simulating a Computer by a TM.

Undecidability: A Language That Is Not Recursively Enumerable: Enumerating the Binary Strings, Codes for Turing Machines, The Diagonalization Language, An Undecidable problem that is RE: Recursive Languages, Compliments of Recursive and RE languages, The Universal Languages, Undecidablity of the Universal Language, Undecidable problems about Turing Machines: Reductions, TM's That Accept The Empty Language, Rice's Theorem and Properties of RE languages, Post's Correspondence Problem: Definition of PCP, The Modified PCP, Other Undecidable Problems.

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffery D Ullman, "Introduction to Automata Theory Languages and Computation", 3rd Ed, Pearson Education, 2007.

Suggested Reading:

1. John C Martin, "Introduction to Language and Theory of Computation", 3rd Ed, TMH, 2003.
2. Daniel Cohen, "Introduction to Computer Theory", 2nd Ed, Wiley Publications, 2007.
3. Mishra K., Chandra Sekaran N," Theory of Computer Science (Automata, Languages and Computation)", 3rd Ed, Prentice Hall of India 2008.
4. Shyamalendra Kandar, "Introduction to Automata Theory, Formal Languages and Computation", Pearson, 2013.

Web Resources:

1. http://nptel.ac.in/courses/106106049/
2. http://online.stanford.edu/course/automata-theory