

MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102



Centre for Distance and Online Education

Master of Computer Applications (M.C.A)

CURRICULUM AND SYLLABUS

(From AY: 2025-26)

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- ❖ Develop industry-focused professionals with a global perspective.
- ❖ Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- ❖ Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- ❖ Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF COMPUTING

Vision

To lead the advancement of computer science research and education that has real-world impact and to push the frontiers of innovation in the field.

Mission

- ❖ Instil within our students fundamental computing knowledge, a broad set of skills, and an inquisitive attitude to create innovative solutions to serve industry and community.
- ❖ Provide an experience par excellence with our state-of-the-art research, innovation, and incubation ecosystem to realise our learners' fullest potential.
- ❖ Impart continued education and research support to working professionals in the computing domain to enhance their expertise in the cutting-edge technologies.
- ❖ Inculcate among the computing engineers of tomorrow with a spirit to solve societal challenges.

DEPARTMENT OF COMPUTER APPLICATIONS

Vision

To become a center of excellence in the field of computer science and applications.

Mission

- Imparting knowledge and skills through contemporary curriculum to the diverse group of students.
- Creating a talent pool of faculty in diverse domains of computer applications through continuous training.
- Domain and transferable skill development for the holistic personality of students to inculcate values and ethics for effective professional practice and as an entrepreneur.

MASTER OF COMPUTER APPLICATIONS (MCA)

PROGRAM EDUCATIONAL OBJECTIVES

After few years of completion of the Program, the graduates of MCA will be able to:

- PEO1.** Pursue higher education in the core and allied areas of computer science by applying computing knowledge and domain-specific knowledge, demonstrating their innovative skills, and considering social and environmental concerns.
- PEO2.** Become professionals in industry and academia with ability to investigate, and solve complex computing problems using modern tools in evolving technologies in the core and allied areas of computer science.
- PEO3.** Become successful entrepreneurs to excel in diverse application skills in the core or allied area of computer science of societal importance.
- PEO4.** Exhibit professionalism, and uplifting health, safety, legal, environmental, ethical, and cultural diversity issues for serving the society and communicating with local, and national peers, bound within regulations and leading to lifelong learning.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M.C.A Program will be able to:

- PO1. Computational Knowledge:** Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
- PO2. Problem Analysis:** Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
- PO3. Design / Development of Solutions:** Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- PO4. Conduct Investigations of Complex Computing Problems:** Use research-based knowledge and research methods including design of experiments, analysis, and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. Modern Tool Usage:** Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

- PO6. Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
- PO7. Life-long Learning:** Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
- PO8. Project management and finance:** Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO9. Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
- PO10. Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.
- PO11. Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
- PO12. Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the graduates of M.C.A Program will be able to:

- PSO1:** Design, implement and test applications for complex computing problems for desired specifications using programming skills.
- PSO2:** Analyze and adapt managerial and domain skills of Information Management to model an application's data requirements to extract information for interpreting the datasets for Decision Making.
- PSO3:** Apply suitable techniques and algorithms to integrate Operating System Services, Network devices, Security mechanisms and Infrastructure to meet the requirements for the deployment of an application and to communicate on networks.

MASTER OF COMPUTER APPLICATIONS (MCA)

Course Structure

T: Theory; T+P: Theory with Practical; P: Practical; T+PBL: Theory with Project Based Learning

T+P+PBL: Theory with Practical and Project Based Learning

I-Semester

S. No	Course Code	Course Title	Course Type	Credits
1.	22CA201001L	COMPUTATIONAL STATISTICS	T	3
2.	22CA201002L	COMPUTER ORGANIZATION AND ARCHITECTURE	T	3
3.	22CA202002L	PYTHON PROGRAMMING	T+P	4
4.	22CA202003L	DATABASE MANAGEMENT SYSTEMS	T+P	4
5.	22CA201003L	SOFTWARE ENGINEERING	T	3
6.	22CA202007L	CLOUD COMPUTING	T+P	4
Total Credits				21

II-Semester

S. No	Course Code	Course Title	Course Type	Credits
1.	22MM201404L	MATHEMATICAL FOUNDATIONS FOR COMPUTER APPLICATIONS	T	3
2.	22ME101703L	MANAGEMENT SCIENCE	T	3
3.	22CA204001L	OBJECT ORIENTED PROGRAMMING THROUGH JAVA	T+P+PBL	5
4.	22CA202005L	COMPUTER NETWORKS	T+P	4
5.	22CA201010L	INTERNET OF THINGS	T	3
PROFESSIONAL ELECTIVE – I				
6.	22CA202021L	CLOUD PRACTITIONER	T+P	4
7.	22CA202017L	CLOUD ARCHITECTURE AND DESIGN		
8.	22CA202018L	CLOUD ARCHITECT		
PROFESSIONAL ELECTIVE – II				
9.	22AI201701L	BUSINESS ANALYTICS	T	3
10.	22CB101703L	FORENSIC SCIENCE		
11.	22ME101704L	MANAGING INNOVATION AND ENTREPRENEURSHIP		
Total Credits				25

III-Semester

S. No	Course Code	Course Title	Course Type	Credits
1.	22CA211001L	INTERNSHIP	-	2
2.	22CA201005L	DATA SCIENCE AND STATISTICAL MODELING	T	3
3.	22CA203001L	OBJECT ORIENTED MODELING AND DESIGN	T+PBL	4
4.	22CA202004LL	DATA MINING	T+P	4
5.	22CA201021L	ARTIFICIAL INTELLIGENCE	T	3
PROFESSIONAL ELECTIVE – III				
6.	22CA202029L	MERN STACK DEVELOPMENT	T+P	4
7.	22CA202024L	FULL STACK CLOUD DEVELOPER		
8.	22CA204003L	MODERN APPLICATION DEVELOPMENT WITH NODE.JS ON AWS	T+P+PBL	
PROFESSIONAL ELECTIVE – IV				
9.	22CA202030L	MACHINE LEARNING	T+P	4
10.	22CA202031L	DATA HANDLING AND VISUALIZATION		
11.	22CA202032L	AI FOR HEALTH CARE		
Total Credits				24

IV-Semester

S. No	Course Code	Course Title	Course Type	Credits
1.	22CA202015L	NATURAL LANGUAGE PROCESSING	T+P	4
2.	22CA201029L	FULL STACK WEB DEVELOPMENT	T	3
3.	22CB101701L	CYBER LAWS AND SECURITY	T	3
4.	22CA208001L	CAPSTONE PROJECT	-	10
Total Credits				20

Total Credits for the award of the Degree: 90

Course Code**Course Title****22CA201001L****COMPUTATIONAL STATISTICS****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course covers measures of Central Tendency, measures of Dispersion and basics of 'R' language. Fitting the Probability distributions of Discrete Probability Distributions, Continuous Probability Distributions and implementing the probability distributions in R. Correlation and Regression Analysis is done and able to calculate Correlation and Regression Coefficients along with fitting lines of Regression in R tool. Testing of hypothesis can be done for Large sample Tests and Small sample tests.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the concepts of descriptive statistics, basics in R, Probability Distributions, Testing of Hypothesis, Correlation and Regression.
- CO2.** Apply testing of hypothesis on small and large sample testing using Z-test, t-test, F-test and chi-square test and to draw the valid inferences and solve the problems on probability distributions.
- CO3.** Use R programming tools to Simulate Binomial, Poisson and Normal distributions, and calculate Correlation and Regression Coefficients, Fitting lines of Regression.
- CO4.** Analyze the relationship between variables using Correlation and Regression.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	2.5	3	3	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT**Module 1: INTRODUCTION TO DESCRIPTIVE STATISTICS**

Measures of Central Tendency: The Arithmetic Mean, The Arithmetic Mean Computed from Grouped data, Median, Mode, Empirical Relation Between the Mean, Median, and Mode, Geometric Mean, Harmonic Mean.

Measures of Dispersion: The Range, The Mean Deviation, The Semi- Interquartile Range, The Standard Deviation, The Variance, coefficient of variation and Moments, measures of Skewness and Kurtosis.

Module 2: BASICS IN R

Basic concepts of R, R Studio, run R, Variables, Data Types, Vectors, Data Frames, Lists, Matrices, Arrays, Classes, Functions, and diagrammatical presentations in R.

Module 3: PROBABILITY DISTRIBUTIONS

Discrete Probability Distributions: Binomial Distribution- Mean and variance and fitting of Binomial distribution; Poisson distribution -Mean and variance and fitting of Poisson distribution.

Continuous Probability Distributions: Normal Distribution- Mean, variance and area properties of Normal distribution.

Implementing in R: Simulate Binomial, Poisson and Normal distributions

Module 4: CORRELATION AND REGRESSION ANALYSIS

Correlation Analysis: Linear Correlation, scatter diagram, Karl Pearson's coefficient of Correlation and Spearman's Rank correlation coefficient (with and without tied ranks).

Regression Analysis: Regression Lines, Fitting of two lines of Regression, Regression coefficients and multiple regression.

Implementing in R: Calculate Correlation and Regression Coefficients and Fitting lines of Regression.

Module 5: TESTING OF HYPOTHESIS

Large sample Tests: Null hypothesis and Alternative hypothesis, Type-I and Type-II errors, Level of significance, Critical Region, one tailed and two tailed tests; Test of Significance of single proportion, Difference of two Proportions, Single mean, Difference of two Means.

Small sample tests: t-test: Single mean, Difference of two Means; F-test; chi-square test: chi-square test for independence of attributes, chi-square test for goodness of fit.

EXPERIENTIAL LEARNING

I. For **Covid 19 scenario**, do the following using R Programming tool:

Globally, the number of new weekly cases has continued to decline since the peak in January 2022. During the week of 30 May to 5 June 2022, over three million cases were reported, a 12% decrease as compared to the previous week. The number of new weekly deaths also continues to decline, with over 7,600 fatalities reported, representing a 22% decrease as compared to the previous week. As of 5 June 2022, over 529 million confirmed cases and over six million deaths have been reported globally.

a. Requirement gathering

- i. Identify the variables and methods
- ii. Draw Histogram for statistical analysis
- iii. Write use cases for Patient information & Recovery percentage

b. Analysis

- i. Fit the Linear Regression model for the system

- ii. Draw Mathematical relationship to find the Patient information
- iii. Identify the Patient current condition and to provide right Medication

C. Design

- i. Design Data Visualization for "patient entry "and conditions
- ii. Draw R-Chart based on the Statistical analysis.

d. Evaluate quality of design

Given R-Chart, diagrammatic Representation of Histogram, evaluation of mathematical relationships will provide the patient recovery percentage in Visualization

II. Do a MOOC on Computational Statistics: <https://www.my-mooc.com/en/categorie/statistics-and-probability>

RESOURCES

TEXT BOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi et al., "*Probability and Statistics*," S. Chand and Company Ltd: New Delhi, 3rd Edition, 2011.
2. Allerhand M. "*Tiny Handbook of R*," Springer Briefs in Statistics, 2011.

REFERENCE BOOKS:

1. Shanaz Bhatul, "*Probability and Statistics*", RIDGE Publications, 2nd Edition, 2006.
2. S.C. Gupta and V.K. Kapoor, "*Fundamentals of Applied Statistics*," S.Chand and Sons, New Delhi, 2010.
3. Baayen R. "*Analyzing Linguistic Data - A Practical Introduction to Statistics using R*," 2008.
4. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, "*Beginner's Guide to R*," Springer, 2009.

SOFTWARE/TOOLS:

1. R Programming
2. R studio

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=GuTd8Yb2jUk>
2. <https://www.youtube.com/watch?v=V8eKsto3Ug>

WEB RESOURCES:

1. <http://www.nptelvideos.in/2012/11/probability-and-statistics.html>
2. <https://www.classcentral.com/course/swayam-probability-and-statistics-5228>
3. <https://www.coursera.org/browse/data-science/probability-and-statistics>

Course Code**Course Title****22MM201404L****MATHEMATICAL FOUNDATIONS FOR
COMPUTER APPLICATIONS****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course addresses the challenges of the relevance of Boolean, Lattice and algebraic systems to computer science and their corresponding systems. To apply number theory, graph theory and their related concepts and algorithm to develop security levels and intelligent systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply mathematical logic and predicate calculus to validate precise statements

CO2. Analyze the basic structures of lattice and Boolean algebra.

CO3. Demonstrate the importance of algebraic properties with regard to working within various number systems.

CO4. Formulate recurring Problems and solve their recurrence relations.

CO5. Apply the concepts of graph theory and trees to implement computer algorithms.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	1		-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	-	2	2	-	-	-	-	-	-	-	-	-	-	-

Correlation Levels:**3: High;****2: Medium;****1: Low**

COURSE CONTENT

Module 1: MATHEMATICAL REASONING

Concepts of mathematical logic, Normal Forms, The Predicate Calculus, Rule of Inference, Consistency, Proof of Contradiction, quantifiers.

Module 2: LATTICES AND BOOLEAN ALGEBRA

Lattices: Partially Ordered Relations, Hasse Diagram, Lattices as Posets, Properties of Lattices

Boolean Algebra: Basic Definitions, Truth Tables, Boolean Functions, Representation and Minimization of Boolean Functions, Karnaugh Map.

Module 3: ALGEBRAIC STRUCTURES AND NUMBER THEORY

Algebraic Structures: Binary Operations and Algebraic Structures Groups, Subgroups, Lagrange's Theorem.

Number Theory: Division Algorithm, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Euler Totient Function, Modular Arithmetic (Fermat's Theorem and Euler's Theorem (without proof))

Module 4: RECURRENCE RELATIONS

Generating Functions of Sequences, Calculating coefficients of generating function, Homogeneous Recurrence relation, solving recurrence relations by substitution and Generating functions, Methods of Characteristic Roots.

Module 5: GRAPH THEORY AND ITS APPLICATIONS

Graphs: Representation of Graphs and Graph Isomorphism, Euler Paths and Circuits, Hamiltonian Paths and Circuits, Planar Graphs, Euler's Formula and Graph Coloring.

Trees: Introduction to Trees, Properties of Trees, Applications of Trees, Spanning Trees, Counting trees, Depth-First Search, Breadth-First Search, Minimum Spanning Trees.

EXPERIENCE LEARNING:

1. To understand the application of Boolean algebra in designing and simplifying circuits. Students will be divided into groups and given a set of logic gate ICs (Integrated Circuits) including AND, OR, NOT, NAND, NOR, XOR, XNOR, along with breadboards, power supplies, LEDs, and connecting wires. Each group will be tasked with designing a circuit that performs a specific function provided to them, such as creating a particular light sequence or simulating a simple arithmetic operation (e.g., addition or subtraction).

2. To apply graph theory concepts to analyze and solve problems in network design and optimization. (Students will use a software tool (such as Gephi, NetworkX in Python, or any graph theory toolkit that is accessible) to model and analyze a network. This could be a social network (e.g., friendships, collaborations), a transportation network (e.g., roads, flights), or a data communication network (e.g., routing, data packets))

RESOURCES

TEXT BOOKS:

1. Kenneth H. Rosen, "*Discrete Mathematics and its Applications*," Tata McGraw Hill, 8th Edition, 2019.
2. Jon Pierre Fortney, "*Discrete Mathematics for Computer Science*," CRC Press, Taylor & Francis Group, 1st Edition, 2021.

REFERENCE BOOKS:

1. Richard Johnsonbaugh, "*Discrete Mathematics*," Prentice Hall, 8th Edition, 2019.
2. NarasingDeo, "*Graph Theory with application to Engineering and Computer Science*," Prentice Hall India 2016.
3. J.P. Trembly and R. Manohar, "*Discrete Mathematical Structures with Applications to Computer Science*," Tata McGraw Hill, 3rd Edition, 2017

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106183>
2. <https://nptel.ac.in/courses/106106094>

WEB RESOURCES:

1. <https://www.coursera.org/learn/discrete-mathematics>
2. <https://people.cs.pitt.edu/~milos/courses/cs441/>
3. <https://web.stanford.edu/class/cs103x/cs103x-notes.pdf>

Course Code**Course Title****22CA201002L COMPUTER ORGANIZATION AND ARCHITECTURE****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on computer organization, architecture and interconnection structures of a digital computer.
- CO2.** Analyze Arithmetic Operations, Addressing Modes, Instruction Formats, Processor and Register organization.
- CO3.** Design digital circuits for the given functional description of microoperations and memory elements.
- CO4.** Investigate the performance of Input/Output Systems, Memory systems, parallel processors, Multicore architectures to evaluate the cost-performance trade-offs.
- CO5.** Demonstrate on Parallel Processing and Multicore Computers.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO COMPUTER SYSTEM

Organization and architecture, Structure and function, IAS computer structure, Computer function, Interconnection structures, Bus interconnection.

Module 2: CENTRAL PROCESSING UNIT

Arithmetic logic unit, Integer multiplication- Booth's algorithm; Floating point representation principles, Machine instruction characteristics, Addressing modes, Instruction formats – Instruction length, Allocation of bits; Processor organization, Register organization – User visible registers, Control and status registers; Instruction cycle.

Module 3: CONTROL UNIT AND INPUT/OUTPUT

Control Unit: Micro operations, Control of the processor – Functional requirements, Control signals, Internal processor organization; Hardwired implementation, Microinstructions, Microprogrammed control unit, Micro instruction sequencing – Design considerations, sequencing techniques, Address generation; Micro instruction execution- A taxonomy of microinstructions, Microinstruction encoding.

Input/Output: External devices, I/O modules, Direct memory access function, I/O Channels and Processors, PCI Physical and Logical Architecture.

Module 4: MEMORY SYSTEMS

Semiconductor Memories: Computer Memory System overview, Semiconductor Main Memory- Organization, DRAM and SRAM, Types of ROM, Chip logic, Chip packaging, Module organization, Interleaved memory; DDR DRAM, Flash Memory, Newer Nonvolatile Solid-State Memory Technologies.

Cache Memory: Cache Memory Principles, Elements of Cache Design-Cache Addresses, Mapping Functions.

External Memory: Solid State Drives.

Module 5: PARALLEL ORGANIZATION

Parallel Processing: Multiple Processor Organizations, Instruction Pipelining, Symmetric Multiprocessors, Nonuniform Memory Access, Multicore Organization.

Multicore Computers: Hardware performance issues, Software performance issues, Multicore organization, Intel Core i7-990X.

EXPERIENTIAL LEARNING

1. Write a report on Product Specifications such as CPU, Memory, Processor Graphics and advanced technologies of Intel Core i9-12900K -New performance hybrid architecture. The World's Best Gaming Processor: Available with up to 16 cores and 24 threads, the new 12th Gen Intel Core processor family includes the world's best gaming processor, the Core i9-12900K, unleashing gaming experiences across top titles. (<https://ark.intel.com/content/www/us/en/ark/products/134599/intel-core-i912900k-processor-30m-cache-up-to-5-20-ghz.html>)

2. Write a report on OpenCL (Open Computing Language) framework used for writing programs that execute across heterogeneous platforms consisting of central processing units, graphics processing units, digital signal processors, field-programmable gate arrays and other processors or hardware accelerators.

(<https://www.khronos.org/api/opencvl>)

RESOURCES

TEXT BOOKS:

1. William Stallings, Computer Organization and Architecture: Design for performance, Pearson, 11th Edition, 2020.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, McGraw Hill Education, 2013.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design - A Hardware software interface, 5th Edition, Morgan Kaufmann, 2014.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs37/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview
3. https://onlinecourses.nptel.ac.in/noc21_cs47/preview
4. <https://freevideolectures.com/course/2277/computer-organization>
5. <https://www.youtube.com/watch?v=4TzMyXmzL8M>

WEB RESOURCES:

1. <https://www.javatpoint.com/computer-organization-and-architecture-tutorial>
2. <https://www.geeksforgeeks.org/last-minute-notes-computer-organization/>
3. <https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation-architecture>
4. <https://tutorialspoint.dev/computer-science/computer-organization-and-architecture/>

Course Code	Course Title
22CA202002L	PYTHON PROGRAMMING

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Basics of Python programming, Control structures, Sequences, Sets, Dictionaries, Regular expressions, Functions, File handling, Object-oriented programming, Exception handling.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on Python constructs, sequences, sets and dictionaries to solve basic computational problems.
- CO2.** Apply the concepts of regular expressions for searching patterns in strings.
- CO3.** Develop and use Python modules to provide solutions to problems.
- CO4.** Apply the knowledge of file operations in Python for file processing.
- CO5.** Design applications using object-oriented programming features – encapsulation, inheritance, polymorphism and exception handling.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	3	3	3		-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PYTHON PROGRAMMING

Introduction to Python, Tokens, Variables, Literals, Identifiers, Keywords, Special symbols, Operators, Fundamental datatypes, Expressions, Type conversions, Handling Input and output in Python.

Module 2: CONTROL STRUCTURES

Selection Statements: if statement, if-else statement, if-elif-else statement, nested-if statement.

Iterative Statements: while loop, for loop, break statement, continue statement, pass and else statements used with loops.

Module 3 SEQUENCES, SETS, DICTIONARIES AND REGULAR EXPRESSIONS

Sequences: Lists and operations – Creating, Inserting elements, Updating elements, Deleting elements, Searching and sorting, List comprehensions, Nested lists; Tuples – Creating, Searching and sorting, Nested tuples; Strings – Initializing a string and string operations, String handling methods, String formatting.

Sets: Set creation, Set operations.

Dictionaries: Operations on dictionaries, Dictionary methods, Sorting elements using lambdas.

Regular Expressions: Regular expressions, Sequence characters in regular expressions, Quantifiers in regular expressions, Special characters in regular expressions.

Module 4 FUNCTIONS AND FILE HANDLING

Functions: Need for functions, Function definition, Function call, Variable scope and lifetime, Return statement, Positional arguments, Keyword arguments, Default arguments and variable length arguments, Recursive functions, Lambda functions, Generators.

File Handling: Types of files, Opening and closing files, Reading and writing data.

Module 5 OBJECT ORIENTED PROGRAMMING AND EXCEPTION HANDLING

Object Oriented Programming: Introduction to object-oriented programming, Classes and objects, Inheritance and polymorphism, Abstract Classes and interfaces.

Exception Handling: Errors in a python program, Exceptions, Exception handling, Types of exceptions, Except block, Assert statement, User defined exceptions.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

- 1) Design a python script to perform the various computations for the amount payable by the customer for Challenger Computers Store. A customer buying two numbers of SSD device, one SSD device cost is Rs. 3575/-. The stores offer 15% of the total cost. The customer has to pay 9% CGST, and 9% SGST. Prepare the Net Amount to be payable by the customer.
- 2) Design a python script to compute and generate the electricity bill as per the following slab rates. Collect the meter reading inputs, such as current unit and previous unit.

Consumption Units	Rate (in Rupees/Unit)
0-200	3.0
201-250	4.5
251-300	5.2
301-400	6.5
Above 400	7.0

- 3) Design a python script to display the sum of numbers divisible by 4. The code must allow the user to accept a number and add it to the sum if it is divisible by 4. It should repeatedly accepting numbers as long as the user wants to provide an input using an appropriate iterative statement and should display the final sum.
- 4) Food Corner home delivers vegetarian and non-vegetarian combos to its customer based on order. A vegetarian combo costs Rs.120 per plate and a non-vegetarian combo costs Rs.150 per plate. Their non-veg combo is really famous that they get more orders for their non-vegetarian combo than the vegetarian combo. Apart from the cost per plate of food, customers are also charged for home delivery based on the distance in kms from the restaurant to the delivery point. The delivery charges are as mentioned below:

Distance in kms	Delivery charge in Rs per km
For first 3kms	0
For next 3kms	3
For the remaining	6

Given the type of food, quantity (no. of plates) and the distance in kms from the restaurant to the delivery point, write a python program to calculate the final bill amount to be paid by a customer. The below information must be used to check the validity of the data provided by the customer.

- Type of food must be 'V' for vegetarian and 'N' for non-vegetarian.
 - Distance in kms must be greater than 0.
 - Quantity ordered should be minimum 1.
 - If any of the input is invalid, bill amount should be considered as -1.
- 5) a) A list has the AP City Names [Tirupati, Kurnool, Kadapa]. Design a python script and perform the operations like, add 3 more AP City names Chittoor, Nellore, Guntur, insert Hyderabad in 3rd position, delete any two city names, update all city names as in Uppercase. Displays the list data, whenever an operation completes.
- b) Design a python script for given an integer tuple, for each element in the tuple, check whether there exists a smaller element on the next immediate position of the tuple. If it exists print the smaller element. If there is no smaller element on the immediate next to the element then print -1.
Example: Input: 4 2 1 5 3 Output: 2 1 -1 3 -1
- 6) a) Sets n1 has the data {1, 3, 5, 7, 9}, n2 has the data {9, 5, 6, 8},
wd1=set(["Mon", "Tue", "Wed", "Thu", "Fri", "Sat", "Sun"]),
wd2=set(["Mon", "Tue", "Wed"]).
Design a python script to perform intersection, difference, and symmetric

- difference operations on the sets n1 and n2, and to perform superset, and subset operations on the sets wd1, and wd2.
- b) The dictionary city_pin has the data {'Tirupati': 517101, 'Hyderabad': 500002, 'Chittoor': 517001, 'Nellore': 524001}. Design a python script using lambda function to sort the dictionary on city name and produce the output and sort the dictionary on pincode and produce the output.
 - c) The string has the data, Wel_str = "Welcome to AI ML DS". Design a python script to search the pattern "AI" using regular expression search and display the three location numbers of the pattern. First shows the pattern starts location, second shows the pattern end location, and the last shows pattern span locations.
- 7)
 - a) Design a python script for the mathematical puzzle, Towers of Hanoi. The puzzle has three rods and n disks. To move the entire stack to another rod, obeying the three rules (i) Only one disk can be moved at a time, (ii) Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e., a disk can only be moved if it is the uppermost disk on a stack, (iii) No disk may be placed on top of a smaller disk.
 - b) Design a python script to display the numbers that do not appear in the Fibonacci series of n numbers where n is given by the user. (If n is 8 then up to 8 Fibonacci numbers has to be printed Ex: 1 1 2 3 5 8 13 21 and in this series missing numbers should be traced and printed, Ex: missing numbers are: 4 6 7 9 10 11 12 14 15 16 17 18 19.
 - 8)
 - a) Design a function Learner_Age_Days with two formal parameters name, age and it computes Learner's age in days, then displays learners name and age in days.
 - (i) Design a driver code to call the function using positional arguments, keyword arguments
 - (ii) Apply the necessary changes in Learner_Age_Days function, and design a driver code to call the function using default arguments.
 - b) Design a python script using lambda and filter functions to construct an odd numbers list from numbers 1 to 10, and construct a negative numbers list from range of numbers -7 to 7 and to find the biggest number from a numbers list.
 - 9)
 - a) Design a python script to create a new file Collect_Literals_Python.txt, collect the data from the keyboard about the contents of collection literals list, tuple, sets, dictionaries details, then write all the data into that file, and then close that file. Afterwards Open the Collect_Literals_Python.txt file in read mode, read the entire contents of the file Collect_Literals_Python.txt, then display all the contents of that file in monitor.
 - b) The file feat_python1.txt has the contents of features of the Python programming language. Design a python script to open that file feat_python1.txt in read mode, open the new file in feat_python2.txt in write mode, then read entire contents of the file feat_python1.txt, then copy all the contents of that file into the new file feat_python2.txt
 - 10)
 - a) Construct a Python script to implement the below requirements. Create a base class Basic_Info with data members name, rollno, gender and two member functions getdata() and display(). Derive a class Physical_Fit from Basic_Info which has data members height and weight and member functions getdata() and display(). Display all the information using object of derived class.
 - b) Design a Python script to implement the below specifications, compute, and produce required output. Define a class REPORT with the following specification

Private members

Admno : 4-digit admission number
Name : 20 characters
Marks : A list of 5 floating point values
Average : average marks obtained

GETAVG() a function to compute the average obtained in five subjects.

Public members

READINFO() function to accept values for Adno, Name, Marks. Invoke the function GETAVG ().

DISPLAYINFO() function to display all data members of report on the screen. You should give function definitions. Write driver code to demonstrate all the functions.

- 11) a) The below scenarios will create Logical Error/Exception, and it will forcibly stop the execution in middle of the program. Design a Python Script the to handle these operations exceptions effectively, and avoid to stop the script execution in the middle.
- i. The variable num has the data 100, the value of num dividing by the value 0.
 - ii. To importing a library file matheqn, this library file not available in Python.
 - iii. A num_List has the values[10,20,30].To print the fifth value of num_List[5]
 - iv. A dictionary has the data, Dict_Univ = {'1':"MBU", '2':"Tirupathi", '3':"CSE"}. to print the fifth key value Dict_Univ[5]
- b) Design a python script to collect the 10 students Python course mark. Check that entered mark is negative, then throw a user defined exception called Negative, otherwise store into the mark in the List Python_mark[].

RESOURCES

TEXT BOOKS:

1. R. Nageswara Rao, "Core Python Programming," 3rd Edition, Dreamtech Press, 2021.
2. Paul J. Deitel, Harvey Deitel, "Python for Programmers with Big Data and Artificial Intelligence Case Studies," Pearson, 2019.

REFERENCE BOOKS:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus," Wiley India, 2016.
2. Christian Hil,"Learning Scientific Programming with Python," 2nd Edition, Cambridge University Press, 2020.

SOFTWARE/TOOLS:

1. Python 3.10
2. Jupyter Notebook/JupyterLab/IDLE/Google CoLab

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. <https://www.coursera.org/specializations/python>
3. <https://www.coursera.org/learn/python-for-applied-data-science-ai>
4. <https://www.youtube.com/watch?v=WGJJrtnfpk>
5. <https://www.youtube.com/watch?v=uQrJ0TkZlc>
6. <https://www.udemy.com/topic/python/>
7. <https://freevideolectures.com/course/2512/python-programming>

WEB RESOURCES:

1. <https://www.w3schools.com/python/>
2. <https://www.programiz.com/python-programming>
3. <https://www.geeksforgeeks.org/python-programming-language/>
4. <https://www.javatpoint.com/python-lists>
5. <https://www.learnpython.org/>

Course Code**Course Title****22CA211001L****INTERNSHIP****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.
- CO2.** Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.
- CO3.** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3 PSO4
CO1	3	3	-	3	3	-	-	3	-	-	-	3	-	-	
CO2	-	3	-	-	-	3	3	-	-	-	3	-	-	-	
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	
Course Correlation Mapping	3	3	-	3	3	3	3	3	3	3	3	3	-	-	

Correlation Level: 3-High; 2-Medium; 1-Low

Course Code	Course Title
22CA208001L	CAPSTONE PROJECT
Pre-Requisite	-
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Preparation of thesis and presentation.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Create/Design computer science engineering systems or processes to solve complex computer science engineering and allied problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.
- CO2.** Consider society, health, safety, environment, sustainability, economics and project management in solving complex computer science engineering and allied problems.
- CO3.** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on computer science engineering systems or processes.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	3	3	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-

Correlation Level: 3-High; 2-Medium; 1-Low

Course Code**Course Title****22ME101703L****MANAGEMENT SCIENCE****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.
- CO2.** Apply the concepts of HRM for selection and management of human resources.
- CO3.** Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services
- CO4.** Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints
- CO5.** Develop network models in time-cost trade-off for effective project management.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	-	1	-	1	2	-	-	-	1	-	3	-	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	3	-	-
CO3	3	3	1	1	1	-	-	-	-	-	-	1	-	3	-	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	-	3	-	-
CO5	3	3	3	1	1	-		-	-	-	-	2	-	3	-	-
Course Correlation Mapping	3	2	1	1	1	-	1	2	-	-	-	1	-	3	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT**Module 1: MANAGERIAL FUNCTION AND PROCESS**

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems

management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

Module 2: HUMAN RESOURCE MANAGEMENT

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

Module 3 OPERATIONS MANAGEMENT

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

Module 4 MARKETING MANAGEMENT

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

Module 5 PROJECT MANAGEMENT

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

EXPERIENTIAL LEARNING

1. Find the social responsibilities in the context of management theoretically and practically in an organization.
2. Identify and apply different marketing strategies to maximize enterprise profitability and customer satisfaction.
3. Apply the network models practically in an industry for effectiveness

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES/ ARTICLES:

Contemporary relevant case studies/Articles will be provided by the course instructor at the beginning.

RESOURCES

TEXT BOOKS:

1. MartandT.Telsang, *Industrial Engineering and Production Management*, S. Chand, 2nd Edition, 2006.

2. Koontz and Weihrich, *Essentials of Management*, TMH, 6th Edition, New Delhi, 2007.

REFERENCE BOOKS:

1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons, 2010.
2. N.D. Vohra, *Quantitative Techniques in Management*, TMH, 2nd Edition, New Delhi.
3. L.M. Prasad, *Principles and practice of Management*, S. Chand and Sons, 2006.

VIDEO LECTURES:

1. <https://archive.nptel.ac.in/courses/122/106/122106032/>
2. <https://www.digimat.in/nptel/courses/video/122102007/L01.html>

WEB RESOURCES:

1. <https://mitsloan.mit.edu/teaching-resources-library/management-simulations>
2. <https://ocw.mit.edu/>

Course Code**Course Title****22CA202003L****DATABASE MANAGEMENT SYSTEMS****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This Course provides theoretical concepts and hands-on experience on Database systems, Database design, Relational model, Relational algebra, SQL queries, Constraints and triggers, PL/SQL, Schema refinement and normal forms, Transaction management, Concurrency control, Overview of storage and indexing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyze and apply the concepts of ER-modeling and normalization to design viable data models for a given problem.
- CO2.** Formulate relational database schemas, apply suitable integrity constraints, for querying databases.
- CO3.** Use SQL to store, query, and manipulate data in relational databases.
- CO4.** Develop PL/SQL blocks to centralize database applications for maintainability and reusability.
- CO5.** Analyze transaction processing, concurrency control and storage methods for database management.

CO-PO-PSO Mapping Table:

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

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO DATABASE SYSTEMS AND DATABASE DESIGN

Introduction to Database Systems: Database system applications, Purpose of database systems, View of data - Data abstraction, Instances and schemas, Data models; Database languages - Data Definition Language, Data Manipulation Language; Database architecture, Database users and administrators.

Introduction to Database Design: Database design and ER diagrams, Entities, attributes and entity sets, Relationships and relationship sets, Additional features of ER model, Conceptual Design with ER model.

Module 2: RELATIONAL MODEL AND RELATIONAL ALGEBRA

Relational Model: Creating and modifying relations, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical database design, Introduction to views, Destroying/altering tables and views.

Relational Algebra: Preliminaries, Relational Algebra operators.

Module 3: SQL AND PL/SQL

SQL: Form of basic SQL query, Nested queries, Aggregate operators, Null values, Complex integrity constraints in SQL, Triggers and active databases.

PL/SQL: Generic PL/SQL block, PL/SQL data types, Control structure, Procedures and functions, Cursors, Database triggers.

Module 4: SCHEMA REFINEMENT AND TRANSACTIONS

Schema Refinement: Problems caused by redundancy, Decompositions, Problems related to decomposition, Functional dependencies, Reasoning about FDs, First normal form, Second normal form, Third normal form, Boyce-Codd normal form, Multivalued dependencies, Fourth normal form, Join dependencies, Fifth normal form.

Transactions: Transaction concept, Transaction atomicity and durability, Concurrent Executions – Serializability, Recoverability, Implementation of isolation, Testing for serializability.

Module 5: CONCURRENCY CONTROL, STORAGE AND INDEXING

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

Storage and Indexing: Data on external storage, File organizations and indexing – Clustered indexes, Primary and secondary indexes; Index data structures – Hash based indexing, Tree based indexing; Comparison of file organizations.

EXPERIENTIAL LEARNING

- 1) Design and analyze an ER-Model for the following use case.
Road way Travels is in business since 1977 with several buses connecting different places in India. Its main office is in Hyderabad. The company wants to computerize its operations in the following areas:
 - a) Reservations
 - b) Ticketing
 - c) Cancellations

Reservations:
Reservations are directly handled by booking office. Reservations can be made 60 days in advance in either cash or credit. In case the ticket is not available, wait listed ticket is issued to the customer. This ticket is confirmed against the cancellation.

Cancellation and Modification:
Cancellations are also directly handled at the booking office. Cancellation charges will be charged. Wait listed tickets that do not get confirmed are fully refunded.
- 2)
 - a) Implement Single Row functions-Character, Numeric and Date functions.
 - b) Implement Data Definition Language commands-CREATE, ALTER, DROP, TRUNCATE, and RENAME.
 - c) Implement Data Manipulation Language commands-INSERT, SELECT, UPDATE, and DELETE.
- 3) Implement various types of integrity constraints-NOT NULL constraint, DEFAULT constraint, UNIQUE constraint, PRIMARY key, FOREIGN key, CHECK constraint.
- 4)
 - a) Implement group functions with different operators such as aggregate operators, GROUP BY, HAVING and ORDER BY.
 - b) Implement nested and correlated nested queries using set operators and set comparison operators.
- 5)
 - a) Creation of views, synonyms, sequence, indexes and save point
 - b) Implement various types of joins-outer join and inner join.

Basic PL/SQL:

- 6) Construct PL/SQL block for the following:
 - a) To determine whether a number is palindrome
 - b) To determine whether a number is an Armstrong number
 - c) To find greatest of three numbers
 - d) To display Fibonacci series

Control Structures:

- 7)
 - a) Write a programming PL/SQL to update the salary of a specific employee by 8% if the salary exceeds the mid-range of the salary against this job and update up to mid-

range if the salary is less than the mid-range of the salary, and display a suitable message.

- b) Write a PL/SQL program to display the description against a student's grade using CASE statement.

Exception Handling:

- 8)
 - a) Develop a PL/SQL program that displays the name and address of a student whose ID is given. If there is no student with the given student ID in the database, the program should raise a run-time exception NO_DATA_FOUND, which should be captured in the EXCEPTION block.
 - b) Construct the user-defined exceptions to get the salary of an employee and check it with the job's salary range. If the salary is below the range, raise an exception BELOW_SALARY_RANGE. If his salary is above the range, raise the exception ABOVE_SALARY_RANGE.

Functions

- 9)
 - a) Write a function that accepts two numbers A and B and performs the following operations.
 - o Addition
 - o Subtraction
 - o Multiplication
 - o Division
 - b) Write a PL/SQL block that updates salary of an employee in Employee table by using incr function which takes employee number as argument and calculates increment and returns increment based on the following criteria.
 - o If salary ≤ 3000, increment = 30% of salary
 - o If salary > 3000 and ≤ 6000, increment = 20% of salary
 - o Else increment = 10% of salary

Procedures:

- 10)
 - a) Write a procedure that accepts two numbers and displays their sum
 - b) Write procedures to demonstrate IN, INOUT and OUT parameters

Cursors:

- 11)
 - a) Write a block in PL/SQL to create a Cursor that displays the employee name and number of jobs he/she has done in the past.
 - b) Write a program in PL/SQL to create a cursor to display the name and salary of each employee in the EMPLOYEES table whose salary is less than that specified by a passed-in parameter value.

Triggers:

- 12) Develop a suitable student database application by considering appropriate attributes. Couple of attributes to be maintained is the attendance of a student in each subject for which he/she has enrolled and internal assessment Using TRIGGERS for the following:

- a) Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the concerned head of the department.
- b) Whenever, the marks in an internal assessment test are entered, check if the marks are less than 40%; if so, notify the concerned head of the department.

RESOURCES

TEXT BOOKS:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw Hill, 3rd Edition, 2014.
2. Abraham Silberschatz, Henry. F. Korth, S. Sudarshan, Database System Concepts, McGraw Hill, 7th edition, 2019.

REFERENCE BOOKS:

1. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB publications, 4th Edition, 2017.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson, 2015.
3. Thomas Connolly, Carolyn Begg, Database Systems, Pearson, 6th edition, 2019.
4. S.K.Singh, Database System Concepts, Design and Applications, 1st Edition, Pearson Education, 2006.
5. SatishAnsani, Oracle Database 11g: Hands-on SQL and PL/SQL, PHI, 2010.
6. Dr. Rajiv Chopra, Database Management Systems, Sultan Chand, 2016.
7. Pranab Kumar Das Gupta, P. Radha Krishna, Database Management System Oracle SQL and PL/SQL, PHI, 2nd Edition, 2009.

VIDEO LECTURES:

1. https://swayam.gov.in/nd1_noc19_cs46/preview
2. <https://nptel.ac.in/courses/106105175>
3. https://onlinecourses.nptel.ac.in/noc21_cs04/preview
4. <https://www.youtube.com/watch?v=MDQxqYVXiVU>
5. <https://www.youtube.com/watch?v=c5HAWKX-suM>

WEB RESOURCES:

1. <https://www.classcentral.com/course/swayam-introduction-to-database-systems-17660>
2. <https://www.scaler.com/topics/dbms/>
3. https://www.academia.edu/27988617/Database_Management_System_DBMS_Tutorial
4. <https://nptel.ac.in/courses/106104135>
5. <https://downloads.mysql.com/docs/mysql-tutorial-excerpt-5.7-en.pdf>

Course Code	Course Title
22CA202004L	DATA MINING

Pre-Requisite DATABASE MANAGEMENT SYSTEMS

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course covers the basic concepts of data mining and select and apply appropriate data pre-processing techniques, Data Cube Computation Methods and data mining algorithms. Association Rule Mining, Classification, and Clustering methods implemented to infer the valid conclusions in addition to forecasting time series, data mining trends and research frontiers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Analyse pre-processing techniques, Data Cube Technology, data mining algorithms and identify frequent itemsets.
- CO2.** Apply data mining techniques and tools to discover knowledge from text, and multimedia data.
- CO3.** Select and apply Classification and Clustering algorithms on pre-processed datasets to infer predictions effectively.
- CO4.** Apply data mining methods to forecasting time series and provide analytical solutions for societal issues.
- CO5.** Work independently or in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO4	2	3	3	-	3	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	3	-	-	-	3	3	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: DATA MINING AND DATA PREPROCESSING

Data Mining: Motivated Data Mining, Kinds of Data to mined, kinds of patterns mined, Technologies Used, Kinds of applications targeted, Major issues in Data Mining.

Data Preprocessing: Need for Pre-processing the Data, Major Tasks in Data Preprocessing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

Module 2: DATA CUBE TECHNOLOGY AND MINING FREQUENT PATTERNS, ASSOCIATIONS, AND CORRELATIONS

Data Cube Technology :Data Cube Computation, Data Cube Computation Methods, Multidimensional Data Analysis in Cube Space.

Association Rule Mining: Basic Concepts, Frequent Itemset Mining Methods: The Apriori algorithm for finding frequent itemsets using candidate generation, generating association rules from frequent itemsets, Mining frequent itemsets without candidate generation, Pattern Evaluation Methods

Module 3: CLASSIFICATION

Classification: Basic Concepts of Classification, Classification by Decision Tree Induction, Bayesian Classification, Rule-based classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy, Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, Classification Using Frequent Patterns

Module 4: CLUSTER ANALYSIS

Clustering: Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning methods - k-means and k-medoids methods, CLARANS, Hierarchical Methods-Agglomerative and divisive hierarchical clustering, **Density-Based Methods:** DBSCAN, **Grid-Based Methods:** STING, Evaluation of Clustering, Outliers and Outlier Analysis.

Module 5: FORECASTING TIME SERIES AND DATA MINING TRENDS AND RESEARCH FRONTIERS

Forecasting Time Series: Concepts of time series, Evaluating time series models, Analysis of the components of time series, Exponential smoothing models.

Data Mining Trends and Research Frontiers: Mining Complex Data Types, Data Mining Applications, Data Mining and Society, Data Mining Trends.

EXPERIENTIAL LEARNING

1. Create data sets in ARFF and CSV formats and load into the Weka Explorer.
2. Perform data preprocessing steps on weather nominal and student information data sets as follows:
 - a) Handle missing values for categorical and nominal values.
 - b) Select relevant attributes.
 - c) Apply normalization techniques

3. Generate strong Association rules by applying Apriori algorithm on preprocessed dataset with Min_Sup=60% and Min_Conf=80%.
4. i) Implement the Classification using Decision Tree algorithm on 'Weather' dataset. Draw the confusion matrix and report the model with accuracy.
(ii) Implement Bayesian Classification and analyze the results on 'iris' dataset.
5. Implement simple k-Means clustering algorithm on 'iris' dataset.
6. Use Experimenter WEKA component to rank the performance of j48, oneR, ID3, algorithms on 'weather nominal' dataset.
7. Verify ID3 classifier performance using Gain ratio and Ranker method using a Knowledge flow WEKA component.
8. Implement SVM / Decision tree classification techniques in R tool.
9. Implement clustering techniques in R tool.
10. Visualize data using any plotting framework in R tool.

RESOURCES

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques," Elsevier, 3rd Edition, 2013.
2. G. K. Gupta, "Introduction to Data Mining with Case Studies," Eastern Economy Edition, Prentice Hall of India, 2006.

REFERENCE BOOKS:

1. Ian H. Witten, Eibe Frank, and Mark, "A Data Mining: Practical Machine Learning Tools and Techniques," Hall Morgan Kaufmann, 3rd Edition, 2011.
2. Mining of Massive Datasets by Anand Rajaraman and Jeff Ullman.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies," PHI, New Delhi, 3rd Edition, 2009.
4. Arun K Pujari, "Data Mining Techniques," Universities Press (India) Pvt. Ltd, 2nd Edition, 2001.

SOFTWARE/TOOLS:

1. WEKA
2. R Studio

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=a4M3GdI5UFY>
2. https://www.youtube.com/watch?v=ykZ-_UGcYWg&list=PLLspfyOYoQcI6Nno3gPkq0h5YSe81hsc
3. https://www.youtube.com/watch?v=ykZ-_UGcYWg&list=PLLspfyOYoQcI6Nno3gPkq0h5YSe81hsc
4. https://www.youtube.com/watch?v=N_whCVtfL9M&list=PLLspfyOYoQcI6Nno3gPkq0h5YSe81hsc&index=4
5. <https://www.youtube.com/watch?v=hEQkqpmtx-Y&list=PLLspfyOYoQcI6Nno3gPkq0h5YSe81hsc&index=5>

WEB RESOURCES:

1. <https://www.cs.waikato.ac.nz/ml/weka/book.html>
2. <http://infolab.stanford.edu/~ullman/mmds/book.pdf>
3. Open source tools for data mining: <http://eprints.fri.uni-lj.si/893/1/2008-OpenSourceDataMining.pdf>
4. <https://www.kaggle.com/datasets>
5. <https://nptel.ac.in/courses/106/105/106105174/>

Course Code**Course Title****22CA202005L****COMPUTER NETWORKS****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Network topology, Protocols, Physical layer, Error detection and Correction, Medium access, Ethernet, Routing protocols, IP addressing, TCP, UDP, Congestion control, DNS, Email, HTTPS.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Interpret different types of network topologies, layers and protocols.
- CO2.** Solve problems related to flow control, error control and congestion control in data transmission.
- CO3.** Evaluate sub netting and routing algorithms for finding optimal paths in networks.
- CO4.** Analyze various congestion control mechanisms and identify appropriate transport layer protocols.
- CO5.** Assess the impact of wired and wireless networks in the context of network protocols such as Ethernet, Bluetooth, DNS, WWW, E-Mail, and Streaming.

CO-PO-PSO Mapping Table:

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

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT**Module 1: INTRODUCTION AND PHYSICAL LAYER**

Introduction: Uses of computer networks, Types, Network technology from local to global, Examples of networks, Network protocols, Reference models.

Physical Layer: Guided transmission media, Wireless transmission, Using the spectrum for transmission, Communication satellites, Comparing different access networks.

Module 2: DATA LINK LAYER AND MEDIUM ACCESS CONTROL SUBLAYER

Data Link Layer: Data link layer design issues, Error detection and correction, Elementary data link protocols.

Medium Access Control Sub layer: ALOHA, Carrier sense multiple access protocols, Collision free protocols. Ethernet, Wireless LANs, Bluetooth, Data link layer switching.

Module 3: NETWORK LAYER

Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing, Any cast routing; Traffic management at the network layer, Software Defined Networking (SDN), Network layer in the internet-The IP version-4 protocol, IP addresses, IP version-6, Internet control protocols, OSPF, BGP.

Module 4: TRANSPORT LAYER

UDP – Introduction to UDP, Remote procedure call, Real-time transport protocols; TCP – service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control; Performance issues.

Module 5: APPLICATION LAYER

Domain Name System - The DNS Lookup Process, The DNS Name Space and Hierarchy, DNS Queries and Responses, Name Resolution. Electronic mail-Architecture and services, User agent, Message formats, Message transfer, Final delivery; The World Wide Web-Architectural overview, HTTP, HTTPS; Streaming audio and video- Digital Audio, Video, Streaming Stored Media, Real-Time Streaming.

EXPERIENTIAL LEARNING

1. Implement the following data link layer framing methods.
 - i) Character count
 - ii) Character stuffing
 - iii) Bit Stuffing
2. Design and develop a program to compute checksum for the given frame 1101011011 using CRC-12, CRC-16, and CRC-CCIP. Display the actual bit string transmitted. Suppose any bit is inverted during transmission. Show that this error is detected at the receiver's end.
3. Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.
4. Implement Dijkstra's algorithm to compute the shortest path through a network.
5. Implement distance vector routing algorithm for obtaining routing tables at each node.

Packet Tracer Simulator:

6. a) Create a simple LAN with hubs and switches and monitor the data flow.

- b) Construct a LAN with single/multiple router and share data to local and remote network.
- 7. Create and implement a standard access list that blocks the student's section from accessing the server section.
- 8. Simulate OSPF routing protocol using packet tracer.

NS2 Simulator:

- 9. Simulate star/mesh network topology used in LAN using TCP/UDP connection.
- 10. Simulate distance vector/link state routing algorithm.

RESOURCES

TEXT BOOKS:

- 1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Pearson, 6th Edition, 2022.
- 2. William Stallings, Data and Computer Communications, 10th Edition, Pearson Education, 2013.

REFERENCE BOOKS:

- 1. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, 5th Edition, 2017.
- 2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson, 8th Edition, 2022.

SOFTWARE/TOOLS:

- 1. Software: J2SDK, Eclipse/Netbeans
- 2. NS-2, Packet Tracer

VIDEO LECTURES:

- 1. <http://nptel.ac.in/courses/106105081>
- 2. <http://nptel.ac.in/courses/106106091>
- 3. <https://archive.nptel.ac.in/courses/106/105/106105183/>
- 4. <https://www.youtube.com/watch?v=frUQMHXhnvs>
- 5. https://www.youtube.com/watch?v=k_lfL93zDNQ

WEB RESOURCES:

- 1. Virtual Labs (Computer Networks Lab – http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php)
- 2. Virtual Labs (Advanced Network Technologies Virtual Lab - <http://vlabs.iitkgp.ernet.in/ant>)

3. <https://www.cisco.com/c/en/us/solutions/small-business/resource-center/networking/networking-basics.html>
4. <https://www.ibm.com/in-en/cloud/learn/networking-a-complete-guide>
5. <https://ipcisco.com/cisco-packet-tracer-configuration-examples/>
6. <https://www.isi.edu/nsnam/ns/>
7. https://www.cisco.com/c/dam/global/fi_fi/assets/docs/SMB_University_120307_Networking_Fundamentals.pdf

Course Code**Course Title****22CA204001L****OBJECT ORIENTED PROGRAMMING
THROUGH JAVA****Pre-Requisite** PYTHON PROGRAMMING**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: this course is emphasize on the fundamentals structure design with classes including development, testing, implementation and documentation. This course also focuses on understanding and practical mastery of object oriented concepts such as classes, objects, data abstraction, methods, method overloading, inheritance and polymorphism. By end of the course, students will acquire the basic knowledge and skills necessary to implement object-oriented programming techniques in software development using Java.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Apply object oriented programming constructs to solve computational problems.
- CO2.** Use Exception handling and multithreading mechanisms to create efficient software applications.
- CO3.** Create Web based applications using collections frameworks to solve real world problems.
- CO4.** Design and develop GUI using applets and swings for internet and system based applications.
- CO5.** Work independently or in team to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	3	-	-	-	2	-	-	-	-	2	3	-	3
CO3	3	3	-	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	-	-	2	2	3	3	2	2	3	-	3

Correlation Levels:**3: High;****2: Medium;****1: Low**

COURSE CONTENT

Module 1: OOPS FUNDAMENTALS

Introduction: History of Java, Byte code, JVM, Java buzzwords, OOP principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays.

Concepts Of Classes And Objects: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, StringTokenizer.

Module 2: INHERITANCE, INTERFACE AND PACKAGES

Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages.

Module 3 EXCEPTION HANDLING AND MULTITHREADING

Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception;

Multithreading: Concepts of multithreading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.

Module 4 COLLECTION FRAMEWORK

Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List - ArrayList, Linked List, Vector, Set - HashSet, TreeSet, Map - Hashtable, HashMap, Accessing a collection via an Iterator, comparator, comparable.

Module 5 GUI PROGRAMMING

GUI Programming With Applets: Applets - Applet Class, Applet skeleton, Simple Applet; Delegation event model - Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.

Exploring Swing Controls: JLabel and Image Icon, JText Field, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box.

EXPERIENTIAL LEARNING

OOPS Fundamentals

1. a) Develop a Java application for generating Electricity bill.

Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
 - First 100 units - Rs. 1 per unit
 - 101-200 units - Rs. 2.50 per unit
 - 201 -500 units - Rs. 4 per unit
 - >501 units - Rs. 6 per unitIf the type of the EB connection is commercial, calculate the amount to be paid as follows:
 - First 100 units - Rs. 2 per unit
 - 101-200 units - Rs. 4.50 per unit
 - 201 -500 units - Rs. 6 per unit
 - > 501 units - Rs. 7 per unit
 - b) Design a class to represent a Student details include the Student ID, Name of the Student, Branch, year, location and college. Assign initial values using Constructor. Calculate average of marks of 6 subjects and calculate attendance percentage.
2. a) Create a class Student which has data members as name, branch, roll no, age, sex, marks in five subjects. Display the name of the student and his percentage who has more than 70%.Use array of objects.
 - b) Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imaginary parts to equal values and third which takes two argument is used to initialized real and imaginary to two different values.

Inheritance

- 3 a) Create a base class basic_info with data members name, roll no, sex and two member functions getdata and display. Derive a class physical_fit from basic_info which has data members height and weight and member functions getdata and display. Display all the information using object of derived class.
- b) Create class first with data members book no, book name and member function getdata and putdata. Create a class second with data members author name, publisher and members getdata and showdata. Derive a class third from first and second with data member no of pages and year of publication. Display all these information using array of objects of third class.

- 4 A High School application has two classes: The Person superclass (Name, age, Gender) and the Student subclass (RegNo, Dept, CGPA). Using inheritance, create two new classes, Teacher and College Student. Teacher will be like Person but will have additional properties such as salary (the amount the teacher earns) and subject (e.g., "Computer Science", "Chemistry", "English", "Other"). The College Student class will extend the Student class by adding a year (current level in college) and major (e.g., "Electrical Engineering", "Communications", "Undeclared"). Create objects and test the functionality of all the methods.
- 5 Develop a java application for generating pay slip on different category of employees using the concept of inheritance.

Exception Handling and Multithreading

- 6 Consider two integers x and y as input and compute the value of x/y.

 Implement a class which raise an exception if x and y are not signed integers or if y is zero.
- 7 a) Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number
- b) Write a program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.

Collection Framework

- 8 Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -, *, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

GUI Programming

- 9 a) Write a java program that simulates a traffic light. The program lets the user select one of three lights: Red, Yellow or Green with radio buttons. On selecting a button an appropriate message with "STOP" or "READY" or "GO" should appear above the buttons in selected color. Initially, there is no message shown.
- b) Write an Applet that computes the payment of a loan on the amount of the loan, the interest rate and the number of months. It takes one parameter from the browser. Monthly; if true, the interest rate is per month, otherwise the interest rate is annual.

- c) Write a java programs to find factorial of a number. User is allowed to enter a number into the text field whose factorial is to be determined. On pressing the button the value of the text field is firstly converted into integer and then processed to find its factorial. The result will get displayed in another text field. (Hint: use swings).

PROJECT BASED LEARNING:

Faculty shall provide Projects relevant to the contents of the course.

Sample Projects:

1. **CALENDER APPLICATION**

Develop a calendar application that uses many windows properties to make it colorful, for example, to indicate the vacation, it uses the red foreground color. The calendar can be used for two purposes. First to see the date and month as usual calendars and second to find out the day corresponding to given date. Some of the salient features of the project are

1. It uses various windows properties to make the program colorful although it has lack of graphics.
2. It entirely uses java code which is written in simple manner with lots of comments and important notes can be added.
3. The date with such notes appears different than others with red background color
4. The months can be navigated using arrow keys.

TICKET RESERVATION SYSTEM

2. Develop Ticket reservation system to manage details of seats, passenger, trains, Bookings and stations. The features required to be implemented are as follows
- a. Provides searching facility based on factors such as seats, trains, booking and stations
 - b. Manage the information of passengers
 - c. Shows the information of the seats and trains
 - d. Provide filter on train, booking, time and station
 - e. Information Management of booking
 - f. Export excel report for trains, passengers and station
 - g. Export pdf for booking details

RESOURCES

TEXT BOOKS:

1. Herbert Schildt, "Java the complete reference", 11th edition, McGraw Hill, Education, 2018.
2. C. Thomas Wu, "An Introduction to Object-Oriented Programming with Java 5th edition", McGraw-Hill Higher Education 2010.

REFERENCE BOOKS:

1. J. Nino and F.A. Hosch, "An Introduction to programming and OOPS design using Java", 3rd edition, John Wiley & sons, 2008.
2. P. Radha Krishna, "Object Oriented Programming through Java", 1st edition, Universities Press, 2007.

SOFTWARE/TOOLS:

1. Software: Eclipse / Net beans / JDK 1.7
2. Java compatible web browser

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105191>
2. <https://www.udemy.com/course/java-tutorial/>

WEB RESOURCES:

1. https://www.tutorialspoint.com/java/java_tutorial.pdf

Course Code**Course Title****22CA201003L****SOFTWARE ENGINEERING****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion on concepts of Software Engineering, Software Process Models, Conventional and Agile Process Models, Software Requirements Engineering Process, System Analysis, Architectural Design, User Interface Design and Re-engineering, Software Testing, Risk and Quality Management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand fundamental concepts of software engineering and analyze process models required to develop a software system.
- CO2.** Analyze software requirements and model requirements for the given scenario.
- CO3.** Apply design concepts and metrics for software development.
- CO4.** Apply testing strategies and techniques for quality software.
- CO5.** Analyze risks in software development life cycle and apply risk strategies to mitigate risks.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	3	3	2	-	-	2	-	3	-	-
CO3	2	3	3	2	-	2	2	-	-	-	3	-	3	-	-
CO4	2	-	-	-	2	3	-	-	-	-	-	-	3	-	-
CO5	2	3	-	-	2	3	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	2	3	3	2	2	3	3	2	-	-	3	-	3	-	-

Correlation Levels:**3: High;****2: Medium;****1: Low**

COURSE CONTENT

Module 1: SOFTWARE ENGINEERING AND SOFTWARE PROCESS

A Generic view of process: The Nature of Software, Software Engineering- Software Engineering Layers; The Software Process, Software Engineering Practice, Software myths.

Process models: A Generic Process Model, Prescriptive Process Models-The Waterfall Model, Incremental Process Models, Specialized Process Models; The Unified Process, Agile Development-Agility, Agile Process, Extreme Programming (XP), Scrum, Dynamic System Development Method, Agile Modeling (AM), Agile Unified Process (AUP).

Module 2: REQUIREMENTS ENGINEERING AND MODELING

Requirements Engineering: Functional and non-functional requirements, The software requirements document, Requirements specifications, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Requirements Modeling: Requirements Analysis, Data Modeling Concepts, Flow-Oriented Modeling, Scenario based Modeling, UML Models that supplement the Use Case, Case study on Requirements modeling for Web and Mobile Apps.

Module 3 DESIGN ENGINEERING AND METRICS

Design using UML: Class Diagram - Terms and concepts, Use case Diagram - Terms and concepts, Activity Diagrams - Terms and concepts, Interaction diagrams - Terms and concepts, State machine Diagram- Terms and concepts, Component Diagram- Terms and concepts, Deployment Diagram- Terms and concepts.

Process and Project Metrics: Metrics in the process and project domains, Software Measurement, Metrics for software quality.

Module 4 SOFTWARE TESTING STRATEGIES AND APPLICATIONS

Testing strategies: A strategic approach to software testing, Strategic issues, Test strategies for conventional software, Test strategies for object oriented software, Validation testing, System testing, The art of debugging.

Testing Conventional Applications: Software testing fundamentals, White box testing-Basis path testing, Control structure testing; Black box testing, Object oriented testing methods.

Module 5 RISK, QUALITY MANAGEMENT AND REENGINEERING

Risk and Quality Management: Reactive and Proactive risk strategies, Software risks, Risk Mitigation Monitoring and Management (RMMM), RMMM plan, Formal Technical Reviews (FTR), Software Quality Assurance (SQA)-Tasks, Goals and Metrics; Software reliability.

Reengineering: Introduction, Business Process Reengineering (BPR), Software Reengineering, Restructuring, Reverse engineering, Forward engineering.

EXPERIENTIAL LEARNING

1. Identify Functional and Non-Functional Requirements for:
 - a. Online Ticket Reservation for Railways
 - b. Recruitment Procedure for Software Industry

2. **Online Ticket Reservation for Railways**

Problem Statement: Computer plays an integral part of the day in today's life. It makes the entire job easier and faster, every job is computerized so as the ticket reservation we can book over the online ticket reservation system. During the booking of the ticket reservation passenger has to select origin, date of journey, destination, class of train etc. The reservation counter keeps track of passenger's information. Thus the system will have all the details about the trains and facilities provided by them. There are various trains with the different level of convenience for the passengers. The whole database will be maintained by database administrator. There are varieties of trains where the passengers can select the train according to the convenience for their destination journey. The journey could be within the state or across the India. Each train has the three types of classes i.e. Sleeper class, First class and the AC compartment. Design the application for the above problem description. Model using Visual modelling tools in different views i.e. component view, Deployment view.

3. **Recruitment Procedure for Software Industry**

Problem Statement: In the software industry the recruitment procedure is the basic thing that goes in the hand with the requirement as specified by the technical management team. HR first gives an advertisement in leading Newspapers, Journals, Weeklies and Websites. The job seekers can apply for it through by Post or by e-mail to the company. The technical skill and the experience of the candidates are reviewed and the short listed candidates are called for the interview. There may be different rounds for interview like the written test, technical interview, and HR interview. After the successful completion of all rounds of interview, the selected candidates' names are displayed. Meanwhile HR gives all the details about the salary, working hours, terms and conditions and the retirement benefit to the candidate. Model using Visual modelling tools in different views i.e. Use case view, logical view

RESOURCES

TEXT BOOKS:

1. Roger S. Pressman, Software Engineering - A Practitioner's Approach, McGraw-Hill International Edition, Eighth Edition, 2015.
2. Ian Sommerville, Software Engineering, Pearson Education, Ninth Edition, 2011.

REFERENCE BOOKS:

1. Grady Booch, James Rumbaugh and Ivar Jacobson, "The Unified Modeling Language User Guide," Second Edition, Pearson Education, 2009.
2. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers, Third Edition, 2007.
3. Shelly Cashman Rosenblatt, Systems Analysis and Design, Thomson Publications, Sixth Edition, 2006.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105087/>
2. <https://nptel.ac.in/courses/106105182/>

WEB RESOURCES:

1. Agile Modeling: <https://www.techtarget.com/searchsoftwarequality/definition/agile-software-development>
2. Functional and Non Functional Requirements: <https://www.linkedin.com/learning/software-design-developing-effective-requirements/functional-vs-non-functional>
3. Software Metrics and Measures: https://www.youtube.com/watch?v=bnydxXPN_rI
4. Risk Management: <https://www.youtube.com/watch?v=8DstdqQBjps>

Course Code	Course Title
22CA202007L	CLOUD COMPUTING

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This Course provides a detailed discussion on Virtualization, Cloud Computing Fundamentals along with Deployment Models. Able to understand Cloud Computing Architecture to work with Cloud adopting Cloud Computing Mechanisms and implementing Cloud Security Mechanisms in Cloud Service Models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the concepts of Cloud Computing, Cloud-Enabling Technology, Cloud Architectures.
- CO2.** Apply virtualization and develop virtual environments for the deployment of cloud applications.
- CO3.** Design applications using cloud service models salesforce.com (SaaS), Google App Engine (PaaS), Amazon (IaaS) and deploy in cloud.
- CO4.** Identify and analyze the Cloud-Enabling Technologies and architectures for developing the applications to solve e-commerce problems.
- CO5.** Adhere to ethics and adapt cloud security mechanisms and Cloud-Based Security Groups for providing security to societal applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	-	3	-			-	-	-	-	-	3	3
CO3	3	3	-	-	3	-			-	-	-	-	-	3	3
CO4	2	3	3	-	3	-			-	-	-	-	-	3	3
CO5	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-
Course Correlation Mapping	3	3	3	-	3	-	-	-	3	-	3	-	-	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTAL CLOUD COMPUTING

Understanding Cloud Computing: Origins and Influences, Concepts and Terminology, Goals and Benefits, Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models.

Module 2: CLOUD COMPUTING MECHANISMS AND ARCHITECTURE

Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology, Web Technology, Multitenant Technology, Service Technology.

Fundamental Cloud Architectures: Workload Distribution, Resource Pooling, Dynamic Scalability, Elastic Resource Capacity, Service Load Balancing, Cloud Bursting, Elastic Disk Provisioning, Redundant Storage.

Module 3: CLOUD COMPUTING ADVANCED ARCHITECTURES

Advanced Cloud Architectures: Hypervisor Clustering, Load Balanced Virtual Server Instances, Non Disruptive Service Relocation, Zero Downtime, Cloud Balancing, Resource Reservation, Dynamic Failure Detection and Recovery, Bare-Metal Provisioning, Rapid Provisioning, Storage Workload Management.

Specialized Cloud Architectures: Direct I/O Access, Direct LUN Access, Dynamic Data Normalization, Elastic Network Capacity, Cross-Storage Device Vertical Tiering, Intra Storage Device Vertical Data Tiering, Load Balanced Virtual Switches, Multipath Resource Access, Persistent Virtual Network Configuration, Redundant Physical Connection for Virtual Servers, Storage Maintenance Window.

Module 4: CLOUD SECURITY

Fundamental Cloud Security: Threat Agents, Cloud Security Threats, Additional Considerations, Case Study Example.

Cloud Security Mechanisms: Encryption, Hashing, Digital Signature, Public Key Infrastructure, Identity and Access Management, Single Sign-On, Cloud-Based Security Groups, Hardened Virtual Server Images.

Module 5: CLOUD SERVICE MODELS

Cloud Service Models: Software as a Service (SaaS) - Characteristics, Examples and Applications. Platform as a Service (PaaS) - Characteristics, Examples and Applications. Infrastructure as a Service (IaaS) - Characteristics, Examples and Applications.

Case Study: SaaS: Salesforce.com, Facebook.com; PaaS: Google App Engine, MS-Azure and IBM Bluemix; IaaS: Amazon EC2, Amazon S3 and Netflix.

EXPERIENTIAL LEARNING

1. Create a word document of your class time table and store locally and on the cloud with doc, and pdf format.
2. Create a spread sheet which contains employee salary information and calculate gross and total sal using the formula DA=10% OF BASIC HRA=30% OF BASIC PF=10% OF

BASIC IF BASIC<=3000 12% OF BASIC IF BASIC>3000 TAX=10% OF BASIC IF BASIC<=1500 =11% OF BASIC IF BASIC>1500 AND BASIC<=2500 =12% OF BASIC IF BASIC>2500 NET_SALARY=BASIC_SALARY+DA+HRA-PF-TAX.

3. Prepare a ppt on cloud computing – Introduction, models, services, and Architectures. PPTs should contain explanations, images and at least 20 slides
4. Create your resume in a neat format using google cloud Programs on PaaS.
5. Create an EC2 instance and invoke Ubuntu operating system with a given set of configuration on amazon web services under IaaS.
6. Create S3 bucket and store a file in it using AWS.
7. Configure web server on Amazon Linux instance with ElasticIP.
8. Develop a web application which contains employee salary information and calculate gross and total sal using the formula DA=10% OF BASIC HRA=30% OF BASIC PF=10% OF BASIC IF BASIC<=3000 12% OF BASIC IF BASIC>3000 TAX=10% OF BASIC IF BASIC<=1500 =11% OF BASIC IF BASIC>1500 AND BASIC<=2500 =12% OF BASIC IF BASIC>2500 NET_SALARY=BASIC_SALARY+DA+HRA-PF-TAX.
9. Generating reports in Salesforce admin.
10. Process of User Management in Salesforce admin.
11. Procedure of Data Management in Salesforce admin.
12. Procedure of providing data security using control access to data using point and click tools in Salesforce admin.

RESOURCES

TEXT BOOKS:

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini "Cloud Computing- Concepts, Technology & Architecture," Pearson Publication, 2014.
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley India Pvt. Ltd, 2011.
3. George Reese "Cloud Application Architectures," O'Reilly Publications, 2009.

REFERENCE BOOKS:

1. Thomas Erl and Ricardo Puttini "Cloud Computing- Concepts, Technology & Architecture," Pearson, 2013.
2. John W. Rittinghouse, James F. Ransome, "Cloud Computing implementation, Management and Security," CRC Press, ISBN: 9788120341609, Taylor & Francis group, 2010.
3. Barrie Sosinsky, "Cloud Computing Bible," Wiley India Pvt Ltd, 2011.
4. Rajkumar Buyya, James Broberg and Andrzej Goscinski, "Cloud computing principles and paradigms", John Wiley and Sons, 2011.

SOFTWARE/TOOLS:

1. Google App Engine
2. Amazon Web Services
3. Sales Force

VIDEO LECTURES:

1. <https://youtu.be/uroryFU78gM>
2. <https://youtu.be/Pg5nj90xh68>
3. <https://youtu.be/2Dd2ducs-ic>
4. <https://youtu.be/Ijkvx1u0w6o>
5. <https://youtu.be/sMIOsYBMRag>

WEB RESOURCES:

1. [www.salesforce tutorial.com](http://www.salesforce.com/tutorial)
2. [Htpps:// trailhead.salesforce.com/en/home](https://trailhead.salesforce.com/en/home)
3. <https://MKyong.com/tutorials/google-App-engine-tutorial/>
4. <https://aws.amazon.com>

Course Code	Course Title
22CA201005L	Data Science and Statistical Modeling

Pre-Requisite	Data Mining
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: This course provides a introduce the field of data science, the nature and structure of data. The importance and application of statistics in analyzing the data. Develop the skills in using data science techniques for solving data intensive problems. Understand learning concepts that is vital for data science and concepts of supervised and unsupervised learning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Memorize the statistics concepts applicable to data science
- CO2.** Demonstrate data analysis, manipulation and visualization of data using Python libraries such as Pandas, Matplotlib and Plotly etc.
- CO3.** Enumerate machine learning algorithms.
- CO4.** Analyze the various applications of data science.
- CO5.** To demonstrate the clustering algorithms.

CO-PO-PSO Mapping Table:

Learning Outcomes	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	3	3	1	3	3	-	-	-	-	-	-	1	-	3	-
CO2	2	-	2	2	-	2	-	-	-	-	-	-	3	2	3	-
CO3	-	3	2	-	3	2	-	-	-	-	-	-	2	2	3	-
CO4	2	-	2	2	-	2	-	-	-	-	-	-	3	-	3	-
CO5	1	2	2	1	2	2	-	-	-	-	-	-	2	2	3	-
Course Correlation Mapping	3	2	2	3	3	2	-	-	3	3	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to Probability

Descriptive Statistics: Measures of central tendency – mean, median, mode, harmonic mean and geometric mean.

Measures of dispersion: mean deviation from mean, standard deviation and variance.

Central moments: Covariance and correlation, rank correlation.

Sampling distributions: Hypothesis testing, definition of random variable and probability.

Module 2: Introduction to Statistics

Probability distributions: Bernoulli, Binomial, Poisson.

Continuous probability distributions: Gaussian, exponential, Chi-square. Definition of Bayes probability. What Is data science, How does data science relate to other fields, Eigen values & Eigen vectors, Sparse matrices.

Module 3: Python for Data Science

Python for Data Analysis: Introduction to Numpy, Numpy Arrays and indexing, Introduction to pandas, Series, Data frames, Missing data, Groupby, Merging Joining and Concatenating, read csv and json, Cleaning Data.

Python for Data Visualization: Matplot lib library, Seaborn Distribution, Matrix and Regression Plots, Introduction to SKlearn and Plotly.

Module 4: Regression

Data Preprocessing in Python, Regression, Simple Linear regression, Multiple Linear Regression, Polynomial regression, Support Vector Regression(SVR), Decision Tree Regression.

Module 5: Supervised Learning -Classification

Introduction to Supervised Learning: Logistic Regression, K-Nearest Neighbors(KNN), Support vector Machine(SVM), Naïve Bayes, Decision Tree Classification, Random Forest Classification.

EXPERIENTIAL LEARNING

- 1 Execute programs using python libraries such as Numpy, Pandas
- 2 Execute and solve data visualization problems with python libraries like matplotlib, Seaborn and Plotly.
- 3 Evaluate various classification techniques.

RESOURCES

TEXT BOOKS:

1. A Hands On Introduction to DataScience, Cambridge University Press, ISBN10: 1108472443, 2020.
2. Principles of DataScience-Learn the techniques and math you need to start making sense of your data by SinanOzdemir,

REFERENCE BOOKS:

1. Joel Grus, Data Science from Scratch, Oreilly media, 2015.
2. Gareth James Daniela Witten Trevor Hastie, Robert Tibshirani, An Introduction to

Statistical Learning with Applications in R, February 11, 2013.

3. Mark Gardener, Beginning R The statistical Programming Language, Wiley, 2015.
4. Han ,Kamber, and J Pei, Data Mining Concepts and Techniques, 3rd edition, Morgan Kaufman, 2012.
5. Linear Algebra and Its Applications, 4th Edition, Gilbert Strang

VIDEO LECTURES:

1. <https://www.dataquest.io/blog/best-free-tools-data-science/>
2. <https://www.youtube.com/watch?v=NOIfMY0KajE>
3. <https://youtu.be/GGL6U0k8WYA>
4. https://www.youtube.com/watch?v=fn1rKKNLuzk&list=PL15FRvx6P0OWTINBS_93NHG2hIn9cynVT
5. <https://www.youtube.com/watch?v=2pWv7GOvuf0&list=PLqYmG7hTraZDM-OYHWgPebj2MfCFzFObQ>

WEB RESOURCES:

1. <https://intellipaat.com/blog/tutorial/data-science-tutorial/>
2. <https://www.guru99.com/data-science-tutorial.html>
3. <https://www.edureka.co/blog/data-science-tutorial/>
4. <https://www.programmer-books.com/introducing-data-science-pdf/>
5. <https://onlinelibrary.wiley.com/doi/book/10.1002/9781119092919>
6. <https://www.digiteum.com/data-visualization-techniques-tools>

Course Code**Course Title****22CA201010L****INTERNET OF THINGS****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion on Internet of Things components, Domain applications, Communication models, Sensors, Connectivity, Prototyping, Hardware, Design Methodology, Development platforms, Data Analytics for IoT, IoT Security and hands-on experience on IoT applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Understand IoT Architecture, communication technologies and various applications of IoT.
- C02.** Analyze sensor technologies and IoT related protocols.
- C03.** Identify suitable hardware platforms and cloud services for developing IoT applications.
- C04.** Understand generic design methodology for various IoT applications.
- C05.** Understand data analytics concepts and security issues in the context of IoT.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C03	2	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C04	2	2	3	2	-	-	-	-	-	-	-	-	-	-	3
C05	2	2	-	2	3	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	2	3	3	2	2	-	-	-	-	-	-	-	-	-	3

Correlation Levels:**3: High;****2: Medium;****1: Low**

COURSE CONTENT

Module 1: INTRODUCTION AND DOMAIN APPLICATIONS

Introduction to Internet of Things: Definition, Conceptual Framework, Architectural View, Technology behind IoT, Communication Technologies, Data Enrichment, Data consolidation and Device management at Gateway.

IoT and M2M: M2M, Difference between IoT and M2M, SDN and NFV for IoT.

Domain Specific IoTs: Home automation, Cities, Environment, Health and Life Style.

Module 2: SENSORS AND CONNECTIVITY

Sensors: Sensor Technology, Actuators, RFID Technology.

Connectivity: Internet Connectivity, Internet-Based Communications, IP Addressing in the IoT, Medium Access Control, Application Layer Protocols.

Module 3: PROTOTYPING AND HARDWARE

Prototyping: Embedded Computing Basics, Embedded platforms for prototyping.

Hardware: Things always connected to the Internet/Cloud, Amazon Web Services for IoT.

Module 4: DESIGN METHODOLOGY AND CASE STUDIES

Design Methodology: Purpose and Requirements specifications, Process Specifications, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specifications, Functional View Specification, Operational View Specification, Device and Component integration, Application development.

Case Studies Illustrating IoT Design: Home Automation, Cities.

Module 5: DATA ANALYTICS AND SECURITY

Data Analytics for IoT: Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis.

IoT Security: Vulnerabilities, Security Requirements and Threat analysis, Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT.

EXPERIENTIAL LEARNING

1.
 - a) Design and Simulate LED 7-Segment Display interfacing with Arduino.
 - b) Design and Simulate Servo motor interfacing with Arduino.
2.
 - a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
 - b) Design and Simulate Flame Sensor interfacing with Arduino.
3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your NodeMCU device using Arduino IDE.
4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and upload data to cloud using MQTT.

RESOURCES

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "*Internet of Things – A hands-on approach*," University Press, 2015.
2. Raj Kamal, "*Internet of Things- Architecture and Design Principles*," Mc Graw Hill, 2017.

REFERENCE BOOKS:

1. Adrian McEwen and Hakim Cassimally, "*Designing the Internet of Things*," Wiley Publishing, 2013.
2. Charles Bell, "*Beginning Sensor Networks with Arduino and Raspberry Pi*," Apress, 2013.
3. Marco Schwartz, "*Internet of Things with the Arduino Yun*," Packt Publishing, 2014.
4. Matt Richardson, Shawn Wallace, "*Getting Started with Raspberry Pi*," Maker Media, Inc, 2012.

SOFTWARE/TOOLS:

1. Software: Arduino IDE/ Raspberry Pi OS

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106105166>

WEB RESOURCES:

1. https://www.tutorialspoint.com/internet_of_things/index.htm
2. <https://www.javatpoint.com/iot-internet-of-things>

Course Code**Course Title****22CA202015L****NATURAL LANGUAGE PROCESSING****Pre-Requisite** Computational Statistics/ Python Programming**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: Language Modeling, Regular Expressions, Text Normalization, Word level analysis, PoS Tagging and Entropy models; Context free grammars and Parsing techniques; Semantics and pragmatics, Discourse analysis and lexical resources.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Show sensitivity to linguistic phenomena and an ability to model them with formal grammars
- CO2.** Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
- CO3.** Able to design, implement, and analyze NLP algorithms
- CO4.** Able to design, implement, and analyze NLP algorithms
- CO5.** Able to design different language modeling Techniques.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	3	3	3	-	-	2	-	3	3	-
CO3	2	3	3	3	-	2	2	-	-	-	3	-	3	3	-
CO4	3	-	-	-	3	3	-	-	-	-	-	-	3	-	-
CO5	2	3	-	-	3	3	-	-	-	-	-	-	3	3	3
Course Correlation Mapping	3	3	3	3	3	3	3	3	-	-	3	-	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FINDING THE STRUCTURE OF WORDS

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models

Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

Module 2: SYNTAX ANALYSIS

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues

Module 3: SEMANTIC PARSING

Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

Module 4: HADOOP ARCHITECTURE

Predicate-Argument Structure, Meaning Representation Systems, Software.

Module 5: DATA ANALYTICS WITH R

Discourse Processing: Cohesion, Reference Resolution, Discourse Cohension and Structure
Language Modeling: Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. To Study Preprocessing of text (Tokenization, Filtration, Script Validation, Stop Word Removal, Stemming).
2. To Study Morphological Analysis.
3. N gram Model
4. POS Tagging
5. Chunking
6. Named Entity Recognition
7. Virtual Lab on Word Generator
8. Mini Project based on NLP Processor

TEXT BOOKS:

1. Multilingual natural Language Processing Applications: From Theory to Practice – Daniel M. Bikel and Imed Zitouni, Pearson Publication.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S. Tiwary

REFERENCE BOOKS:

1. Speech and Natural Language Processing - Daniel Jurafsky& James H Martin, Pearson Publications.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=d4gGtcobq8M>
2. <https://www.youtube.com/watch?v=fNxaJsNG3-s>

WEB RESOURCES:

1. <https://www.udemy.com/course/data-science-natural-language-processing-in-python/>
2. https://www.tutorialspoint.com/natural_language_processing/index.htm
3. <https://www.javatpoint.com/nlp>
4. www.udemy.com/learn-today/online-course

Course Code**Course Title****22CA202021L****CLOUD PRACTITIONER****Pre-Requisite** CLOUD COMPUTING**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: A Course provides a detailed discussion on Fundamental of Cloud and AWS Environment. Able to work with AWS Resources along with various services of core computing, Database, and Networking of AWS adopting EC2 Pricing Models. A course also covers to Automate AWS Workloads with the Imperative Approach and the Declarative Approach with launch Configurations and Launch Templates, Auto Scaling Groups, Scaling Actions and Configuration Management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the concepts of Cloud and AWS Environment,
Cloud Architectures to work with AWS in Virtual Private Cloud.
- CO2.** Apply AWS resources to work with AWS Management Console for AWS Console Mobile Application.
- CO3.** Analyze core compute services, EC2 pricing models, core storage and database services for AWS Implementation.
- CO4.** Identify and use core networking services for automating AWS Workload with AWS CLI, EC2 in cloud.
- CO5.** Work independently or in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	-	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	-	-	3	-	-	-	-	-	-	-	-	3	3
CO4	2	3	3	-	3	-	-	-	-	-	-	-	-	3	3
CO5	-	-	-	-	-	-	-	-	3	-	3	-	-	3	3
Course Correlation Mapping	3	3	3	-	3	-	-	-	3	-	3	-	-	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTAL OF CLOUD AND AWS ENVIRONMENT

Fundamental of Cloud: Concepts of Cloud Computing, Highly Available and Scalable Resources, Professionally Secured Infrastructure, Metered Payment Model.

AWS Environment: AWS Global Infrastructure: AWS Regions, Regionally Based Services, Globally Based Services, Service Endpoint, AWS Global Infrastructure: Availability Zones, Availability Zone Designations, Availability Zone Networking, Availability Zones and High Availability, AWS Global Infrastructure: Edge Locations, Edge Locations and CloudFront, Regional Edge Cache Locations, The AWS Shared Responsibility Model, Managed Resources, Unmanaged Resources, Service Health Status, AWS Acceptable Use Policy.

Module 2: WORKING WITH AWS RESOURCES

Working with AWS Resources: The AWS Management Console, Accessing the AWS Management Console, Opening a Service Console, Working with Shortcuts, Selecting a Region, The Account Name Menu, Resource Groups, Tag Editor, Tagging Strategies, The AWS Console Mobile Application, The AWS Command Line Interface, Requirements, Installation, Software Development Kits, Mobile Software Development Kits, Internet of Things Device Software Development Kits, CloudWatch, CloudWatch Metrics, CloudWatch Alarms, CloudWatch Dashboards, CloudWatch Logs, CloudWatch Events, API and Non-API Events, Management and Data Events, Event History, Trails, Log File Integrity Validation

Module 3: THE CORE COMPUTE SERVICES AND EC2 PRICING MODELS

The Core Compute Services: Deploying Amazon Elastic Compute Cloud Servers, Amazon Machine Images, EC2 Instance Types, Server Storage: Elastic Block Store and Instance, Store Volumes.

EC2 Pricing Models: Simplified Deployments through managed Services, Amazon Lightsail, AWS Elastic Beanstalk, Deploying Container and Serverless Workloads, Containers, Serverless Functions.

Module 4: THE CORE STORAGE AND DATABASE SERVICES

The Core Storage Services: Simple Storage Service, Objects and Buckets, S3 Storage Classes, Access Permissions, Encryption, Object Life Cycle Configurations, S3 Glacier, Archives and Vaults, Retrieval Options, AWS Storage Gateway, File Gateways, Volume Gateways, Tape Gateways, AWS Snowball, Hardware Specifications, Security, Snowball Edge,

The Core Database Services: Database Models, Relational Databases, Structured Query Language, Non-relational (No-SQL) Databases, Amazon Relational Database Service, Database Engines Licensing, Instance Classes, Scaling Vertically, Storage, Scaling Horizontally with Read Replicas, High Availability with Multi-AZ, Backup and Recovery, Determining Your Recovery Point Objective, DynamoDB, Items and Tables, Scaling Horizontally.

Module 5: THE CORE NETWORKING SERVICES AND AUTOMATING AWS WORKLOADS

The Core Networking Services: Virtual Private Cloud, VPC CIDR Blocks, Subnets, Internet Access, Security Groups, Network Access Control Lists, VPC Peering, Virtual Private Networks, Direct Connect, Route, Resource Records, Domain Name Registration, Hosted Zones, Routing Policies, Health Checks, Traffic Flow and Traffic Policies, CloudFront.

Automating AWS Workloads: The Imperative Approach, The Declarative Approach,

Infrastructure as Code, CloudFormation, Templates, Stacks, CloudFormation vs. the AWS CLI, AWS Developer Tools, CodeCommit,, CodeBuild, CodeDeploy, CodePipeline, EC2 Auto Scaling, Launch Configurations and Launch Templates, Auto Scaling Groups, Scaling Actions, Configuration Management, Systems Manager, OpsWorks.

EXPERIENTIAL LEARNING

1. Amazon User Account Creation by access URL with account number. Add Security credentials with Enabling Multi-Factor Authentication to Secure Your Access.
2. Create an EC2 instance and invoke Ubuntu operating system with a set of configuration on amazon web services under IaaS.
Create New Amazon Elastic Block Store (Amazon EBS) EBS Volume to EC2 Instance for provides persistent block storage volumes for use with Amazon EC2 instances in the AWS Cloud.
3. Creating Amazon Machine Image (AMI) for provides the information required to launch an instance, which is a virtual server in the cloud.
4. Create your First EC2 windows instance
5. Assign Elastic IP Addresses to Instance (Static IP Address)
6. Amazon Elastic File System: Amazon Elastic File System (Amazon EFS) provides simple, scalable file storage for use with Amazon EC2. With Amazon EFS, storage capacity is elastic, growing and shrinking automatically as to add and remove files, to applications to store as they require, when they need it.
7. Launch RDS Instance Amazon Relational Database Service (Amazon RDS) which is a web service that makes it easier to set up, operate, and scale a relational database in the cloud.
8. Accessing MySQL Instance Using Workbench.
9. Create AWS S3 Bucket – (Object Storage) Amazon Simple Storage Service (Amazon S3) which is storage for the Internet. Use Amazon S3 to store and retrieve any amount of data at any time, from anywhere on the web.
10.
 - i) AWS S3 Lifecycle Management
 - ii) S3 Bucket Replication to Cross-Region
 - iii) S3 Bucket Policies to control AccessCreate VPC – Virtual Private Cloud (isolated Network)
11.
 - i) Create subnets
 - ii) Create Internet gateway and attach to VPC
 - iii) Create Virtual Private Gateway and Attach to VPC

RESOURCES

TEXT BOOKS:

1. Ben Piper and David Clinton "AWS Certified Cloud Practitioner," John Wiley & Sons, Inc., ISBN: 978-1-119-49070-8,2019.
2. Cloud Practitioner (CLF-C01) Cert Guide, 1/E by Anthony Sequeira, PEARSON INDIA
3. Aws Certified Cloud Practitioner by Neville Dawson, Dilaber Consulting Ltd

REFERENCE BOOKS:

1. Dennis Hutten "AWS: The Beginners Guide to Amazon Web Services",ASIN : B0757XM97V,2017.
2. Gordon Wong, "AWS Basics: Beginner's Guide," Createspace Independent Pub, ISBN: 978-1542885751, February 2017.
3. Aurobindo Sarkar and Amit Shah, "Learning AWS," ISBN:978-1784394639, Packt Publishing,2015
4. Bernard Golden, "Amazon Web Services for Dummies, ISBN:: 978-1118571835,Dummies; 1st edition,2013.
5. Andreas Wittig and Michael Wittig "Amazon Web Services in Action", Manning; 2nd edition, 2018.

SOFTWARE/TOOLS:

1. Amazon EC2
2. Amazon S3
3. Amazon DynamoDB
4. AWS Aurora

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=SOTamWNgDKc>
2. <https://www.youtube.com/watch?v=3hLmDS179YE>
3. <https://www.youtube.com/watch?v=XjPUyGKRjZs>

WEB RESOURCES:

1. https://docs.aws.amazon.com/ec2/index.html?nc2=h_ql_doc_ec2
2. <https://aws.amazon.com/training/digital/aws-cloud-practitioner-essentials/>

Course Code	Course Title
22CA202017L	CLOUD ARCHTEITECTURE AND DESIGN
Pre-Requisite	Cloud computing
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: Topics covered include- distributed system models, different cloud service models, service oriented architectures, cloud programming and software environments, resource management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand fundamentals and various paradigms of computing
- CO2.** Demonstrate cloud characteristics and models.
- CO3.** Identify the ways in which the cloud can be programmed and deployed.
- CO4.** Recognize the services and platform of cloud
- CO5.** Design different cloud services from different vendors.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	3	3	3	-	-	-	-	-	-	-	2	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO5	-	-	-	-	3	-	-	-	3	3	-	-	2	-	3
Course Correlation Mapping	3	3	3	3	3	-	-	-	3	3	-	-	2	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: COMPUTING PARADIGMS:

High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing

Module 2: CLOUD COMPUTING FUNDAMENTALS:

Introduction to Cloud Computing, Characteristics of Cloud Computing, Cloud Models, Cloud Services Examples, Cloud based services and Applications, Cloud Concepts and Technologies, Virtualization, Load Balancing, Scalability and Elasticity.

Module 3: CLOUD COMPUTING ARCHITECTURE AND MANAGEMENT

Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications, on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure Managing the Cloud application, Migrating Application to Cloud.

Module 4: CLOUD SERVICES AND PLATFORMS

Compute Services, Storage Services, Database Services, Application Services, Content Delivery Services, Analytics Services, Deployment and Management Services, Apache Hadoop, Hadoop Map Reduce Job Execution, Hadoop Schedulers.

Module 5: CLOUD SERVICE PROVIDERS

Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue ,service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM.

EXPERIENCE LEARNING

1. Implement a parallel algorithm using MPI. Measure and compare its performance on a single core versus multiple cores.
2. Configure a distributed file system on a cluster and simulate a node failure. How does the system respond?
3. Create a small application that utilizes both cloud and grid computing. Analyze and document the differences in setup, cost, and performance.
4. Deploy a VM on a cloud platform, install a web server, and dynamically adjust its resources based on simulated load.
5. Use a cloud storage service to host and manage a static website. Explore the service's interface for asset management and access control.
6. Setup a VPC and demonstrate the configuration of its network connectivity using subnets, gateways, and route tables.
7. Migrate a local web application to the cloud. Document the migration process, focusing on changes in the application architecture and deployment.
8. Deploy a Hadoop cluster using a cloud service and run a MapReduce job. Discuss the impact of different Hadoop schedulers on the job execution.
9. Use a cloud-based analytics service to analyze a dataset. Highlight key findings and how cloud analytics can influence business decisions.

10. Compare the execution of a serverless function (e.g., AWS Lambda vs. Google Cloud Functions) in terms of performance, cost, and ease of use.

RESOURCES

TEXT BOOKS:

1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
2. Arshadeep Bhaga, Vijay Madiseti, "Cloud Computing A Handson Approach", Universities Press, 2018

REFERENCE BOOKS:

1. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.
4. Chris Hay, Brian Prince, "Azure in Action" Manning Publications [ISBN: 9781935182481], 2010.
5. Henry Li, "Introducing Windows Azure" Apress; 1 edition [ISBN: 978-14302-2469- 3], 2009.

VIDEO LECTURES:

1. https://www.youtube.com/results?search_query=nptel+cloud+computing
2. <https://www.youtube.com/watch?v=2LaAJq1lB1Q&pp=ygUY2xvdWQgY29tcHV0aW5nIHBsYXIsaXN0>

WEB RESOURCES:

1. <https://www.javatpoint.com/cloud-computing>
2. <https://www.geeksforgeeks.org/architecture-of-cloud-computing/>
3. <https://www.guru99.com/architecture-of-cloud-computing.html>
4. <https://www.w3schools.in/cloud-computing/cloud-computing-architecture>

Course Code**Course Title****22CA202018L****CLOUD ARCHITECT****Pre-Requisite** Cloud computing**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: Virtualization and Containerization technologies, VPC, VPN, Cloud architecture design principles, cloud service providers, Hybrid and Multi-cloud strategies, Cloud security and Identity management, Cloud Migration, integration and deployment strategies, Cloud Cost optimization, Cloud Monitoring and governance frameworks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the concepts of cloud architecture, benefits, virtualization and containerization technologies, network architectures to create VPC, VPN.
- CO2.** Analyze the pricing models and cost management strategies to implement cloud architecture design principles.
- CO3.** Design applications by using hybrid and multi-cloud architectures and provide security by using network security and firewalls.
- CO4.** Solve complex problems by cloud migration, integration and deployment strategies by implementing cost optimization tools.
- CO5.** Make use of governance frameworks, self service provisioning and monitoring strategies in the development of applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	-	3
CO2	3	-	3	3	3	-	-	-	-	-	-	-	2	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO5	-	-	-	-	3	-	-	-	3	3	-	-	2	-	3
Course Correlation Mapping	3	3	3	3	3	-	-	-	3	3	-	-	2	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CLOUD ARCHITECTURE, INFRASTRUCTURE AND NETWORKING

Introduction to Cloud Architecture: Importance of cloud architecture, cloud adoption, Benefits and challenges of cloud adoption.

Cloud Infrastructure and Networking: Virtualization and containerization technologies, Cloud infrastructure components (compute, storage, network), Network architectures and connectivity options (VPC, VPN, Direct Connect), Cloud-based security and compliance considerations.

Module 2: CLOUD ARCHITECTURE DESIGN PRINCIPLES AND CLOUD SERVICE PROVIDERS

Cloud Service Providers: Overview of major cloud providers (e.g., AWS, Azure, Google Cloud), Comparison of cloud platforms and services, Pricing models and cost management strategies.

Cloud Architecture Design Principles: Scalability, elasticity, and high availability, Fault tolerance and disaster recovery, Resilient and distributed system design, Performance optimization and monitoring.

Module 3: HYBRID AND MULTI-CLOUD ARCHITECTURES & CLOUD SECURITY AND IDENTITY MANAGEMENT

Hybrid and Multi-Cloud Architectures: Integrating on-premises infrastructure with the cloud, Hybrid cloud architectures and use cases, Multi-cloud strategies and considerations.

Cloud Security and Identity Management: Cloud security best practices, Identity and Access Management (IAM) in the cloud, Network security and firewall configurations, Data encryption and key management.

Module 4 CLOUD MIGRATION AND DEPLOYMENT STRATEGIES & CLOUD COST OPTIMIZATION

Cloud Migration and Deployment Strategies: Assessing and planning cloud migration projects, Lift-and-shift, re-platforming, and refactoring approaches, Cloud-native application development and deployment, Continuous integration and deployment (CI/CD) in the cloud.

Cloud Cost Optimization: Cost models and pricing considerations, Resource provisioning and right-sizing, Monitoring and optimization tools, Reserved instances and spot instances.

Module 5 CLOUD GOVERNANCE AND MANAGEMENT

Cloud Governance and Management: Cloud governance frameworks and best practices, Resource tagging and organization, Service catalog and self-service provisioning, Cloud monitoring, logging, and auditing.

EXPERIENTIAL LEARNING

1. Setting Up a Virtual Private Cloud (VPC):

Create a VPC with multiple subnets and define network ACLs (Access Control Lists) and security groups.

Configure private and public subnets, internet gateways, and NAT gateways.

Establish connectivity between on-premises infrastructure and the cloud VPC using VPN or Direct Connect.

2. Implementing High Availability and Load Balancing:

Deploy a highly available architecture using load balancers, autoscaling groups, and multiple instances across availability zones.

Test the failover and load balancing capabilities by simulating traffic spikes or instance failures.

3. Securing Cloud Resources:

Implement security best practices by configuring network security groups, implementing SSL/TLS certificates, and setting up Web Application Firewalls (WAF).

Use IAM (Identity and Access Management) to manage user access and permissions to different cloud resources.

Perform security audits and vulnerability assessments using security tools and services provided by the cloud platform.

4. Implementing Serverless Architecture:

Build a serverless application using services like AWS Lambda, Azure Functions, or Google Cloud Functions.

Implement event-driven architecture by integrating services like SNS (Simple Notification Service), SQS (Simple Queue Service), or Pub/Sub.

5. Data Storage and Database Management:

Set up and configure cloud-based storage services such as Amazon S3, Azure Blob Storage, or Google Cloud Storage.

Provision and manage databases using services like Amazon RDS, Azure SQL Database, or Google Cloud SQL.

Implement backup and disaster recovery strategies for databases.

6. Containerization and Orchestration:

Use Docker to containerize applications and create Docker images.

Deploy and manage containers using container orchestration platforms like Kubernetes, AWS ECS (Elastic Container Service), Azure Kubernetes Service, or Google Kubernetes Engine.

7. Cloud Migration and Hybrid Architecture:

Perform a lift-and-shift migration of an on-premises application to the cloud platform of your choice.

Implement a hybrid architecture by connecting on-premises infrastructure with cloud resources using VPN or Direct Connect.

8. Cost Optimization and Resource Management:

Monitor and analyse cloud resource usage to identify cost optimization opportunities.

Implement cost-saving techniques such as rightsizing instances, leveraging reserved instances, or using spot instances.

Implement automated resource provisioning and management using Infrastructure as Code (IAC) tools like AWS CloudFormation or Azure Resource Manager.

9. DevOps and Continuous Integration/Deployment (CI/CD):

Set up a CI/CD pipeline using tools like Jenkins, AWS CodePipeline, Azure DevOps, or Google Cloud Build.

Automate application deployments, testing, and infrastructure provisioning using infrastructure-as-code principles.

RESOURCES

TEXT BOOKS:

1. Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", PHI publisher, 1st Edition, 2013.
2. Michael J. Kavis "Architecting the Cloud: Design Decisions for Cloud Computing Service Models", Wiley CIO series, 1st Edition, 2014.
3. Joe Baron, Hisham Baz, and Tim Bixler "AWS Certified Solutions Architect - Official Study Guide", Sybex, Study Guide, 2016.

REFERENCE BOOKS:

1. Ritesh Modi "Azure for Architects", Packt Publishing Limited, Standard Edition, 2017.
2. Dan Sullivan "Google Cloud Certified Professional Cloud Architect Study Guide", Sybex, 1st Edition, 2019.
3. Andrea Mauro and Paolo Valsecchi "Mastering VMware vSphere 6.7", Packt Publishing, 2nd Edition, 2019.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=-8O32k26RWA>
2. <https://www.youtube.com/watch?v=sd0qz4HnbpE>

WEB RESOURCES:

1. www.opengroup.org/subjectareas/cloud-computing
2. www.cloudcomputing-news.net
3. www.reddit.com/r/cloudcomputing
4. www.cncf.io
5. www.thecloudcast.net
6. www.microsoft.com/en-us/ignite

Course Code**Course Title****22CA203001L OBJECT ORIENTED MODELING AND DESIGN****Pre-Requisite** Software Engineering**Anti-Requisite** -**Co-Requisite** -**COURSE OUTCOMES:** After successful completion of the course, students will be able to:

- CO1** Demonstrate knowledge on Things, principles of Object Oriented Development.
- CO2** Analyze the specifications of Class, Use case, Activity, Sequence and State diagrams and develop models using pre conditions and post conditions.
- CO3** Design application artifacts to construct the Logical, Behavioral and Architectural model of an Application.
- CO4** Solve complex system behavior using common modeling techniques of things.
Make use of UML Tool such as Rational Rose or Visual Paradigm to design Class, Use
- CO5** Case, Sequence, Collaboration, Activity, State Chart, Component and Deployment Diagrams for an application.

CO-PO-PSO Mapping Table:

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

Correlation Levels:**3: High;****2: Medium;****1: Low****COURSE CONTENT****Module 1: INTRODUCTION TO UML**

The meaning of Object Orientation, object identity, Importance of modeling, principles of modeling, object-oriented modeling, An overview of UML, conceptual model of the UML, Architecture.

Classes – Terms and concepts, Common Modeling Techniques.

Relationships – Modeling simple dependencies, single Inheritance and structural relationships, Common Mechanisms and UML Diagrams.

Module 2: STRUCTURAL MODELING

Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages, Instances.

Class Diagrams – Terms, concepts, modeling techniques for Class Diagram, Modeling Simple collaboration, Logical database Schema, Forward and Reverse Engineering.

Object Diagrams – Modeling object structures, Forward and Reverse engineering.

Module 3 BASIC BEHAVIORAL MODELING

Use cases – Terms and Concepts, Common Modeling techniques.

Use case Diagrams – Terms and Concepts, Common Modeling Techniques.

Sequence Diagrams – Terms and Concepts, Modeling flows of control by time ordering; **Collaboration Diagrams** – Terms and Concepts, Modeling flows of control by Organization, Forward and Reverse Engineering.

Module 4 ADVANCED BEHAVIORAL MODELING

Activity Diagrams – Terms and Concepts, Modeling a workflow, Modeling an operation, forward and reverse Engineering.

Events and Signals, State Machines, Processes and Threads, Time and Space, State Chart Diagrams – Modeling Reactive Objects.

Module 5 ARCHITECTURAL MODELING

Component Diagrams – Terms and Concepts, Modeling Source Code, Modeling Physical Database, Forward and Reverse Engineering;

Deployment Diagrams – Terms and Concepts, Modeling Embedded System, Modeling Distributed System, Forward and Reverse Engineering.

Patterns and Frameworks, Artifact Diagrams.

EXPERIENTIAL LEARNING

1. Annotated Requirement Specification and Linguistic Analysis of Leave Management System.
2. Implementation of class and object diagrams using Visual Paradigm for Leave Management System.
3. Implementation of Usecase and Interaction diagrams using Visual Paradigm for Leave Management System.
4. Implementation of Activity and State Chart diagrams using Visual Paradigm for Leave Management System.
5. Implementation of Component and Deployment diagrams using Visual Paradigm for Leave Management System.
6. Draw the UML diagrams using Visual Paradigm for Library Management System.
7. Draw the UML diagrams using Visual Paradigm for Railway Reservation System.

RESOURCES

TEXT BOOK:

1. Grady Booch, James Ram Baugh and Ivar Jacobson, "The Unified Modeling Language User Guide," Pearson Education, 1999.

REFERENCE BOOKS:

1. John W. Satzinger, Robert B. Jackson and Stephen D. Burd, "Object-Oriented Analysis and Design with the Unified Process," Cengage Learning, 2004.
2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons and David Fado, "UML 2: Toolkit," Wiley India Pvt. Ltd., 2004.

VIDEO LECTURES:

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105153/

WEB RESOURCES

1. <https://courses.cs.washington.edu/courses/cse403/11sp/lectures/lecture08-uml1.pdf>
2. <https://www.uml-diagrams.org/index-examples.html>

Course Code**Course Title****22CA201029L****FULL STACK WEB DEVELOPMENT****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Hypertext markup language (HTML), Features of HTML5, Cascading style sheets (CSS), JavaScript, JQuery, Bootstrap, Hypertext preprocessor (PHP), MySQL.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on web page design elements, dynamic content and database interaction.
- CO2.** Analyze user requirements to develop web applications.
- CO3.** Design client-server applications using web technologies.
- CO4.** Demonstrate problem solving skills to develop enterprise web applications.
- CO5.** Use HTML, CSS, JavaScript, JQuery, Bootstrap and PHP technologies for device independent web application development.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-	3	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO4	2	2	2	3	-	-	-	-	-	-	-	-	3	-	3	-
CO5	2	2	3	2	3	-	-	-	-	-	-	-	3	-	3	-
Course Correlation Mapping	2	2	3	2	3	-	3	-	3	3	-	-	3	-	3	-

Correlation Levels:**3: High;****2: Medium;****1: Low**

COURSE CONTENT

Module 1: HTML AND CSS

HTML5: Introduction, HTML5 document structure, Creating editable content, Checking spelling mistakes, Exploring custom data attributes, Client-Side storage, Drag and drop feature, Offline web applications, Web communications, Cross-Document messaging and desktop notifications.

CSS3: Introduction, CSS selectors, Inserting CSS in an HTML document, Backgrounds, Fonts, and Text styles, Creating boxes, Displaying, Positioning and floating elements, Features of CSS3, Media queries.

Module 2: JAVASCRIPT AND JQUERY

JavaScript: Overview of JavaScript, JavaScript functions, Events, Image maps and animations, JavaScript objects, Working with browser and document objects.

JQuery: Introduction, JQuery Selectors, Events, Methods to access HTML elements and attributes, Introduction to AJAX.

Module 3: BOOTSTRAP

Getting started with Bootstrap, Creating responsive layouts using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, The grid system, Constructing data entry forms, Packaged components in Bootstrap - The page header, Glyphicons, The navigation bar, Badges, Alerts, Toolbars and button groups, Panels.

Module 4: INTRODUCTION TO PHP

Introduction, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Functions, Arrays, Embedding PHP code in web pages, Object Oriented PHP.

Module 5: PHP WEB FORMS AND MYSQL

PHP Web forms: PHP and web forms, Sending form data to a server, Working with cookies and session handlers.

PHP with MySQL: Interacting with the database, Prepared statement, Database transactions.

EXPERIENTIAL LEARNING

1. Explore Basic HTML Tags and Elements.
2. Familiarize with JS, and CSS, Animation using sample webpage
3. Design a Webpage using advance HTML Form tags input-date, time, number, email, HTML5 Header And Footer, spell check and editable areas.
4. Write a JavaScript/JQuery code to validate the following fields of the Registration web page.
 - a. First Name/Last Name - should contain only alphabets and the length should not be less than 8 characters.

- b. Username - It should contain combination of alphabets, numbers and underscore. It should not allow spaces and special symbols.
 - c. Password - It should not less than 8 characters in length and it contains one uppercase letter and one special symbol.
 - d. Date of Birth - It should allow only valid date; otherwise display a message stating that entered date is invalid. Ex. 29 Feb. 2009 is an invalid date.
 - e. Postal Code: It must allow only 6 digit valid number.
 - f. Mobile No. - It should allow only numbers and total number of digits should be equal to 10.
 - g. e-mail id - It should allow the mail id with the following format: Ex. mailid@domainname.com
5. Design a web page with the following features using HTML5, JavaScript and JQuery
 - a. Displaying of images with Custom animated effects
 - b. Playing of selected video from the list of videos
 - c. Showing the animated text in increasing and decreasing font size
 - d. Changing the size of the area in a web page using DIV tag
 - e. Hiding and Showing elements in a web page.
 6. Design a web page with the following features using Bootstrap and Media Query.
 - a. Components
 - b. Responsive tables
 - c. Responsive images and videos
 - d. Toolbars, Buttons and Lists
 7.
 - a. Deploy and navigate web pages of online book store using WAMP/XAMPP web server.
 - b. Write a PHP program to read user name and favorite color from the HTML form. Display the name of the user in green color and sets user favorite color as a background for the web page.
 8. Change a Content of webpage using AJAX. Perform Different Operations using JQUERY Selectors.
 9. Write a PHP code to read user details entered through the registration web page and store the same into MySQL database.
 10. Write a PHP code for storing books details like Name of the book, author, publisher, edition, price, etc into MySQL database. Embed a PHP code in catalogue page of the online book store to extract books details from the database.

RESOURCES

TEXT BOOKS:

1. Kogent Learning Solutions Inc, "*HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery*," Dreamtech Press, 2nd Edition, 2016.
2. W. Jason Gilmore, "*Beginning PHP and MySQL*," APress," 4th Edition, 2011.

REFERENCE BOOKS:

1. Snig Bahumik, "*Bootstrap Essentials*," PACKT Publishing, 1st Edition, 2015. (e-book).
2. Thomas A. Powell, "*The Complete Reference: HTML and CSS*," Tata McGraw Hill, 5th Edition, 2010.
3. Andrea Tarr, "*PHP and MySQL*," Willy India, 1st Edition, 2012.

SOFTWARE/TOOLS:

1. Editor: Notepad++
2. Programming Language: Javascript, JQuery, PHP

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=Q33KBiDriJY>
2. <https://www.coursera.org/learn/html-css-javascript-for-web-developers?=>
3. <https://www.edx.org/course/using-javascript-jquery-and-json-in-django>
4. <https://www.edx.org/course/building-web-applications-in-django>
5. <https://www.udemy.com/course/web-technology-for-entrepreneurs/>
6. <https://www.edx.org/course/html5-apps-and-games>
7. <https://www.classcentral.com/course/openhpi-web-technologies-3517>
8. <https://www.edx.org/course/css-basics>

WEB RESOURCES:

1. <https://www.w3schools.com/php/DEFAULT.asp>
2. <https://www.w3schools.com/js/>
3. <https://www.geeksforgeeks.org/web-technology/>
4. <https://www.smashingmagazine.com/2021/03/complete-guide-accessible-front-end-components/>
5. <https://css-tricks.com/>
6. <https://davidwalsh.name/css-optional>
7. <https://jquery.com/>

Course Code**Course Title****22CA202029L****MERN STACK DEVELOPMENT****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on MERN Stack, Building a Webserver with ExpressJS, Building a Restful API, Building Web Applications with React, MongoDB, NodeJS and Managing state with Redux.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge on fundamentals of MongoDB and NodeJS.
- CO2.** Build web server using ExpressJS to configure and customize web applications.
- CO3.** Apply Restful API with ExpressJS and Mongoose.
- CO4.** Apply React to design enterprise web applications.
- CO5.** Develop web applications through MERN stack and Redux store as per societal needs.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-
CO3	2	3	3	2	-	-	-	-	-	-	-	-	3	-	2	-
CO4	1	2	3	-	3	-	-	1	-	-	-	-	3	-	1	-
CO5	1	2	3	-	-	1	1	-	-	-	-	-	3	-	1	-
Course Correlation Mapping	2	3	3	2	3	1	1	1	3	3	-	-	3	-	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: MERN STACK

Introduction to MERN STACK, The Model View Controller (MVC) architectural pattern, Installing and configuring MongoDB, Installing Node.js and Installing npm packages.

Module 2: BUILDING A WEB SERVER WITH EXPRESSJS

Routing in ExpressJS, Modular route handlers, Writing middleware functions, Writing configurable middleware functions, Writing router-level middleware functions, Writing error-handler middleware functions, Using ExpressJS' built-in middleware function for serving static as sets, Parsing the HTTP request body, Compressing HTTP responses, Using an HTTP request logger.

Module 3: BUILDING A RESTFUL API

CRUD operations using ExpressJS' route methods, CRUD operations with Mongoose, Using Mongoose query builders, Defining document instance methods, Defining static model methods, Writing middleware functions for Mongoose, Writing custom validators for Mongoose's schemas, Building a RESTful API to manage users with ExpressJS and Mongoose.

Module 4: BUILDING WEB APPLICATIONS WITH REACT

Understanding React elements and React components, Composing components, Stateful components and life cycle methods, Working with React.PureComponent, React event handlers, Conditional rendering of components, Rendering lists with React, Understanding refs and how to use them, Understanding React portals, Catching errors with error boundary components, Type checking properties with PropTypes.

Module 5: MANAGING STATE WITH REDUX

Defining actions and action creators, Defining reducer functions, Creating a Redux store, Binding action creators to the dispatch method, Splitting and combining reducers, Writing Redux store enhancers, Time traveling with Redux, Understanding Redux middleware, Dealing with asynchronous data flow.

EXPERIENTIAL LEARNING

Front-end Web Application Library

1. Installing Node.js framework and configuring Visual Studio (VS) Code Integrated Development Environment (IDE), and its dependencies.
2. Create and Run —Hello World— Application in VS Code.
3. Build two mini applications using Router that will be served in two different sub-domains virtual domains through ExpressJS and Virtual domains.
4. Develop the code for Securing an ExpressJS web application with Helmet.
5. Create a React application that includes simple functional components.
6. Create a React application that includes simple class components.
7. Develop a React application to insert and access props (properties) and state of

components.

8. Create a React application to demonstrate event handling.
9. Develop a React application for list rendering.
10. Implement a React application for form handling.

Hosting Web Applications

1. Choosing a hosting server and selecting a plan for web hosting.
2. Choosing and configuring DNS address.
3. Uploading, configuring and running the website over the internet.

RESOURCES

TEXT BOOKS:

1. Eddy Wilson IriarteKoroliova, MERN Quick Start Guide: Build Web Applications with MongoDB, Express.js, React, and Node, Packt, May 2018.
2. Greg Lim, BeginningMERN Stack Development, First Edition, June 2021.

REFERENCE BOOKS:

1. Brad Dayley, Node.js, MongoDB and Angular Web Development, Pearson, 2nd Edition, 2017.
2. Kogent Learning Solutions Inc, HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery, Dreamtech Press, Second Edition, 2016.

SOFTWARE/TOOLS:

1. Software: Node.js, MongoDB and Visual Studio Code; Express and React modules.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=E-GA9GKJWuE>
2. <https://www.youtube.com/watch?v=Oe421EPjeBE>
3. <https://www.youtube.com/watch?v=KNZZZ3pbqco>
4. <https://www.youtube.com/watch?v=bbkBuqC1rU4>

WEB RESOURCES:

1. Node.js Tutorial - <https://www.w3schools.com/nodejs/>
2. Express.js Tutorial - <https://www.javatpoint.com/expressjs-tutorial>
3. MongoDB Tutorial - <https://www.tutorialspoint.com/mongodb/index.htm>
4. Learn ReactJS Tutorial - <https://www.javatpoint.com/reactjs-tutorial>
5. Redux Tutorial - <https://www.tutorialspoint.com/redux/index.htm>

Course Code	Course Title
22CA202024L	FULL STACK CLOUD DEVELOPER

Pre-Requisite Full Stack Web Development

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Introduction to Full Stack Development, Web Development Fundamentals, Back-End Development, Cloud Computing Basics, Cloud Infrastructure and Front-End Frameworks, Security, Performance Optimization and Scalability

COURSE OUTCOMES: After successful completion of this course, the student will be able to:

CO1. Understand full stack development, Role of a full stack developer.

CO2. Describe Database design and cloud computing platforms.

CO3. Understand Cloud Infrastructure and Services.

CO4. Create Back-End Frameworks and Tools.

CO5. Understand Security, Performance Optimization and Scalability.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO3	3	2	3	3	3	-	-	-	-	-	-	-	2	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
CO5	-	-	-	-	-	-	-	-	3	3	-	-	2	-	3
Course Correlation Mapping	3	3	3	3	3	-	-	-	3	3	-	-	2	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1 INTRODUCTION TO FULL STACK AND WEB DEVELOPMENT

Introduction to Full Stack Development: Overview of full stack development, Role of a full stack developer, Understanding the cloud computing paradigm.

Web Development Fundamentals:HTML5, CSS3, and JavaScript, Introduction to front-end frameworks (e.g., React, Angular, or Vue.js), Responsive web design and mobile development

Module 2 BACK-END DEVELOPMENT AND CLOUD COMPUTING BASICS

Back-End Development: Introduction to server-side programming languages (e.g., Python, Node.js, or Ruby), Database design and management (e.g., SQL, NoSQL), RESTful API development, Authentication and authorization mechanisms Cloud Computing Basics: Introduction to cloud computing platforms (e.g., AWS, Azure, or Google Cloud), Virtualization and containerization (e.g., Docker, Kubernetes), Deployment and scaling strategies.

Module 3 CLOUD INFRASTRUCTURE AND FRONT-END FRAMEWORKS

Cloud Infrastructure and Services: Cloud storage and file systems, Serverless computing (e.g., AWS Lambda, Azure Functions), Message queues and event-driven architectures, Load balancing and auto-scaling.

Front-End Frameworks and Tools: Advanced front-end frameworks (e.g., React, Angular, or Vue.js) Build tools (e.g., Webpack, Gulp), Package managers (e.g., npm, Yarn).

Module 4 BACKEND TOOLS AND DATABASE

Back-End Frameworks and Tools: Popular server-side frameworks (e.g., Express.js, Django, or Ruby on Rails), Testing frameworks (e.g., Jest, Mocha), Logging and monitoring tools Database and Data Storage: Relational databases (e.g., MySQL, PostgreSQL), NoSQL databases (e.g., MongoDB, Cassandra), Data Modeling and Optimization.

Frameworks and Tools: Popular server-side frameworks (e.g., Express.js, Django, or Ruby on Rails), Testing frameworks (e.g., Jest, Mocha), Logging and monitoring tools

Database and Data Storage: Relational databases (e.g., MySQL, PostgreSQL), NoSQL databases (e.g., MongoDB, Cassandra), Data modeling and optimization.

Module 5 PERFORMANCE OPTIMIZATION AND SCALABILITY SECURITY

Security and DevOps: Web application security best practices, Continuous integration and deployment (CI/CD), Infrastructure as code (IaC) using tools like Terraform or CloudFormation, Monitoring and alerting systems.

Performance Optimization and Scalability: Caching strategies (e.g., Redis, Memcached) Performance profiling and optimization, Horizontal and vertical scaling techniques.

EXPERIENTIAL LEARNING:

1. Build a Full Stack Web Application: Create a web application using a front-end framework like React, Angular, or Vue.js, and a back-end framework like Node.js, Django, or Ruby on Rails. Deploy your application to a cloud platform like AWS, Azure, or Google Cloud.
2. Implement User Authentication and Authorization: Add user authentication and authorization functionality to your web application. Use technologies like JSON Web Tokens (JWT) or OAuth to authenticate and authorize users. Store user information securely in a database.
3. Develop a RESTful API: Create a RESTful API using a back-end framework of your choice. Define endpoints for performing CRUD (Create, Read, Update, Delete) operations on a database. Test the API using tools like Postman or Insomnia.
4. Implement Serverless Functions: Use a serverless computing platform like AWS Lambda or Azure Functions to develop and deploy serverless functions. Create functions that perform specific tasks, such as image processing or data transformation.
5. Build a Real-time Chat Application: Create a real-time chat application using technologies like Socket.io or Firebase Realtime Database. Enable users to send and receive messages instantly and see real-time updates.
6. Deploy and Manage Containers: Use containerization technologies like Docker and container orchestration tools like Kubernetes to deploy and manage your application in a containerized environment. Explore concepts like scaling, load balancing, and service discovery.
7. Integrate with Cloud Services: Utilize cloud services like AWS S3 for file storage, AWS SES for email sending, or Google Cloud Vision API for image recognition. Integrate these services into your application to add additional functionality.
8. Implement Continuous Integration and Deployment (CI/CD): Set up a CI/CD pipeline using tools like Jenkins, CircleCI, or GitLab CI/CD. Automate the build, test, and deployment processes for your application.
9. Monitor and Analyze Application Performance: Use monitoring and logging tools like AWS CloudWatch, Azure Monitor, or ELK Stack to track the performance and availability of your application. Set up alerts and visualize metrics to gain insights into your application's behavior.
10. Secure Your Application: Implement security best practices in your application. Protect against common vulnerabilities like cross-site scripting (XSS) and SQL injection. Explore techniques like encryption, secure communication (HTTPS), and user input validation.

RESOURCES

TEXT BOOKS:

1. "Full Stack Development with JHipster" by Deepu K Sasidharan and Sendil Kumar N
2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011

REFERENCE BOOKS:

1. "Full Stack Development with React and Node: Modern Web Development with Universal React" by Tomasz Dyl and Adam Boduch.
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010

ADDITIONAL LEARNING RESOURCES:

1. MDN Web Docs: The MDN (Mozilla Developer Network) Web Docs is an excellent resource for learning web development fundamentals, including HTML, CSS, and

JavaScript. It offers comprehensive documentation, tutorials, and guides: <https://developer.mozilla.org/>

2. W3Schools: W3Schools is a popular online learning platform that provides tutorials and references for web development technologies. It covers HTML, CSS, JavaScript, and various frameworks like React, Angular, and Vue.js: <https://www.w3schools.com/>
3. Stack Overflow: Stack Overflow is a community-driven question and answer platform that covers a wide range of programming topics, including full stack development. It can be a valuable resource for troubleshooting and finding solutions to specific development challenges: <https://stackoverflow.com/>
4. AWS Documentation: If you're interested in cloud development with Amazon Web Services (AWS), their official documentation is an invaluable resource. It provides detailed information, tutorials, and guides on various AWS services and features: <https://docs.aws.amazon.com/>
5. Microsoft Azure Documentation: Microsoft Azure offers comprehensive documentation for developers looking to work with their cloud platform. It covers various Azure services, deployment options, and development tools: <https://docs.microsoft.com/azure/>

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Ow_q1qR9jTw
2. https://www.youtube.com/watch?v=_wiFwn-H39Y

WEB RESOURCES:

1. <https://www.executivelevels.com/full-stack-developer-vs-cloud-computing-full-comparison/>
2. https://www.bing.com/search?q=full+stack+cloud+developer&cvid=82c58938f8174bf6affdccc6735b2e56c&gs_lcrp=EgZjaHJvbWUqBggCEAAyQDIGCAAQRRg5MgYIARAAGEAyBggCEAAyQDIGCAMQABhAMgYIBBAAGEAyBggFEAAyQDIGCAYQABhAMgYIBxAAGEAyBggIEAAyQNIBCDY0MzZqMGo0qAIIIsAIB&FORM=ANAB01&PC=U531

Course Code**Course Title****22CA204003L****MODERN APPLICATION DEVELOPMENT
WITH NODE.JS ON AWS****Pre-Requisite:** Cloud Computing**Anti-Requisite:** -**Co-Requisite:** -

COURSE DESCRIPTION: This Course provides a detailed discussion on Application Programming Interfaces(APIs), AWS SDK Exploration, AWS Toolkit, Amazon API Gateway authentication and authorization mechanisms, Amazon Cognito, Serverless Computing, AWS Lambda, creating a lambda function using AWS CLI, AWS Step Functions, Step Functions API exploration, Step Function Service Integrations, Call back patterns, Standard vs Express Step functions, Observability, Amazon X-Ray, API Gateway and Lambda Using the AWS X-Ray SDK with (Node), API Gateway and Lambda Logs, Amazon Cloud Watch Logs integration with API Gateway.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Understand the concepts of Application Programming Interfaces (APIs) and Amazon Web Services Command Line Interface (CLI).
- CO2.** Analyze the Amazon API Gateway terminology for authentication and authorization of various resources and Amazon Cognito to sign in and call the APIs.
- CO3.** Design and develop applications using AWS Lambda permissions and functions using AWS Toolkit.
- CO4.** Create serverless workflows using Step functions for the integration and call back patterns.
- CO5.** Adhere to ethics and adapt observability using X-Ray and Configuring Cloud Watch Logs in API Gateway.

CO-PO-PSO Mapping Table:

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

Correlation Levels:**3: High; 2: Medium; 1: Low****COURSE CONTENT**

Module 1: APPLICATION PROGRAMMING INTERFACES (APIs)

Architecting for the Cloud What we are building? AWS Cloud9, AWS Command Line Interface (CLI) and Application Programming Interfaces (APIs), APIs AWS CLI, AWS SDK Exploration (Node), AWS Credentials in Cloud9, Introduction to the Serverless Application Model (SAM), AWS Toolkit for (Cloud9/IntelliJ/PyCharm).

Module 2: AMAZON API GATEWAY TERMINOLOGY

API Driven Design, API driven development, what is Amazon API Gateway? Amazon API Gateway terminology, Section Readings, Models and Mapping, Creating an API with Mock integration, Using Mappings, Using Models, Section Readings, Publish API, Using Postman to create requests, API Authentication, Amazon API Gateway authentication, Amazon API Gateway access controls, Amazon API Gateway authentication and authorization mechanisms, Amazon Cognito, Amazon Cognito, Using Amazon Cognito to sign in and call Amazon API Gateway.

Module 3: AWS LAMBDA

Serverless Computing and AWS Lambda, AWS Lambda Execution, AWS Lambda permissions, Section Readings, Triggers, Push, Pull model. AWS Lambda execution context and reuse, AWS Lambda Compliance, Asynchronous vs Synchronous Responses, Versions and Aliases, creating a lambda function using the AWS CLI, Creating and Debugging an AWS Lambda Function using the AWS Toolkit.

Module 4: AWS STEP FUNCTIONS

Orchestration, Creating a serverless workflow, AWS Step Functions, Step Functions API exploration, Step Function State types, Step Function Service Integrations, Amazon API Gateway and Step function Integration, Call back patterns, Step Function Activities, Standard vs Express Step functions.

Module 5: OBSERVABILITY AND API GATEWAY

Observability, Amazon X-Ray, API Gateway and Lambda, Using the AWS X-Ray SDK with (Node), API Gateway and Lambda Logs, Amazon Cloud Watch Logs integration with API Gateway, Step Functions and Lambda Configuring, Cloud Watch Logs in API Gateway, Step Functions and Lambda.

EXPERIENTIAL LEARNING

1. Setting Up and Exploring the SDK
2. Amazon API Gateway
3. Amazon Cognito Authentication
4. Create a static website in Amazon S3
5. API
6. AWS Lambda Functions
7. AWS Step Functions
8. Optimizing an Application

RESOURCES

TEXT BOOKS:

1. Nader Dabit "*Full Stack Serverless: Modern Application Development with React, AWS, and GraphQL*", 1st Edition, O'Reilly Publications, November 2020.

REFERENCE BOOKS:

1. Saurabh Shrivastava, Neelanjali Srivastav and Artasanchez "*AWS for Solutions Architects: The definitive guide to AWS Solutions Architecture for migrating to, building, scaling, and succeeding in the cloud*," 2nd Edition, Packt Publishing Limited, April 2023.

SOFTWARE/TOOLS:

1. Cloud9 Toolkit
2. SDK

VIDEO LECTURES:

1. <https://youtu.be/9PfCvI6xIOE>
2. <https://youtu.be/iFMLyMgCUTs>
3. <https://youtu.be/clSWroo2snY>

WEB RESOURCES:

1. https://docs.aws.amazon.com/ec2/index.html?nc2=h_ql_doc_ec2
2. <https://docs.aws.amazon.com/AWSEC2/latest/APIReference/Welcome.html>

Course Code**Course Title****22CA202030L****MACHINE LEARNING****Pre-Requisite** Data mining /Python Programming**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks, Ensemble learning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01.** Analyze the process of machine learning modeling and evaluation to automatically infer a general description for a given learning problem.
- C02.** Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
- C03.** Design and implement machine learning solutions for classification, regression, and clustering problems.
- C04.** Design and implement efficient neural architectures to model patterns for a given learning problem.
- C05.** Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.
- C06.** Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3
C02	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
C03	2	3	3	3	3	-	-	-	-	-	-	-	-	-	3
C04	3	3	3	1		-	-	-	-	-	-	-	-	-	3
C05	1	3	3	3	3	3	-	-	-	-	-	-	-	-	3
C06	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	-	-	3	3	-	-	-	-	3

Correlation Levels:**3: High;****2: Medium; 1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning.

Preparing to Model: Machine learning activities, Types of data, Exploring structure of data, Data quality and remediation.

Module 2: MODELING AND EVALUATION, BAYESIAN CONCEPT LEARNING

Modeling and Evaluation: Selecting a model, Training a model, Model representation and interpretability, Evaluating performance of a model, Improving performance of a model.

Feature Engineering: Feature transformation, Feature subset Selection.

Bayesian Concept Learning: Introduction, Importance, Bayes' theorem, Bayes' theorem and concept learning, Bayesian belief network.

Module 3: SUPERVISED LEARNING

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Support vector machines, Decision Tree - Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis, Polynomial regression model, Logistic regression.

Module 4: UNSUPERVISED LEARNING

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS, ENSEMBLE LEARNING

Artificial Neural Networks: Neural network representations, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion.

Ensemble Learning: Bagging, Boosting, Gradient boosting.

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

2. Introduction to Python machine learning libraries.
3. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
4. Implement K-Nearest Neighbor algorithm to solve classification problem.
5. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Explore the problem of overfitting in decision tree and develop solution using pruning technique.
6. Perform Exploratory Data Analysis on the given dataset. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7. Train an SVM Classifier with Linear Kernel. Use an appropriate data set for building the SVM Classifier and apply this knowledge to classify a new sample.
8. Build linear regression and multiple regression models to predict the price of the house (Boston House Prices Dataset).
9. Build a polynomial regression model for predicting the salary of the employees.
10. Build a neural network that will read the image of a digit and correctly identify the number.
11. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit kumar das, Machine Learning, Pearson, 2019.

REFERENCE BOOKS:

1. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning Using Python, Packt Publishing, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly, 2019.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
4. Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

SOFTWARE/TOOLS:

1. Python
2. Scikit-learn/Keras/TensorFlow

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106202/>
2. <https://www.coursera.org/learn/machine-learning>
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
5. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
6. <https://www.coursera.org/learn/ntumlone-algorithmicfoundations>
7. <https://www.coursera.org/specializations/machine-learning-introduction>
8. <http://ndl.iitkgp.ac.in/document/YkxIRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhIVXBhUVVWaXZINDNyZUVldU9ldlYvd20wbkQ4MC92UQ>
9. <https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning>

WEB RESOURCES:

1. <https://www.ibm.com/topics/machine-learning>
2. <https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning>
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. <https://developers.google.com/machine-learning/crash-course>
5. <https://www.greenteapress.com/thinkstats/>
6. <https://info.deeplearning.ai/machine-learning-yearning-book>
7. <https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners>
8. <https://machinelearningmastery.com/machine-learning-in-python-step-by-step/>

Course Code	Course Title
22CA202031L	DATA HANDLING AND VISUALIZATION
Pre-Requisite	Data Analytics
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: Introduction to data Visualization, Methodology, Data Presentation, design objectives, Seven stages of data visualization, Data representation methods, Acquiring data, Parsing data, data processing, Drawing with data, Port scan visualization, Attacking and defending visualization systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the fundamentals of representing complex and voluminous data.
- C02** Design and use various methodologies in visualization.
- C03** Understanding the various process and tools used for visualization.
- C04** Using interactive visualization to make inference.
- C05** Discuss the process involved and security issues present in visualization.

CO-PO-PSO Mapping Table

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	3	3	-	-	-	2	3	-	-	-	-	3	-	-
C02	3	3	3	3	3	-	2	2	3	-	-	-	-	2	2
C03	1	3	3	-	-	-	-	3	-	-	-	-	2	2	3
C04	1	3	3	-	-	-	2	-	-	-	-	-	3	2	-
C05	-	3	3	-	-	-	-	2	2	-	-	-	-	-	-
Course Correlation Mapping	2	3	3	3	3	-	3	-	3	-	-	-	3	2	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1 INTRODUCTION

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

Module 2 VISUALIZING DATA METHODS

Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods- Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

Module 3 VISUALIZING DATA PROCESS

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, Using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

Module 4 INTERACTIVE DATA VISUALIZATION

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3, .js, tablo.

Module 5 SECURITY DATA VISUALIZATION

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

EXPERIENTIAL LEARNING:

1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
3. Working with Numpy arrays, Pandas data frames , Basic plots using Matplotlib.
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
5. Perform Time Series Analysis and apply the various visualization techniques.
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform EDA on Wine Quality Data Set.

RESOURCES

TEXT BOOKS:

1. Scott Murray, "Interactive data visualization for the web", O'Reilly Media, Inc., 2013.
2. Ben Fry, "Visualizing Data", O'Reilly Media, Inc., 2007.
3. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", NoStarch Press Inc, 200

REFERENCE BOOKS:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015..

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=jLfo9uqgKFk&list=PL7yAVmu-X0Mm5cjTIDBZRvL8i7bFsWsce>
2. <https://www.youtube.com/watch?v=MiiANxRHSv4&t=176s>

WEB RESOURCES:

1. <https://www.geeksforgeeks.org/data-handling/>
2. <https://www.tableau.com/learn/articles/data-visualization>

Course Code	Course Title
22CA201021L	ARTIFICIAL INTELLIGENCE

Pre-Requisite Computational Statistics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to artificial intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Probabilistic reasoning, Represent knowledge and reason under uncertainty, Robotics, Ethics and safety in AI.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

- CO1.** Architect intelligent agents using artificial intelligence techniques and principles.
- CO2.** Analyze and interpret the problem, identify suitable solutions using heuristic functions, optimization algorithms and search algorithms.
- CO3.** Select and apply appropriate knowledge representation to build Bayesian network models to reason under uncertainty.
- CO4.** Investigate robot hardware and frameworks for intelligent robotic perception.
- CO5.** Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	-	1	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	1	-	2	-	-	-	-	-	-	3
Course Correlation Mapping	3	2	2	-	-	1	-	2	-	-	-	-	-	-	3

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT:

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 PROBLEM SOLVING BY SEARCHING

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 3 SEARCH IN COMPLEX ENVIRONMENTS

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

Module 4 PROBABILISTIC REASONING

Representing Knowledge in an uncertain domain, Semantics of Bayesian networks, Probabilistic reasoning over time – Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman Filter.

Module 5 ROBOTICS, ETHICS AND SAFETY IN AI

Robotics: Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

Ethics and Safety in AI: Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety.

EXPERIENTIAL LEARNING:

1. Solve the travelling sales man problem using Hill Climbing search algorithm.
2. Design and implement solution for 8-puzzle problem using Greedy Best First Search.

RESOURCES

TEXT BOOK(S):

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition, 2020.
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education, 2017.
3. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

REFERENCE BOOKS:

1. Stephen Lucci , Danny Kopec, Artificial Intelligence in the 21st Century, Mercury Learning and Information, 3rd Edition, 2018.
2. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.

VIDEO LECTURES:

1. <https://www.coursera.org/courses?query=artificial%20intelligence>

WEB RESOURCES:

1. <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>
2. <http://aima.cs.berkeley.edu/>
3. <https://ai.google/education/>
4. <https://www.edureka.co/blog/artificial-intelligence-with-python/>

Course Code**22CA202032L****Course Title****AI FOR HEALTHCARE****Pre-Requisite** Artificial Intelligence**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1** Understand the fundamental concepts of AI in Healthcare sector.
- CO2** Analyze the present state and future of AI in Healthcare specialties for different Scenarios.
- CO3** Apply design concepts and metrics for AI in Healthcare.
- CO4** Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.
- CO5** Develop AI applications through AI techniques for healthcare.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	2	3	3	3	-	-	-	-	-	3	3	3	3	-
CO3	3	3	2	-	-	-	-	-	-	3	-	-	3	3	3
CO4	3	3	3	3	3	3	-	3	-	-	3	3	3	3	3
CO5	3	3	3	3	3	3	-	3	-	-	3	3	3	3	-
Course Correlation Mapping	3	3	3	-	3	3	-	3	-	3	3	3	3	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT**Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE**

Introduction to AI in Healthcare, Benefits and Risks, AI in the health sector, AI versus Human Intelligence, The future of AI in health sector, AI and Neural networks.

Module 2: THE PRESENT STATE AND FUTURE OF AI IN HEALTHCARE SPECIALITIES

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE

IBM Watson, The role of Google and Deep mind in AI in Healthcare, Baidu, Facebook and AI in Healthcare, Microsoft and AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI

Evidence-based medicine, personalized medicine, Connected medicine, Disease and Condition Management, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Education, Incentivized Wellness, Artificial Intelligence, Block chain, Robots.

Module 5: APPLICATIONS OF AI IN HEALTHCARE

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering a Scalable and Engaging Digital Therapy.

EXPERIENTIAL LEARNING

1. Study of PROLOG Programming Language and its Functions.
2. Write simple fact for the statements using PROLOG.
3. Write a Prolog program for the usage of all arithmetic Operators.
4. Write a Prolog program for solving the Towers of Hanoi problem
5. Write a Prolog program to solve Monkey and banana problem.
6. Write a Prolog program for depicting and inferring from the given Family relationship.
7. Write a Prolog program for implementing the solution for 8-Puzzle problem.

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, Artificial Intelligence in Healthcare, MedManthra Publications, First Edition 2019.
2. Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril, National Academy of Medicine Publication, First Edition, 2019.

VIDEO LECTURES:

1. <https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320> (AI for Healthcare)

WEB REFERENCES:

1. <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare> (Surgical robots, new medicines and better care: 32 examples of AI in healthcare)
2. <https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare> (Future of Artificial Intelligence in Healthcare)

Course Code**Course Title****22AI201701L****BUSINESS ANALYTICS****Pre-Requisite****Anti-Requisite****Co-Requisite**

COURSE DESCRIPTION: This course emphasizes on the basic concepts of Business Analytics. It covers the basic excel skills, Excel look up functions for database queries in business analytics. By the end of this course students will acquire basic knowledge to implement statistical methods for performing descriptive, predictive and prescriptive analytics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the basic concepts and models of Business Analytics
- C02** Select Suitable basic excel function to perform analytics on spread sheets.
- C03** Apply different statistical methods and tools for data summarization and visualization.
- C04** Develop user-friendly Excel applications by using statistical models for effectiveness decision making.
- C05** Understand different optimization models used in prescriptive analytics.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	-	-	-	1	-	-	-	-	-	-	-	3	-	3
C02	3	3	2	2	1	-	-	-	-	-	-	-	3	-	3
C03	3	2	-	2	2	-	-	-	-	-	-	-	3	-	3
C04	3	-	3	2	2	-	-	-	-	-	-	-	3	-	3
C05	3	2	-	-	2	-	-	-	-	-	-	-	3	-	3
Course Correlation Mapping	3	2.3	2.5	2	1.6	-	-	-	-	-	-	-	3	-	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FOUNDATIONS OF BUSINESS ANALYTICS

Introduction, What is Business Analytics, Evolution of Business Analytics, Scope of Business Analytics, Data for Business Analytics, Models in Business Analytics, Problem Solving with Analytics.

Module 2: ANALYTICS ON SPREADSHEETS

Basic Excel Skills, Excel Functions, Using Excel Lookup Functions for Database Queries, Spreadsheet Add-Ins for Business Analytics.

Module 3 DESCRIPTIVE ANALYTICS

Data Visualization, Creating Charts In Microsoft Excel, Other Excel Data Visualization, Statistical Methods For Summarizing Data, Exploring Data Using Pivot tables

Module 4 PREDICTIVE ANALYTICS

Trend lines And Regression Analysis, Modeling Relationships And Trends In Data, Simple Linear Regression, Multiple Linear Regression, Building Good Regression Models, Strategies for predictive decision modeling, implementing models on spreadsheets, spreadsheet applications in business analytics, developing user-friendly excel applications, analyzing uncertainty and model assumptions, model analysis using analytic solver platform

Module 5 PRESCRIPTIVE ANALYTICS

Building Linear Models, Implementing Linear Optimization Models On Spreadsheets, Graphical Interpretation Of Linear Optimization, Formulating Decision Problems, Decision Strategies Without Outcome Probabilities, Decision Trees With Outcome Probabilities, Decision Trees.

RESOURCES

TEXT BOOK:

1. James Evans, "Business Analytics," Pearson Education ,2nd Edition, 2017.

REFERENCE BOOKS:

1. Marc J.Schniederjans, "Business Analytics," Pearson Education,2015
2. Camm,Cochran, "Essentials of Business Analytics," cenage learning,2015

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/110105089>
2. <https://archive.nptel.ac.in/courses/110/107/110107092/>
3. <https://nptel.ac.in/courses/110106050>

WEB RESOURCES:

1. <https://www.proschoolonline.com/certification-business-analytics-course/what-is-ba>
2. https://michael.hahsler.net/SMU/EMIS3309/slides/Evans_Analytics2e_ppt_01.pdf
3. <https://www.guru99.com/business-analyst-tutorial-course.html>

Course Code	Course Title
22CB101701L	CYBER LAWS AND SECURITY
Pre-Requisite	-
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Crimes and Indian IT Act; Cyber Offenses; Tools and Methods used in Cyber Crime; Phishing and Identity Theft; Indian and Global Perspective on Cyber Crimes and Cyber Security; Organizational Implications on Cyber Security; IPR Issues; Cyber Crime and Terrorism; Cyber Crime Illustrations

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate knowledge in Cyber security, Cybercrimes and its related laws in Indian and Global Act.
- CO2.** Analyze the legal perspectives and laws related to cybercrimes in Indian context.
- CO3.** Apply security and privacy methods in development of modern applications and in organizations to protect people and to prevent cybercrimes.
- CO4.** Solve Cyber security issues using privacy policies and Use antivirus tools to minimize the impact of cyber threats.
- CO5.** Apply security standards for the implementation of Cyber Security and laws.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	2	3	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CYBER CRIMES AND OFFENSES

Cyber Crimes: Introduction, Definition, Origin, Cybercrime and information security, Cyber criminals, Classifications of cybercrimes, The legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, Global perspective on cybercrimes.

Cyber Offenses: Introduction, Criminals planning on attacks, Social engineering, Cyber stalking, Cyber cafe and crimes, Botnets.

Module 2: TOOLS AND METHODS USED IN CYBER CRIME AND PHISHING AND IDENTITY THEFT

Introduction, Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spywares, Virus, Worms and Ransomware, Trojan horses and Backdoors, Steganography, DoS and DDoS attacks.

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Module 3 CYBER CRIMES AND CYBER SECURITY-LEGAL PERSPECTIVES

Introduction, Cyber laws in Indian context, The Indian IT act, Challenges to Indian law and Cybercrime scenario in India, Consequences of not addressing the weakness in IT act, Digital signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber law, Technology and Students in India scenario.

Module 4 CYBER SECURITY-ORGANIZATIONAL IMPLICATIONS

Introduction, Web threats for organizations – evils and perils, Security and privacy implications from cloud computing, Social Media Marketing-Security risks and Perils for organizations, Social computing and associated challenges for organizations, Protecting people's privacy in organization, Organizational guidelines for internet usage, Safe computing and Usage policy, Incident handling and Best practices.

Module 5 CYBER CRIME AND TERRORISMAND ILLUSTRATIONS

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, The ethical dimension of cybercrimes, The psychology, Mindset and skills of hackers and cyber criminals, Sociology of cyber criminals, Information warfare.

Cyber Crime Illustrations: Indian banks lose millions of rupees, Justice vs. Justice, Parliament attack, The Indian case of online gambling, Bank and credit card related frauds, Purchasing goods and services scam, Nigerian 419 scam.

EXPERIENTIAL LEARNING

1. The Cyber Security Risks on Social Media – Learn from Case Studies: <https://www.rswebsols.com/tutorials/internet/cyber-security-risks-social-media>
2. SIX automates key cybersecurity tasks to actively protect itself against social media threats: <https://www.hootsuite.com/resources/six-group-case-study>
3. Important Cyber Law Case Studies : <https://www.cyberalegalservices.com/detail-casestudies.php>

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Nina Gobole, SunitBelapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India, 2011.

REFERENCE BOOKS:

1. Prashant Mali, *Cyber Law and Cyber Crimes*, Snow White Publications Pvt. Ltd., 2013.
2. Alfred Basta and et al, *Cyber Security and Cyber Laws*, Cengage Learning India 2018

VIDEO LECTURES:

1. Learn Cyber Security | Cyber Security Training: <https://www.youtube.com/watch?v=PIHnamdwGmw>
2. Cyber Security For Beginners: <https://www.youtube.com/watch?v=4RE4d23tDFw>

WEB RESOURCES:

1. <https://study.com/academy/course/computer-science-110-introduction-to-cybersecurity.html>

2. <https://www.pandasecurity.com/en/mediacenter/panda-security/types-of-cybercrime/>
3. <https://mediasmarts.ca/digital-media-literacy/digital-issues/cyber-security/cyber-security-spam-scams-frauds-identity-theft>

Course Code**Course Title****22CB101703L****FORENSIC SCIENCE****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- C01** Understand the basic concepts of Forensic science.
- C02** Apply various tools and techniques in forensic science for crime investigation.
- C03** Understand Forensic Photography fundamentals.
- C04** Perform Crime scene investigation, scene reconstruction and prepare reports.
- C05** Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
C02	3	3	2	2	2	-	-	-	-	-	-	-
C03	3	3	-	-	-	-	-	-	-	-	-	-
C04	3	3	2	2	2	-	-	-	-	-	-	-
C05	3	3	2	2	2	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	2	2	2	-	-	-	-	-	-	-

Correlation Levels:**3: High;****2: Medium;****1: Low****COURSE CONTENT****Module 1: INTRODUCTION**

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis, Enzyme Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

EXPERIENCIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. Identify and list the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Houck M.M and Siegel J.A, *Fundamentals of Forensic Science*, Elsevier, 2nd edition, 2010.
2. Sharma B.R, *Forensic Science in Criminal Investigation and Trials*, Universal Publishing Co., New Delhi, 2003.

REFERENCE BOOKS:

1. Nanda B.B and Tewari, R.K, *Forensic Science in India- A vision for the Twenty First Century*, Select Publisher, New Delhi, 2001.
2. James, S.H and Nordby, J.J, *Forensic Science- An Introduction to Scientific and Investigative Techniques*, CRC Press, USA, 2003.

3. Saferstein, Criminalistics, *An Introduction of Forensic Science*, Prentice Hall Inc, USA, 2007.
4. Barry, A.J. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, NewYork, 7th edition, 2003.

VIDEO LECTURES:

1. <https://nptel.ac.in/courses/106106178>
2. <https://www.youtube.com/watch?v=X5fo1H7bc0g>

WEB RESOURCES:

1. <https://www.nist.gov/forensic-science>
2. <https://www.coursera.org/learn/forensic-science>

Course Code**Course Title****22ME101704L****MANAGING INNOVATION AND
ENTREPRENEURSHIP****Pre-Requisite** -**Anti-Requisite** -**Co-Requisite** -**COURSE DESCRIPTION:**

Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies; Concepts of Shifting Composition of the Economy Purposeful Innovation & Sources of Innovative Opportunity; The Innovation Process; Innovative Strategies; Entrepreneurial Motivation; Entrepreneurs versus inventors; Ethics and International Entrepreneurship; Strategic Issues in International Entrepreneurship; Problem solving Innovation and Diversification

COURSE OUTCOMES: After successful completion of the course, students will be able to:

- CO1.** Demonstrate the principles of innovation process for establishing Industrial ventures.
- CO2.** Identify and analyze the gaps in an organization for innovation in the context of developed economies
- CO3.** Develop a comprehensive and well-planned business structure for a new venture.
- CO4.** Demonstrate knowledge on intellectual property rights, patents, trademarks, copyrights, trade secrets and commercialization of intellectual property.
- CO5.** Apply ethics in constructive innovation framework and problem solving.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	1	1	1	1	-	-	1	-
CO2	3	2	1	-	1	-	-	-	-	-	1	-
CO3	3	3	1	1	1	-	-	-	-	-	1	-
CO4	3	2	1	1	1	1	-	-	-	-	1	-
CO5	3	3	3	1	1	1	-	-	-	-	2	-
Course Correlation Mapping	3	2	1	1	1	1	1	1	-	-	1	-

Correlation Levels:**3: High;****2: Medium;****1: Low****COURSE CONTENT****Module 1: CREATIVITY AND INNOVATION**

Introduction, Levels of innovation, Purposeful innovation and the sources of innovative opportunity, The innovation process, Innovative strategies, Strategies that aim at introducing and innovation, Dynamics of ideation and creativity – Inbound, Outbound; Context and process of new product development, Theories of outsourcing.

Module 2: PARADIGMS OF INNOVATION

Systems approach to innovation, Innovation in the context of developed economies and Emerging economies, Examining reverse innovation and its application, Performance gap, Infrastructure gap, Sustainability gap, Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: SOURCES OF FINANCE AND VENTURE CAPITAL

Importance of finance, Comparison of venture capital with conventional development capital, Strategies of venture funding, Investment phases, Investment process, Advantages and disadvantages of venture capital, Venture capital developments in India.

Module 4: INTELLECTUAL PROPERTY INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship, Evolution of entrepreneurship from economic theory, Managerial and entrepreneurial competencies, Entrepreneurial growth and development, Concepts, Ethics and Nature of International Entrepreneurship, Intellectual property – forms of IP, Patents, Trademarks, Design registration, Copy rights, Geographical indications, Patent process in India.

Module 5: OPEN INNOVATION FRAME WORK & PROBLEM SOLVING

Concept of open innovation approach, Difference between open innovations and Closed innovation approaches, Limitations and Opportunities of open innovation framework, Global context of strategic alliance, Role of strategic alliance, Problem Identification and Problem Solving, Innovation and Diversification

EXPERIENTIAL LEARNING

1. Identify the Innovative Marketing Strategies for Startups
2. Identify the Coca-cola Company Intellectual Property Rights

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES/ARTICLES:

Contemporary relevant case studies/ Articles will be provided by the course instructor at the beginning.

1. Tesla Inc.: Disrupting the Automobile Industry
This case study examines how Tesla Inc. disrupted the traditional automobile industry through its innovative electric vehicles and sustainable energy solutions. It discusses the sources of innovative opportunity that Tesla leverages, the ideation and creativity dynamics involved in new product development, and the strategies that the company uses to introduce and market its innovations.
2. Google Inc.: Innovation in Developed Economies
This case study explores how Google Inc. became a global leader in the technology industry through its innovative search engine, advertising, and cloud computing solutions. It highlights the performance gap that Google addressed, the regulatory and sustainability gaps that it leveraged, and the impact of its innovation strategies on the company's growth and profitability.

3. **Flipkart: From Startup to Unicorn**
This case study examines how Flipkart, an Indian e-commerce company, secured venture capital funding to become one of the largest online marketplaces in India. It discusses the importance of finance in entrepreneurship, the advantages and disadvantages of venture capital, and the strategies that Flipkart used to attract venture funding.
4. **Patanjali Ayurved: Building a Brand through Intellectual Property**
This case study explores how Patanjali Ayurved, an Indian consumer goods company, built a strong brand through its intellectual property strategies. It discusses the forms of IP that Patanjali leverages, the patent process in India, and the impact of IP on the company's growth and profitability.
5. **Procter & Gamble: Innovation through Open Innovation**
This case study analyzes how Procter & Gamble, a global consumer goods company, leveraged open innovation to achieve unprecedented success in product development and marketing. It discusses the difference between open and closed innovation approaches, the limitations and opportunities of open innovation, and the role of strategic alliances in global innovation.

RESOURCES

TEXT BOOKS:

1. Vinnie Jauhari, Sudhanshu Bhushan, *Innovation Management*, Oxford University Press, 1st Edition, 2014.
2. Drucker, P.F., *Innovation and Entrepreneurship*, Taylor & Francis, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Robert D Hisrich, Claudine Kearney, *Managing Innovation and Entrepreneurship*, Sage Publications, 1st Edition, 2014.
2. V.K. Narayanan, *Managing Technology and Innovation for Competitive Advantage*, Pearson India, 1st Edition, 2002.

VIDEO LECTURES:

1. <https://www.youtube.com/watch?v=wWsl48VLfVY>
2. <https://www.youtube.com/watch?v=dDpQ9ALKX0U>
3. https://www.youtube.com/watch?v=Eu_hkxkJGTg