B.Tech II Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	BS&H	Discrete Mathematics & Graph Theory	3	0	0	3
2	BS&H	Universal HumanValues 2– Understanding Harmony	2	1	0	3
3	Engineering Science	Digital Logic & Computer Organization	3	0	0	3
4	Professional Core	Advanced Data Structures & Algorithms Analysis	3	0	0	3
5	Professional Core	Object Oriented Programming Through Java	3	0	0	3
6	ProfessionalCore	Advanced Data Structures and Algorithms Analysis Lab	0	0	3	1.5
7	Professional Core	Object Oriented Programming Through Java Lab	0	0	3	1.5
8	Skill Enhancement Course	Python Programming	0	1	2	2
9	Audit Course	Environmental Science	2	0	0	0
Total			**16**	**2**	**8**	**20**

B.Tech II Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Management Course- I	Managerial Economic and Financial Analysis	2	0	0	2
2	Engineering Science/ Basic Science	Probability & Statistics	3	0	0	3
3	Professional Core	Operating Systems	3	0	0	3
4	Professional Core	Microprocessors & Microcontrollers	3	0	0	3
5	Professional Core	Computer Networks	3	0	0	3
6	Professional Core	Computer Networks &Operating Systems Lab	0	0	3	1.5
7	Professional Core	Microprocessors & MicrocontrollersLab	0	0	3	1.5
8	Skill Enhancement course	Full Stack Development-1	0	1	2	2
9	BS&H	Design Thinking &Innovation	1	0	2	2
Total			**15**	**1**	**10**	**21**
Mandatory Community Service Project Internship of 08 weeks duration during summer Vacation						

II Year I Semester

L	T	P	C
3	0	0	3

DISCRETE MATHEMATICS & GRAPH THEORY

Course Objectives:

The main objectives of the course is to

- Use classical methods of combinatorial counting to determine exact and asymptotic values.
- Solve a variety of recurrence relations, using linear algebra and generating functions.
- Deduce, conjecture, and prove fundamental results in graph theory.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Apply mathematical logic to solve problems. (L2, L3)

CO2: Understand the concepts and perform the operations related to sets, relations and functions. Gain the conceptual background needed and identify structures of algebraic nature.(L3, L5)

CO3: Apply basic counting techniques to solve combinatorial problems. (L3)

CO4: Formulate problems and solve recurrence relations. (L2, L3)

CO5: Apply Graph Theory in solving computer science problems (L3, L5)

UNIT I

Mathematical Logic: Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, Functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus.

UNIT II

Set theory: The Principle of Inclusion- Exclusion, Pigeon hole principle and its application, Functions composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties. Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups and Monoids, groups, sub groups, homomorphism, Isomorphism.

UNIT III

Elementary Combinatorics: Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems.

UNITIV :

Recurrence Relations: Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generating functions, The Method of Characteristic roots, Solutions of Inhomogeneous, Recurrence Relations.

UNIT IV

Graphs: Basic Concepts, Isomorphism and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs.

Textbooks:
1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.

ReferenceBooks:
1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science. Online Learning Resources:

Online References:
1. http://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf

II Year I Semester

L	T	P	C
2	1	0	3

UNIVERSAL HUMAN VALUES 2–UNDERSTANDING HARMONY

Course Objectives:

- To help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

- Define the terms like Natural Acceptance, Happiness and Prosperity (L1, L2)
- Identify one's self, and one's surroundings (family, society nature) (L1, L2)
- Apply what they have learnt to their own self in different day-to-day settings in real life (L3)
- Relate human values with human relationship and human society. (L4)
- Justify the need for universal human values and harmonious existence (L5)
- Develop as socially and ecologically responsible engineers (L3, L6)

Course Topics

The course has 28 lectures and 14 tutorials in 5 modules. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions.

The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

UNIT I   Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II   Harmony in the Human Being (6 lectures and 3 tutorials for practice session)

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III   Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV   Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice
session)

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V   Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values

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KAKINADA – 533 003, Andhra Pradesh, India
R23 CSE IOT COURSE STRUCTURE & SYLLABUS

Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Practice Sessions for UNIT I – Introduction to Value Education
PS1 Sharing about Oneself
PS2 Exploring Human Consciousness
PS3 Exploring Natural Acceptance

Practice Sessions for UNIT II – Harmony in the Human Being
PS4 Exploring the difference of Needs of self and body
PS5 Exploring Sources of Imagination in the self
PS6 Exploring Harmony of self with the body

Practice Sessions for UNIT III – Harmony in the Family and Society
PS7 Exploring the Feeling of Trust
PS8 Exploring the Feeling of Respect
PS9 Exploring Systems to fulfil Human Goal

Practice Sessions for UNIT IV – Harmony in the Nature (Existence)
PS10 Exploring the Four Orders of Nature
PS11 Exploring Co-existence in Existence

Practice Sessions for UNIT V – Implications of the Holistic Understanding – a Look at Professional Ethics
PS12 Exploring Ethical Human Conduct
PS13 Exploring Humanistic Models in Education
PS14 Exploring Steps of Transition towards Universal Human Order

READINGS:
Textbook and Teachers Manual
a. The Textbook
R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books
1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautifu*l - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal
9. *Rediscovering India* - by Dharampal
10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi
11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Mode of Conduct:
Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analyzing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content.

Additional content may be offered in separate, higher courses. This course is to be taught by faculty from every teaching department, not exclusively by any one department.

Teacher preparation with a minimum exposure to at least one 8-day Faculty Development Program on Universal Human Values is deemed essential.

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf

2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf

3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf

4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%202023.pdf

5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf

6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf

7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%202023-25%20Ethics%20v1.pdf

8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385

9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

II Year I Semester

L	T	P	C
3	0	0	3

DIGITAL LOGIC & COMPUTER ORGANIZATION

Course Objectives:

The main objectives of the course is to

- Provide students with a comprehensive understanding of digital logic design principles and computer organization fundamentals
- Describe memory hierarchy concepts
- Explain input/output(I/O) systems and their interaction with the CPU,memory,and peripheral devices

UNIT–I:

Data Representation: Binary Numbers, Fixed Point Representation. Floating Point Representation.Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes Digital Logic Circuits-I: Basic Logic Functions, Logic gates, universal logic gates,Minimization ofLogicexpressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers

UNIT – II:

Digital Logic Circuits-II: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters, Basic Structure of Computers: Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Von- Neumann Architecture

UNIT – III:

Computer Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations. Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control

UNIT – IV:

The Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

UNIT – V:

Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

Textbooks:

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, Safwat Zaky, 6th edition,

McGraw Hill
2. Digital Design, 6th Edition, M. Morris Mano, Pearson Education.
3. Computer Organization and Architecture, William Stallings, 11thEdition, Pearson.

Reference Books:
1. Computer Systems Architecture, M.Moris Mano, 3rdEdition, Pearson
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier
3. Fundamentals of Logic Design, Roth, 5thEdition, Thomson

Online Learning Resources:
1. https://nptel.ac.in/courses/106/103/106103068/

II Year I Semester

L	T	P	C
3	0	0	3

ADVANCED DATA STRUCTURES & ALGORITHM ANALYSIS

Course Objectives:

The main objectives of the course is to

- Provide knowledge on advance data structures frequently used in Computer Science domain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

UNIT–I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, A symptotic Notations. AVL Trees–Creation, Insertion, Deletion operations and Applications. B.Trees–Creation, Insertion, Deletion operations and Applications

UNIT–II:

Heap Trees (PriorityQueues)– Min and Max Heaps, Operations and Applications. Graphs–Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications. Divide and Conquer:The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

UNIT–III:

Greedy Method: General Method, Job Sequencing with deadlines ,Knap sack Problem, Minimum costs panningtrees, Single Source Shortest Paths Dynamic Programming:General Method, Allpairs shortest paths, Single Source Shortest Paths–General Weights(BellmanFordAlgorithm), Optimal Binary SearchTrees,0/1 Knapsack, String Editing, Travelling Sales person problem

UNIT–IV:

Back tracking:General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knap sack Problem. Branch and Bound: The General Method,0/1KnapsackProblem,Travelling Salesperson problem

UNIT–V:

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem. NP Hard Graph Problems: Clique Decision Problem(CDP),Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem(TSP). NP Hard Scheduling Problems: Scheduling Identical Processors, Job ShopScheduling

Text books:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj;Mehta, Dinesh, 2nd Edition Universities Press
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition University Press

Reference Books:

1. Data Structures and program designin C, Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications,Trembley & Sorenson, Mc Graw Hill
3. The Art of Computer Programming,Vol.1:Fundamental Algorithms, Donald EKnuth, Addison-Wesley,1997.
4. Data Structures using C&C++: Langsam, Augenstein &Tanenbaum, Pearson,1995
5. Algorithms +Data Structures & Programs:,N.Wirth,PHI
6. Fundamentals of Data Structures in C++: Horowitz Sahni&Mehta, GalgottiaPub.
7. Data structures in Java:,Thomas Standish, Pearson Education Asia

OnlineLearningResources:

- https://www.tutorialspoint.com/advanced_data_structures/index.asp
- http://peterindia.net/Algorithms.html

II Year I Semester

L	T	P	C
3	0	0	3

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Objectives:
The learning objectives of this course are to:

- Identify Java language components and how they work together in applications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

UNIT I
Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.**Control Statements**: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator ?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II
Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.**Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.**Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. **Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT IV

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.**Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.
Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

UNIT V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.
Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread- Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.**Java Database Connectivity:**Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface. **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2) Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3) JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:

1) The complete Reference Java, 11th edition, Herbert Schildt,TMH
2) Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

1) https://nptel.ac.in/courses/106/105/106105191/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

II Year I Semester

L	T	P	C
0	0	3	1.5

ADVANCED DATA STRUCTURES & ALGORITHM ANALYSIS LAB

Course Objectives:

The objectives of the course is to

- acquire practical skills in constructing and managing Data structures
- apply the popular algorithm design methods in problem-solving scenarios

Experiments covering the Topics:

- Operations on AVL trees, B-Trees, Heap Trees
- Graph Traversals
- Sorting techniques
- Minimum cost spanning trees
- Shortest path algorithms
- 0/1 Knapsack Problem
- Travelling Salesperson problem
- Optimal Binary Search Trees
- N-Queens Problem
- Job Sequencing

Sample Programs:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.
2. Construct B-Tree an order of 5 with a set of 100 random elements stored in array. Implement searching, insertion and deletion operations.
3. Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.
4. Implement BFT and DFT for given graph, when graph is represented by
   a) Adjacency Matrix   b) Adjacency Lists
5. Write a program for finding the biconnected components in a given graph.
6. Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).
7. Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists.
8. Implement Job Sequencing with deadlines using Greedy strategy.
9. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
10. Implement N-Queens Problem Using Backtracking.
11. Use Backtracking strategy to solve 0/1 Knapsack problem.
12. Implement Travelling Sales Person problem using Branch and Bound approach.

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, Sahni Sartaj, Mehta, Dinesh, 2nd Edition, Universities Press

2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition, University Press

3. Data Structures and program design in C, Robert Kruse, Pearson Education Asia

4. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill

Online Learning Resources:

1. http://cse01-iiith.vlabs.ac.in/
2. http://peterindia.net/Algorithms.html

II Year I Semester

L	T	P	C
0	0	3	1.5

OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

Course Objectives:

The aim of this course is to

- Practice object oriented programming in the Java programming language
- implement Classes, Objects, Methods, Inheritance, Exception, Runtime Polymorphism, User defined Exception handling mechanism
- Illustrate inheritance, Exception handling mechanism, JDBC connectivity
- Construct Threads, Event Handling, implement packages, Java FX GUI

Experiments covering the Topics:

- Object Oriented Programming fundamentals- data types, control structures
- Classes, methods, objects, Inheritance, polymorphism,
- Exception handling, Threads, Packages, Interfaces
- Files, I/O streams, JavaFX GUI

Sample Experiments:

Exercise – 1:

a) Write a JAVA program to display default value of all primitive data type of JAVA

b) Write a java program that display the roots of a quadratic equation $ax^2+bx=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.

Exercise - 2

a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.

b) Write a JAVA program to sort for an element in a given list of elements using bubble sort

c) Write a JAVA program using StringBuffer to delete, remove character.

Exercise - 3

a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.

b) Write a JAVA program implement method overloading.

c) Write a JAVA program to implement constructor.

d) Write a JAVA program to implement constructor overloading.

Exercise - 4

a) Write a JAVA program to implement Single Inheritance

b) Write a JAVA program to implement multi level Inheritance

c) Write a JAVA program for abstract class to find areas of different shapes

Exercise - 5

a) Write a JAVA program give example for "super" keyword.

b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?

c) Write a JAVA program that implements Runtime polymorphism

Exercise - 6

a) Write a JAVA program that describes exception handling mechanism

b) Write a JAVA program Illustrating Multiple catch clauses

c) Write a JAVA program for creation of Java Built-in Exceptions

d) Write a JAVA program for creation of User Defined Exception

Exercise - 7

a) Write a JAVA program that creates threads by extending Thread class. First thread display "Good Morning "every 1 sec, the second thread displays "Hello "every 2 seconds and the third display "Welcome" every 3 seconds, (Repeat the same by implementing Runnable)

b) Write a program illustrating **is Alive** and **join ()**

c) Write a Program illustrating Daemon Threads.

d) Write a JAVA program Producer Consumer Problem

Exercise – 8

a) Write a JAVA program that import and use the user defined packages

b) Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX)

c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI

II Year I Semester

L	T	P	C
0	1	2	2

PYTHON PROGRAMMING
(Skill Enhancement Course)

Course Objectives:

The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these

UNTI-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language. Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list:
   i. addition   ii. insertion   iii. slicing
6. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:
Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. Write a program to sum all the items in a given dictionary.

UNIT-IV:
Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be

lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.
6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:
Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
   a) Apply head () function to the pandas data frame
   b) Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

II Year I Semester

L	T	P	C
2	0	0	0

ENVIRONMENTAL SCIENCE

Course Objectives:
- To make the students to get awareness on environment
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of humanlife
- To save earth from the inventions by the engineers.

Course Outcomes:
- Grasp multidisciplinary nature ofenvironmental studies and various renewable and non-renewable resources.
- Understand flow and bio-geo-chemical cycles and ecological pyramids.
- Understand various causes of pollution and solid wastemanagement and related preventive measures.
- About the rainwater harvesting, watershed management, ozone layer depletion and waste landreclamation.
- Casus of population explosion, value education and welfare programmes.

UNIT–I
Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need forPublicAwareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timberextraction – Mining, dams and other effects on forest and tribal people – Water resources – Use andover utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems–Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources,case studies– Food resources: World food problems,changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, casestudies.–Energy resources:

UNIT–II
Eco systems: Concep to fanecosystem.–Structure and function of an ecosystem–Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids–Introduction, types, characteristic features, structure and function of the following ecosystem:
  a. Forest ecosystem.
  b. Grassland ecosystem
  c. Desert ecosystem
  d. Aquatic ecosystems(ponds,streams,lakes,rivers,oceans,estuaries)

Biodiversity And Its Conservation: Introduction Definition: genetic, species and ecosystem diversity –Bio-geographical classification of India–Value of biodiversity: consumptiveuse, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and locallevels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitatloss, poaching of wildlife, man-wild life conflicts–Endangered and endemic species of India –Conservation of biodiversity:In-situand Ex-situ conservation of biodiversity.

UNIT–III
Environmental Pollution: Definition, Cause, effects and control measures of:
  a. Air Pollution.
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Roleof an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT–IV
Social Issues and the Environment: From Unsustainable to Sustainable development–Urban problems related to energy – Water conservation, rain water harvesting, watershed management –Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions–Climate change, global warming, acid rain, ozone layer depletion,nuclear accidents and holocaust. Case Studies – Waste land reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act–Wild life Protection Act–Forest Conservation Act–Issues involved inenforcement of environmental legislation–Public awareness.

UNIT–V
Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education–HIV/AIDS–Women and Child Welfare–Role of information Technology in Environment and human health–Case studies.
FieldWork:Visit to alocal area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural

Study of common plants, insects, and birds–river,hillslopes,etc..

Text books:
1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission,Universities Press.
2. Palaniswamy,"Environmental Studies",Pearson education
3. S.AzeemUnnisa,"Environmental Studies"Academic Publishing Company
4. K.RaghavanNambiar,"Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus",Scitech Publications(India),Pvt.Ltd.

Reference Books:

1. Deeksha DaveandE.Sai Baba Reddy,"Text book of Environmental Science",Cengage Publications.
2. M.AnjiReddy,"Text book of Environmental Sciences and Technology",BSPublication.
3. J.P.Sharma,Comprehensive Environmental studies,Laxmi publications.
4. J.GlynnHenry and GaryW.Heinke,"Environmental Sciences and Engineering",Prentice Hall of India Private limited
5. G.R.Chatwal,"AText Book of Environmental Studies"Himalaya Publishing House
6. GilbertM.Masters and WendellP.Ela,"Introduction to Environmental Engineering and Science, Prentice Hall of India Private limited.

II Year II Semester

L	T	P	C
2	0	0	2

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Course Objectives:

- To inculcate the basic knowledge of microeconomics and financial accounting
- To make the students learn how demand is estimated for different products, input-output relationship for optimizing production and cost
- To Know the Various types of market structure and pricing methods and strategy
- To give an overview on investment appraisal methods to promote the students to learn how to plan long-term investment decisions.
- To provide fundamental skills on accounting and to explain the process of preparing financial statements.

Course Outcomes:

- Define the concepts related to Managerial Economics, financial accounting and management.
- Understand the fundamentals of Economics viz., Demand, Production, cost, revenue and markets
- Apply the Concept of Production cost and revenues for effective Business decision
- Analyze how to invest their capital and maximize returns
- Evaluate the capital budgeting techniques
- Develop the accounting statements and evaluate the financial performance of businessentity.

UNIT-I

Managerial Economics: Introduction – Nature, meaning, significance, functions, and advantages. Demand-Concept, Function,Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management.

UNIT-II

Production and Cost Analysis: Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and long run Production Function- Isoquants and Isocosts, MRTS -Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale.Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) -Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations ofBreak-EvenAnalysis.

UNIT-III

Business Organizations and Markets: Introduction–Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises.Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly-Monopolistic Competition–Oligopoly-Price-Output Determination-Pricing Methods and Strategies

UNIT-IV

Capital Budgeting: Introduction – Nature, meaning, significance, functions and advantages. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting–Features, Proposals, Methods and Evaluation. Projects– Pay Back Method, Accounting Rate of Return(ARR)Net Present Value (NPV) Internal Rate Return (IRR) Method (sample problems)

UNIT-V

Financial Accounting and Analysis: Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions- Double-Entry Book Keeping, Journal, Ledger, Trial Balance-Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).Financial Analysis-Analysis and Interpretation of Liquidity Ratios, Activity Ratios,and Capital structure Ratios and Profitability.

Textbooks:
  1. Varshney & Maheswari: Managerial Economics, Sultan Chand,2013.

Reference Books:
 1. Managerial Economics: Principles And Worldwide Applications, 9E
    (Adaptation)by Dominick Salvatore and Siddhartha Rastogi
 2. Managerial Economics: Principles and Worldwide Applications
     by Dominick Salvatore

II Year II Semester

L	T	P	C
3	0	0	3

PROBABILITY & STATISTICS

Course Objectives

The main objectives of the course is to make student

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.

Course Outcomes:

After successful completion of this course, the students should be able to:

CO1: Acquire knowledge in finding the analysis of the data quantitatively or categorically and various statistical elementary tools.(L2, L3)

CO2: Develop skills in designing mathematical models involving probability, random variables and the critical thinking in the theory of probability and its applications in real life problems.(L3, L5)

CO3: Apply the theoretical probability distributions like binomial, Poisson, and Normal in the relevant application areas.(L3)

CO4: Analyze to test various hypotheses included in theory and types of errors for large samples.(L2, L3)

CO5: Apply the different testing tools like t-test, F-test, chi-square test to analyze the relevant real life problems.(L3, L5)

UNITI :

Descriptive statistics

Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Measures of Central tendency, Measures of Variability (spread or variance) Skewness, Kurtosis, correlation, correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines.

UNIT II

Probability: Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

UNIT III

Probability distributions: Probability distributions: Binomial, Poisson and Normal-their properties (Chebyshevs inequality). Approximation of the binomial distribution to normal distribution.

UNIT IV

Estimation and Testing of hypothesis, large sample tests: Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

UNIT V

Small sample tests:Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi2$ - test for goodness of fit, $\chi2$ - test for independence of attributes.

Textbooks:
1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:
1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
3. B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education.

Online Learning Resources:
1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://onlinecourses.nptel.ac.in/noc22_mg31/preview

II Year II Semester

L	T	P	C
3	0	0	3

OPERATING SYSTEMS

Course Objectives:

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

UNIT - I

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT - II

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT – III

Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT - IV

Memory-Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

UNIT - V

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File-

System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Text Books:

1. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.
2. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson , 2016

Reference Books:

1. Operating Systems -Internals and Design Principles, Stallings W, 9th edition, Pearson, 2018
2. Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Edition, McGraw- Hill, 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/106/106/106106144/
2. http://peterindia.net/OperatingSystems.html

II Year II Semester

L	T	P	C
3	0	0	3

MICRO PROCESSORS AND MICRO CONTROLLERS

Course Outcomes: At the end of the course, student will be able to

    CO1 : Develop programs for different addressing modes.
    CO2 : 8086 interfacing with different peripherals and implement programs
    CO3 : Describe the key features of serial and parallel communication
    CO4 : Design a microcontroller for simple applications
    CO5 : Illustrate how the different peripherals are interfaced with

Unit – 1 :

8086/8088 MICROPROCESSORS: Register organization of 8086, Architecture, signal description of 8086, physical memory organization, general bus operation, I/O addressing capability, special purpose activities, Minimum mode, maximum mode of 8086 system and timings, machine language instruction formats, addressing mode of 8086, instruction set of 8086,assembler directives and operators

Unit – 2 :

PROGRAMMING WITH 8086 MICROPROCESSOR: Machine level programs, programming with an assembler, Assembly language programs, introduction to stack, stack structure of 8086/8088, interrupts and interrupt service routines, interrupt cycle of 8086, non-mask able interrupt and mask able interrupts, interrupt programming.

Unit -3:

BASIC AND SPECIAL PURPOSE PROGRAMMABLE PERIPHERALS AND THEIR INTERFACING WITH 8086. Semiconductor memory interfacing, dynamic RAM interfacing, interfacing i/o ports, PIO 8255 modes of operation of 8255,interfacing to D/A and A/D converters, stepper motor interfacing. Block diagram and functional aspects of 8254 PIT, 8259A, PIC, 8279 keyboard/display controller, 8251 USART, 8257 DMA Controller.

Unit -4 :

ADVANCED MICRO PROCESSORS: Salient features of 0386DX, architecture and signal description of 80386, register organization of 80386 and addressing modes, data types of 80386, real address mode of 80386, protected mode of 80386, segmentation and Paging, virtual 8086 mode and enhanced mode.Instruction set of 80386.The coprocessor 80387.

Unit -5 :

8051 MICROCONTROLLER: Introduction to microcontrollers, 8051Microcontrollers, 8051pin description, connections, I/O ports and memory organization, MCS51addressing modes and instructions, assembly language programming tools.Introduction to RISC, processor design tradeoffs, Introduction to 16/32 bit processors, ARM architecture and

organization, ARM family, Thumb instructions, programming models of ARM 7, Register set, CPSR, SPSR.

TEXT BOOKS:
1. Douglas V Hall, ―Microprocessors and Interfacing Programming and Hardware‖, New Delhi Tata McGrawHill Publishing Company Limited
2. A.K.Ray, K.M.Bhurchandi ,‖Advanced Microprocessors and Peripherals‖, Tata McGraw Hill Publications,2000.
3. Steve Furber, ―ARM System on Chip Architecture‖, second edition, Pearson publications, 2009.
4. Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.McKinlay, The 051 microcontroller and embedded systems‖ second edition, Pearson publications.

REFERENCES:
1. Ajay V Deshmukh, ‖Microcontrollers‖, TATA McGraw Hill publications,2012.
2. Krishna Kant, ―Microprocessors and Microcontrollers‖, PHI Publications, 2010.
3. N.Sentil Kumar, M.Saravanan, S.Jeevananthan, ―Microprocessors and Microcontrollers‖, Oxford University Press, 2010.

II Year II Semester

L	T	P	C
3	0	0	3

COMPUTER NETWORKS

Course Objectives:

The main objectives of the course is to

- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OSI model and the functions of layered structure.
- To explain networking protocols, algorithms and design perspectives

UNIT I

Introduction: Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship of Services to Protocols ,Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

UNIT II

The Data Link Layer: Guided Transmission Media, Persistent Storage, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Data Link Layer Design Issues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet,40- And 100-Gigabit Ethernet, Retrospective On Ethernet.

UNIT III

The Network Layer: Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing,

Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, Traffic Management at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internetworking, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes: Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

UNIT IV
The Transport Layer: The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Bandwidth Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols, The Internet Transport Protocols: TCP, Introduction To TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

UNIT V
The Application Layer: Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.

Text Books:

Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6th Edition, Global Edition.

Reference Books:

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2017.
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 6th edition, Pearson, 2019.
3. Youlu Zheng, Shakil Akthar, "Networks for Computer Scientists and Engineers", Oxford Publishers, 2016.

Web-Resources:

- https://nptel.ac.in/courses/106105183/25
- http://www.nptelvideos.in/2012/11/computer-networks.html
- https://nptel.ac.in/courses/106105183/3

II Year II Semester

L	T	P	C
0	0	3	1.5

COMPUTER NETWORKS AND OPERATING SYSTEMS LAB

Course Objectives:
- To understand the different types of networks
- To discuss the software and hardware components of a network
- To enlighten the working of networking commands supported by operating system
- To familiarize the use of networking functionality supported by JAVA
- To familiarize with computer networking tools**.**

List of Activities/Experiments (Computer Networks):

1. Study different types of Network cables (Copper and Fiber) and prepare cables (Straight and Cross) to connect Two or more systems. Use crimping tool to connect jacks. Use LAN tester to connect the cables.
   - Install and configure Network Devices: HUB, Switch and Routers. Consider both manageable and non-manageable switches. Do the logical configuration of the system. Set the bandwidth of different ports.
   - Install and Configure Wired and Wireless NIC and transfer files between systems in Wired LAN and Wireless LAN. Consider both adhoc and infrastructure mode of operation.
2. Work with the commands Ping, Tracert, Ipconfig, pathping, telnet, ftp, getmac, ARP, Hostname, Nbtstat, netdiag, and Nslookup
3. Use Packet tracer software to build network topology and configure using Distance vector routing protocol.
4. Use Packet tracer software to build network topology and configure using Link State routing protocol.
5. Using JAVA RMI Write a program to implement Basic Calculator.
6. Implement a Chatting application using JAVA TCP and UDP sockets.
7. Hello command is used to know whether the machine at the other end is working or not. Echo command is used to measure the round-trip time to the neighbor. Implement Hello and Echo commands using JAVA.
8. Using Wireshark perform the following operations:
   - Inspect HTTP Traffic
   - Inspect HTTP Traffic from a Given IP Address,
   - Inspect HTTP Traffic to a Given IP Address,
   - Reject Packets to Given IP Address,
   - Monitor Apache and MySQL Network Traffic.

Experiments covering the Topics:
- UNIX fundamentals, commands & system calls
- CPU Scheduling algorithms, thread processing
- IPC, semaphores, monitors, deadlocks
- Page replacement algorithms, file allocation strategies
- Memory allocation strategies

Sample Experiments:
1. Practicing of Basic UNIX Commands.
2. Write programs using the following UNIX operating system calls
   fork, exec, getpid, exit, wait, close, stat, opendir and readdir
3. Simulate the following CPU scheduling algorithms
   a) FCFS b) SJF c) Priority d) Round Robin
4. Write a program to solve producer-consumer problem using Semaphores.
5. Implement the following memory allocation methods for fixed partition
   a) First fit b) Worst fit c) Best fit
6. Simulate the following page replacement algorithms
   a) FIFO b) LRU c) LFU
7. Simulate Paging Technique of memory management.
8. Implement Bankers Algorithm for Dead Lock avoidance

Text Books:
1. ShivendraS.Panwar, Shiwen Mao, Jeong-dong Ryoo, and Yihan Li, "TCP/IP Essentials:A Lab-Based Approach", Cambridge University Press, 2004.
2. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.

Reference Books:
1. Cisco Networking Academy, "CCNA1 and CCNA2 Companion Guide", Cisco Networking Academy Program, 3rd edition, 2003.
2. Elloitte Rusty Harold, "Java Network Programming", 3rd edition, O'REILLY, 2011.
3. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson, 2016

Online Learning Resources:
https://www.netacad.com/courses/packet-tracer - Cisco Packet Tracer.
Ns Manual, Available at: https://www.isi.edu/nsnam/ns/ns-documentation.html, 2011.
https://www.wireshark.org/docs/wsug_html_chunked/ -Wireshark.
https://nptel.ac.in/courses/106105183/25
http://www.nptelvideos.in/2012/11/computer-networks.html
https://nptel.ac.in/courses/106105183/3
http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php
https://www.cse.iitb.ac.in/~mythili/os/
http://peterindia.net/OperatingSystems.html

II Year II Semester

L	T	P	C
0	0	3	1.5

MICRO PROCESSORS AND MICRO CONTROLLERS LAB

The students are required to develop the necessary Algorithm, Flowchart and Assembly Language Program Source Code for executing the following functions using MASM/TASM software and to verify the results with necessary Hardware Kits.

PART-I: MICROPROCESSOR 8086

1. Introduction to MASM/TASM.

2. Arithmetic operation- Multi byte Addition and Subtraction, Multiplication and Division- Signed and unsigned Arithmetic operation, ASCII- Arithmetic operation.

3. Logic operations-Shift and rotate- Converting packed BCD to unpacked BCD, BCD to ASCII conversion.

4. By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Lengthof the string, String comparison.

5. DOS/BIOS programming: Reading keyboard (Buffered with and without echo)- Display characters, Strings.

PART-II: INTERFACING WITH MICROPROCESSOR

1. 8259 - Interrupt Controller-Generate an interrupt using 8259 timer.

2. 8279 - Keyboard Display- Write a program to display a string of characters.

3. 8255 - PPI-Write ALP to generate sinusoidal wave using PPI.

4. 8251 - USART-Write a program in ALP to establish Communication between two processors.

PART-III: MICROCONTROLLER 8051

1. Reading and Writing on a parallel port.

2. Timer in different modes.

3. Serial communication implementation.

PART-IV: INTERFACING WITH MICROCONTROLLER

Write C programs to interface 8051 chip to Interfacing modules to Develop single chip solutions.

1. Simple Calculator using 6 digit seven segment display and Hex Keyboard interface to 8051.

2. Alphanumeric LCD panel and Hex keypad input interface to 8051.

3. External ADC and Temperature control interface to 8051.

4.Generate different waveforms Sine, Square, Triangular, and Rampetc. using DAC interface to 8051; change the frequency and Amplitude.

EQUIPMENT REQUIRED FOR LABORATORY

1. MASM/TASM software

2. 8086 Microprocessor Kits

3. 8051 Micro Controller kits

4. Interfaces/peripheral subsystems

i) 8259 PIC

ii) 8279-KB/Display iii) 8255 PPI

iv) 8251 USART

v) A/D and D/AC Interface

II Year II Semester

L	T	P	C
0	1	2	2

FULL STACK DEVELOPMENT – 1
(Skill Enhancement Course)

Course Objectives:

The main objectives of the course are to

- Make use of HTML elements and their attributes for designing static web pages
- Build a web page by applying appropriate CSS styles to HTML elements
- Experiment with JavaScript to develop dynamic web pages and validate forms

Experiments covering the Topics:

- Lists, Links and Images
- HTML Tables, Forms and Frames
- HTML 5 and Cascading Style Sheets, Types of CSS
- Selector forms
- CSS with Color, Background, Font, Text and CSS Box Model
- Applying JavaScript - internal and external, I/O, Type Conversion
- JavaScript Conditional Statements and Loops, Pre-defined and User-defined Objects
- JavaScript Functions and Events
- Node.js

Sample Experiments:

1. Lists, Links and Images

a. Write a HTML program, to explain the working of lists.
   Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.

b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.

c. Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.

d. Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

2. HTML Tables, Forms and Frames

a. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)

b. Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.).

c. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).

d. Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame → image, second frame → paragraph, third frame → hyperlink. And also make sure of using "no frame" attribute such that frames to be fixed).

3. HTML 5 and Cascading Style Sheets, Types of CSS

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, <span> tags.

b. Write a HTML program, to embed audio and video into HTML web page.

c. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value).

4. Selector forms

a. Write a program to apply different types of selector forms

   i. Simple selector (element, id, class, group, universal)
   ii. Combinator selector (descendant, child, adjacentsibling, general sibling)
   iii. Pseudo-class selector
   iv. Pseudo-element selector
   v. Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model

a. Write a program to demonstrate the various ways you can reference a color in CSS.

b. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.

c. Write a program using the following terms related to CSS font and text:

   i. font-size   ii. font-weight   iii. font-style
   iv. text-decoration   v. text-transformation   vi. text-alignment

d. Write a program, to explain the importance of CSS Box model using

   i. Content   ii. Border   iii. Margin   iv. padding

6. Applying JavaScript - internal and external, I/O, Type Conversion

a. Write a program to embed internal and external JavaScript in a web page.

b. Write a program to explain the different ways for displaying output.

c. Write a program to explain the different ways for taking input.

d. Create a webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not

7. JavaScript Pre-defined and User-defined Objects

    a. Write a program usingdocument object properties and methods.

    b. Write a program using window object properties and methods.

    c. Write a program usingarray object properties and methods.

    d. Write a program usingmath object properties and methods.

    e. Write a program usingstring object properties and methods.

    f. Write a program usingregex object properties and methods.

    g. Write a program usingdate object properties and methods.

    h. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

8. JavaScript Conditional Statements and Loops

    a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML text as "EQUAL NUMBERS".

    b. Write a program to display week days using switch case.

    c. Write a program to print 1 to 10 numbers using for, while and do-while loops.

    d. Write aprogram to print data in object using for-in, for-each and for-of loops

    e. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,$1^3 + 5^3 + 3^3 = 153$]

    f. Write a program to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)

9. Javascript Functions and Events

    a. Design a appropriate function should be called to display

        i. Factorial of that number

        ii. Fibonacci series up to that number

        iii. Prime numbers up to that number

        iv. Is it palindrome or not

    b. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display

        i. Factorial of that number

        ii. Fibonacci series up to that number

        iii. Prime numbers up to that number

        iv. Is it palindrome or not

    c. Write a program to validate the following fields in a registration page

        i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)

    ii.   Mobile (only numbers and length 10 digits)

    iii.   E-mail (should contain format like xxxxxxx@xxxxxx.xxx)

10. Node.js

a. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.

b. Write a program to transfer data over http protocolusing http module.

c. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)

d. Write a program to parse an URL using URL module.

e. Write a program to create an user-defined module and show the workflow of Modularization of application using Node.js

Text Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Web Links:

- https://www.w3schools.com/html
- https://www.w3schools.com/css
- https://www.w3schools.com/js/
- https://www.w3schools.com/nodejs
- https://www.w3schools.com/typescript

II Year II Semester

L	T	P	C
1	0	2	2

DESIGN THINKING AND INNOVATION

Course Objectives:

The main objectives of the course is to

- Familiarize students with design thinking process as a tool for breakthrough innovation.
- Aims to equip students with design thinking skills and ignite the minds to create innovative ideas.
- Student can develop solutions for real-time problems.

Course Outcomes:

- Define the concepts related to design thinking.
- Explain the fundamentals of DesignThinking and innovation
- Apply the design thinking techniques for solving problems in various sectors.
- Analyse to work in a multidisciplinary environment
- Evaluate the value of creativity
- Formulate specific problem statements of real time issues

UNIT-I

Introduction to Design Thinking Introduction to elements and principles of Design, basics of design-dot, line, shape, formas fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT-II

Design Thinking Process Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map,brain storming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flowdiagram or flowchart etc.Every student should explain about product development.

UNIT-III

Innovation

Art of innovation, Difference between innovation and creativity, role of creativity and innovation inorganizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value ofcreativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate onvalue-basedinnovation.

UNIT-IV

Product Design

Problem formation , introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.
Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT-V

Design Thinking in Business Processes

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business–Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.
Activity: How to market our own product,About maintenance,Reliability and plan for startup.

Text books:
1. Change by design,Tim Brown,Harper Bollins(2009)
2. Design Thinking for Strategic Innovation, IdrisMootee,2013,JohnWiley & Sons.

Reference Books:
2. Design Thinkingin the Class room by David Lee,Ulyssespress
3. Design the Future,by Shrrutin NShetty,Norton Press
4. Universal principles of design-Williamlidwell, kritinaholden, Jillbutter.
5. The era of open innovation–chesbrough.H

B.Tech. – III Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	ProfessionalCore	Internet of Things	3	0	0	3
2	ProfessionalCore	Database Management Systems	3	0	0	3
3	ProfessionalCore	Embedded Systems	3	0	0	3
4	Professional Elective-I	1. Software Engineering 2. Wireless Sensor Networks 3. Artificial Intelligence 4. Cryptography & Network Security 5. 12-week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective- I	OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	Internet of Things and Embedded Systems Lab	0	0	3	1.5
7	Professional Core	Database Management Systems Lab	0	0	3	1.5
8	Skill Enhancement Course	Full Stack Development-2	0	1	2	2
9	Engineering Sciences	User Interface Design Using Flutter	0	0	2	1
10	Evaluation of Community ServiceInternship		-	-	-	2
		Total	**15**	**1**	**10**	**23**

MC	Minor Course (Student may select from the same specialized minors pool)	3	0	3	4.5
MC	Minor Course through SWAYAM / NPTEL (Minimum 12 Week, 3 credit course)	3	0	0	3
HC	Honors Course (Student may select from the same Honors pool)	3	0	0	3
HC	Honors Course (Student may select from the same Honors Pool)	3	0	0	3

Remarks :
1. In professional elective -I included12week MOOC Swayam/NPTEL course recommended by the BoS.
2.In place of tinkering lab the BOS member suggested Ui Design-Flutter in above sl.no : 09.

B.Tech.– III Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	IoT Data Analytics	3	0	0	3
2	Professional Core	Cloud Computing	3	0	0	3
3	Professional Core	Machine Learning	3	0	0	3
4	Professional Elective-II	1.DevOps 2.IOT Security 3.Multi Agent Systems 4.Automata Theory & Compiler Design 6.12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Professional Elective-III	1. Block Chain Technologies 2. Natural Language Processing 3. Security Assessment and Risk Analysis 4. Android application development. 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
6	Open Elective – III		3	0	0	3
7	Professional Core	Cloud Computing Lab	0	0	3	1.5
8	Professional Core	IOT Data Analytics Lab	0	0	3	1.5
9	Skill Enhancement Course	Soft skillsORIELTS	0	1	2	2
10	Audit Course	TechnicalPaper Writing&IPR	2	0	0	0
Total			**20**	**1**	**08**	**23**
MandatoryIndustryInternshipof 08 weeksduration duringsummervacation						
MC	Student may select from the same minors pool		3	0	3	4.5
MC	Minor Course (Student may select from the same specialized minors pool)		3	0	0	3
HC	Student may select from the same honors pool		3	0	0	3
HC	Honors Course (Student may select from the honors pool)		3	0	0	3

Remarks :

1. In place of big data analytics for IoT included IoT Data Analytics
2. In place of sensors, Actuators And Data Acquisition included Machine Learning
3. Multi Agent Systems included
4. In professional elective -III included12week MOOC Swayam/NPTEL course recommended by the BoS.
5. In place of Big Data Analytics lab included IOT Data Analytics Lab

COURSES OFFERED FOR HONOURS DEGREE IN BTech CSE(IoT)

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	**T**	**P**	
1		Social Media Security	3	0		3
2		Cloud Computing Security	3	0		3
3		Machine Learning for Cyber security	3	0		3
4		IOT security	3	0		3
5		Cyber Physical Systems and Security	3	0		3
6		IOT security Lab			3	1.5
7		Cyber Physical Systems and Security Lab			3	1.5
		Total				**18**

III Year I Semester	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Outcome(s):

This course will help students understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. Students will get an overview of an end to endIoT system encompassing the edge, cloud and application tiers. This course will build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own. The lab exercises will consist of hands-on experiments that will lead to building an IoT application end-to-end. Some of the specialized topics will be covered via student seminars where students are expected to research and present their findings in a seminar format.

UNIT– I
Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.

UNIT- II
Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing.

UNIT-III
Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.

UNIT–IV
Networking and Communication for IoT: Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers).

UNIT –V
IoT Data Processing and Storage: Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.

IoT Seminars: Selected topics in IoTshould be handled via student seminars. Recommended that students form a group do research on at least one of the following topics and present it through seminars. They are expected to do a literature survey of the topic and present their survey paper to the class. The suggested topics are –

a) **IoT Applications**
   - Smart Cities
   - Connected Vehicles and Telematics
   - Smart Grids
   - Smart Homes

b) **IoT data visualization**

c) **Survey of cloud based IoT platforms**

d) **Low power wide area networks for IoT**

e) **IoT device management**

f) **Survey of chips, embedded modules and development boards for IoT devices**

g) **Embedded and real-time operating systems for IoT**

h) **IoT Security**
   - Security risks in IoT
   - Securing IoT endpoint devices and secure communication protocols for IoT
   - Security and Privacy of IoT data

Text Books:

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

Reference Books / Links:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzi, O Reilly Media
7. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

III Year I Semester	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:
The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQLasa universal Database anguage
- Demonstrate the principles behind systematic database design approaches by covering conceptual
- design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage etechniques

UNIT-I
Introduction: Database system, Characteristics (Database Vs File System), Database Users,Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.
Entity RelationshipModel: Introduction, Representation of entities, attributes, entityset, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT-II
RelationalModel: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Keyconstraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus.
 BASIC SQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete,update).

UNIT-III
SQL: Basic SQL querying (selectand project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).Creating tables withrelationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non-updatable), relational set operations.

UNIT-IV
Schema Refinement (Normalization): Purpose of Normalization or schemare finement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3NF), concept of surrogatekey, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

UNIT-V
Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability,lockbased, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.
IntroductiontoIndexingTechniques: B+Trees, operations on B+Trees, Hash Based Indexing

Text Books:
1. Data base Management Systems, 3rdedition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2,3,4)
2.Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter1 and Chapter 5)

ReferenceBooks:
1. Introduction to Database Systems, 8th edition, CJDate, Pearson.
2. Database Management System, 6thedition, Ramez Elmasri,Shamkant B.Navathe,Pearson
3.Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, PeterRobb, Cengage Learning.

Web-Resources:
1.https://nptel.ac.in/courses/106/105/106105175/
2.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview

III Year I Semester	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

Upon completing this course, the student will be able to

1. To understand the selection procedure of Processors in the embedded domain.
2. Design Procedure for Embedded Firmware.
3. To visualize the role of Real time Operating Systems in Embedded Systems.
4. To evaluate the Correlation between task synchronization and latency issues

UNIT-I
Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT-II

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT-III

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator UNIT-, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT-IV

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT-V

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets,

Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, Methods to Choose an RTOS.

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

III Year I Semester	SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

CourseObjectives:

The objectives of this course are to introduce

- Software life cycle models
- Software requirements and SRS document.
- How to plan for a project.
- The quality control and how to ensure good quality software.
- Testing methods of software, use of CASE tools
- Implementation issues,validation and verification procedures.

CourseOutcomes:

CO	Course Outcomes	Knowledge Level(K)#
CO1	Compare and analyse various process models	**K1**
CO2	Develop SRS document and estimate the modularity of the project	**K2**
CO3	Develop data flow diagrams and compare the user interface design	**K2**
CO4	Compare testing strategies and analyse the software quality	**K3**
CO5	Apply Computer Aided Software Engineering tools and analyse the components of software maintenance and reuse.	**K2**

#basedonsuggestedRevisedBTL

UNIT- I

INTRODUCTION: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

SOFTWARE LIFE CYCLE MODELS: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model and Spiral model.

UNIT-II

SOFTWARE PROJECT MANAGEMENT: Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, and risk management.

REQUIREMENTS ANALYSIS AND SPECIFICATION: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT- III

SOFTWARE DESIGN: Overview of the design process, How to characterise a good software design? Layered arrangement of modules, Cohesion and Coupling.approaches to software design.

FUNCTION-ORIENTED SOFTWARE DESIGN:
Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.

USER INTERFACE DESIGN: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

UNIT-IV

CODING AND TESTING: Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing, Testing object-oriented programs, Smoke testing, and Some general issues associated with testing.

SOFTWARE RELIABILITY AND QUALITY MANAGEMENT: Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000.SEI Capability maturity model. Few other important quality standards, and Six Sigma.

UNIT-V

COMPUTER-AIDED SOFTWARE ENGINEERING (CASE): CASE and its scope, CASE environment, CASE support in the software life cycle, Other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

SOFTWARE MAINTENANCE: Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost.

SOFTWARE REUSE: What can be reused? Why almost no reuse so far? Basic issues in any reuse program, A reuse approach, and Reuse at organisation level.

Text Books:

1. Fundamentals of Software Engineering, Rajib Mall, Fifth Edition, PHI.

Reference Books:

1. Software Engineering A practitioner's Approach, Roger S. Pressman, Ninth Edition, Mc Graw Hill International Edition.
2. Software Engineering, Ian Sommerville, Tenth Edition, Pearson Education.
3. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

e-Resources:

1. https://nptel.ac.in/courses/106/105/106105182/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01260589506387148827_shared/overview
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview

III Year I Semester	**WIRELESS SENSOR NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

CourseObjectives:

- To acquire the knowledge about various architectures and applications of Sensor Networks
- To understand issues, challenges and emerging technologies for wireless sensor networks
- To learn about various routing protocols and MAC Protocols
- To understand various data gathering and data dissemination methods
- To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

CourseOutcomes: Upon completion of the course, the student will beable to:

- Analyze and compare various architectures of Wireless Sensor Networks
- Understand Design issues and challenges in wireless sensor networks
- Analyze and compare various data gathering and data dissemination methods.
- Design, Simulate and Compare the performance of various routing and MAC protocol

UNIT-I
Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT-II
Mobile Adhoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

UNIT-III
Routingprotocols, MACprotocols: Classificationof MACProtocols, S-MACProtocol, B-MACprotocol, IEEE 802.15.4 standard and ZigBee

UNIT-IV
Dissemination protocolforlarge sensor network.Data dissemination, data gathering, and datafusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT-V
Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication and Internet to WSN Communication. Single –node architecture, Hardware components & designconstraints, Operating systems and execution environments, introduction to Tiny OS and nesC.

TextBooks:

1. Ad-Hoc Wireless Sensor Networks - C.Siva Ram Murthy, B.S.Manoj, Pearson
2. Principles of Wireless Networks – KavehPahLaven and P.KrishnaMurthy,2002,PE

Referencebooks:

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communications – Andrea Gold smith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao,Pearson Education, 2012.
4. Wireless Communication and Networking–William Stallings, 2003, PHI.

III Year I Semester	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Outcome(s):

This course introduces students to the basic knowledge representation, problem solving, and learning methods of artificial intelligence.

UNIT–I

Introduction, Overview of Artificial intelligence: Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving, Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

UNIT–II

Search techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

UNIT–III

Constraint satisfaction problems: Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT–IV

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

UNIT–V

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Home Assignments:

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbors, decision trees, etc. can be included in home assignments.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

Reference Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS

III Year I Semister	**CRYPTOGRAPHY & NETWORK SECURITY**	**L**	**T**	**P**	**C**
		3	0	0	3

Course Objectives:
- Explain the objectives of information security
- Explain the importance and application of each of confidentiality, integrity, authentication and availability
- Understand the basic categories of threats to computers and networks
- Discusses the Mathematics of Cryptography
- Discuss the fundamental ideas of Symmetric and Asymmetric cryptographic Algorithms
- Discusses the Network layer, Transport Layer and Application layer Protocols Enhanced security mechanisms

Course Outcomes: At the end of the course, student will be able to

CO	Course Outcomes	Knowledg Level (K)#
CO1	Student will be able to understand security issues related to computer networks and learn different symmetric key techniques	**K2**
CO2	Students will be able learn mathematic of cryptography for symmetric and Asymmetric algorithms and apply this knowledge to understand the Cryptographic algorithms	**K3**
CO3	Students will be able learn different types of symmetric and Asymmetric algorithms	**K3**
CO4	Students will be able learn different algorithms of Hash functions, message authentication and digital signature and their importance to the security	**K4**
CO5	Students will be able learn different Enhanced security protocols of Application Layer, Transport Layer and Network layer	**K4**

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

UNIT- I
Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography.Classical Encryption Techniques-symmetric cipher model, Substitution techniques, Transposition techniques, Rotor Machines, Stenography.

UNIT- II
Introduction to Symmetric Cryptography: Algebraic Structures-Groups, Rings, Fields, GF(2^n) fields, Polynomials.**Mathematics of Asymmetric cryptography:** Primes, Checking For Primness, Eulers phi-functions, Fermat's Little Theorem, Euler's Theorem, Generating Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence, Exponentiation And Logarithm.

UNIT-III
Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, IDEA, Block cipher operation, Stream ciphers: RC4, RC5. **Asymmetric key Ciphers:** Principles of public key cryptosystems, RSA algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

UNIT-IV
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithms (SHA). **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MAC'S,MAC'S Based On Hash Functions: HMAC, MAC'S Based On Block Ciphers: DAA And CMAC.
Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme,   Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.

UNIT-V
Network and Internet Security: Transport-Level Security: Web Security Considerations, Transport Level Security, HTTPS, SSH.**IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Authentication Header Protocol.**Electronic-Mail Security:** Internet-mail Security, Email Format, Email Threats and Comprehensive Email Security, S/MIME, PGP.

Text Books:
1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 7th Edition, 2017
2. Cryptography and Network Security: Behrouz A. Forouzan Debdeep, Mc Graw Hill, 3rd Edition, 2015

Reference Books:
1. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition
2. Introduction to Cryptography with Coding Theory: Wade Trappe, Lawrence C. Washington, Pearson.
3. Modern Cryptography: Theory and Practice ByWenbo Mao. Pearson

III Year I Semester	INTERNET OF THINGS AND EMBEDDED SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing and I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small, low-cost embedded IoT system using Arduino/Raspberry Pi/open platform.
- To apply the concept of the Internet of Things in real-world scenarios.

Course Outcomes:

CO1: Explain the architecture of embedded processors.

CO2: Write embedded C programs.

CO3: Design simple embedded applications.

CO4: Compare the communication models in IoT.

CO5: Design IoT applications using Arduino/Raspberry Pi/open platform.

LIST OF EXPERIMENTS:

1. Write 8051 Assembly Language experiments using a simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.
4. Write basic and arithmetic programs using Embedded C.
5. Introduction to Arduino platform and programming.
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
7. Introduction to Raspberry Pi platform and Python programming.
8. Interface sensors with Raspberry Pi.
9. Communicate between Arduino and Raspberry Pi using any wireless medium.
10. Set up a cloud platform to log the data.
11. Log data using Raspberry Pi and upload to the cloud platform.
12. Design an IoT-based system.

III Year I Semester	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives: This Course will enable students to:

- Populate and query a database using SQL DDL/DML Commands.
- Declare and enforce integrity constraints on a database.
- Write queries using advanced concepts of SQL.
- Program PL/SQL including procedures, functions, cursors, and triggers.

Experiments covering the topics:

- DDL, DML, DCL commands.
- Queries, nested queries, built-in functions.
- PL/SQL programming-control structures.
- Procedures, Functions, Cursors, Triggers.
- Database connectivity-ODBC/JDBC.

Sample Experiments:

1. Creation, altering, and dropping of tables and inserting rows into a table (use constraints while creating tables). Examples using SELECT command.

2. Queries (along with sub-queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, Constraints. Example: Select the roll number and name of the student who secured the fourth rank in the class.

3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX, and MIN), GROUP BY, HAVING, and Creation and dropping of Views.

4. Queries using Conversion functions (to_char, to_number, to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr, instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date).

5. i.Create a simple PL/SQL program which includes declaration section, executable section, and exception-handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found).

ii. Insert data into student table and use COMMIT, ROLLBACK, and SAVEPOINT in PL/SQL block.

6. Develop a program that includes the features NESTED IF, CASE, and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT-IN Exceptions, USER-defined Exceptions, RAISE-APPLICATION ERROR.

8. Program development using creation of procedures, passing parameters IN and OUT of PROCEDURES.

9. Program development using creation of stored functions, invoke functions in SQL Statements, and write complex functions.

10. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT OF clause, and CURSOR variables.

11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers, and INSTEAD OF Triggers.

12. Create a table and perform the search operation on table using indexing and non-indexing techniques.

13. Write a Java program that connects to a database using JDBC.

14. Write a Java program to connect to a database using JDBC and insert values into it.

15. Write a Java program to connect to a database using JDBC and delete values from it.

Textbooks/Suggested Reading:

- Oracle: The Complete Reference by Oracle Press.
- Nilesh Shah, "Database Systems Using Oracle," PHI, 2007.
- Rick F. Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007.

III Year I Semester	FULL STACK DEVELOPMENT – 2	L	T	P	C
		0	1	2	2

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Make use of router, template engine and authentication using sessions to develop application in Express JS.
CO2: Build a single page application using RESTful APIs in Express JS.
CO3: Make use of components, props, stats and render data in ReactJS.
CO4: Apply router and hooks in designing ReactJS application.
CO5: Make use of MongoDB queries to perform CRUD operations on document database.

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO	2	2	3		2				2	2		2
CO	2	3	2		2				2	2		2
CO	2	2	3		2				2	2		2
CO	2	3	2		2				2	2		2
CO	2	2	3		2				2	2		2

List of Experiments:

Experiment 1: Node.js

a. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
b. Write a program to transfer data over http protocolusing http module.
c. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)
d. Write a program to parse an URL using URL module.
e. Write a program to create an user-defined module and show the workflow of Modularization of application using Node.js

Experiment 2: Typescript

a. Write a program to understand simple and special types.
b. Write a program to understand function parameter and return types.
c. Write a program to show the importance with Arrow function. Use optional, default and REST parameters.
d. Write a program to understand the working of typescript with class, constructor, properties, methods and access specifiers.
e. Write a program to understand the working of namespaces and modules.
f. Write a program to understand generics with variables, functions and constraints.

Experiment 3-15:

Augmented Programs: (Any 2 must be completed from Experiment 3-5)

1. Write a CSS program, to apply 2D and 3D transformations in a web page.
2. a web page with new features of HTML5 and CSS3.
3. Design a to-do list application using JavaScript.

Experiment 6:

ExpressJS – Routing, HTTP Methods, Middleware

a. Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
b. Write a program to accept data, retrieve data and delete a specified resource using http methods.
c. Write a program to show the working of middleware.
d.

Experiment 7:

ExpressJS – Templating, Form Data

a. Write a program using templating engine.
b. Write a program to work with form data.

Experiment 8:

ExpressJS – Cookies, Sessions, Authentication

a. Write a program for session management using cookies and sessions.
b. Write a program for user authentication

Experiment 9:

ExpressJS – Database, RESTful APIs

    a. Write a program to connect MongoDB database using Mangoose and perform CRUD operations.
    b. Write a program to develop a single page application using RESTful APIs

Experiment 10:

ReactJS – Render HTML, JSX, Components – function & Class

    a. Write a program to render HTML to a web page.
    b. Write a program for writing markup with JSX.
    c. Write a program for creating and nesting components (function and class).

Experiment 11:

ReactJS – Props and States, Styles, Respond to Events

    a. Write a program to work with props and states.
    b. Write a program to add styles (CSS & Sass Styling) and display data.
    c. Write a program for responding to events.

Experiment 12:

ReactJS – Conditional Rendering, Rendering Lists, React Forms

a. Write a program for conditional rendering.
b. Write a program for rendering lists.
c. Write a program for working with different form fields using react forms

Experiment 13:

ReactJS – React Router, Updating the Screen

a. Write a program for routing to different pages using react router.
b. Write a program for updating the screen.

Experiment 14:

ReactJS – Hooks, Sharing data between Components

a.Write a program to understand the importance of using hooks.

b.Write a program for sharing data between components

Experiment 15:

ReactJS Applications – To-do list and Quiz

    a.   Design to-do list application

Experiment 16:

MongoDB – Installation, Configuration, CRUD operations

    a.   Install MongoDB and configure ATLAS
    b.   B.Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

Experiment 17:

MongoDB – Databases, Collections and Records

a. Write MongoDB queries to Create and drop databases and collections.
b. Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate()

Experiment 18-20:

Augmented Programs: (Any 2 must be completed)

18.   Design a to-do list application using NodeJS and ExpressJS.
19.   Design a Quiz app using ReactJS.
20.   Complete the MongoDB certification from MongoDB University website.

Text Books:

1.Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.

2.Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, A Press, O'Reilly.

Web Links:

1.ExpressJS - https://www.tutorialspoint.com/expressjs

2.ReactJS - https://www.w3schools.com/REACT (and)   https://react.dev/learn#

3.MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb

		L	T	P	C
III Year I Semester	**USER INTERFACE DESIGN USING FLUTTER**	0	0	2	1

Course Objectives:
- Learns to Implement Flutter Widgets and Layouts
- Understands Responsive UI Design and with Navigation in Flutter
- Knowledge on Widges and customize widgets for specific UI elements, Themes
- Understand to include animation apart from fetching data

List of Experiments:

Students need to implement the following experiments

1. a) Install Flutter and Dart SDK.
b) Write a simple Dart program to understand the language basics.

2. a) Explore various Flutter widgets (Text, Image, Container, etc.).
b) Implement different layout structures using Row, Column, and Stack widgets.

3. a) Design a responsive UI that adapts to different screen sizes.
b) Implement media queries and breakpoints for responsiveness.

4. a) Set up navigation between different screens using Navigator.
b) Implement navigation with named routes.

5. a) Learn about stateful and stateless widgets.
b) Implement state management using set State and Provider.

6. a) Create custom widgets for specific UI elements.
b) Apply styling using themes and custom styles.

7. a) Design a form with various input fields.

b) Implement form validation and error handling.

8. a) Add animations to UI elements using Flutter's animation framework.

b) Experiment with different types of animations (fade, slide, etc.).

9. a) Fetch data from a REST API.

b) Display the fetched data in a meaningful way in the UI.

10. a) Write UNIT- tests for UI components.

b) Use Flutter's debugging tools to identify and fix issues.

Text Book:
1. Marco L. Napoli, Beginning Flutter: A Hands-on Guide to App Development.
2. Rap Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile Apps 1st Edition, Apres

III Year II Semester	IOT DATA ANALYTICS	L	T	P	C
		3	0	0	3

CourseObjectives:
- To learn the concepts of big data analytics
- To learn the concepts about Internet of things
- To understand and implement smart systems

Course Outcomes:
- Understand the different types of Big Data platforms
- Familiar with the fog computing concepts
- Understanding the cloud computing concepts

UNIT-I

BIG DATA PLATFORMS FOR THE INTERNET OF THINGS

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements coming from different Smart City applications

UNIT-II

RFID FALSE AUTHENTICATIONS: On RFID False Authentications: YA TRAP – Necessary and sufficient condition forfalse authentication prevention - Adaptive Pipe lined Neural Network Structure in Self-aware Internet of Things: self-healing systems- Role of adaptive neural network-Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models

UNIT-III

FOG COMPUTING : Fog Computing: A Platform for Internet of Things and Analytics: massively distributed number of sources - Big Data Metadata Management in Smart Grid semantic inconsistencies – role of metadata

UNIT-IV

WEB ENHANCED BUILDING : Toward Web Enhanced Building Automation System heterogeneity between existing installations and native IP devices - loosely-coupled Web protoc stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access Vehicular Environment Technology for Developing Smart Cities: advantages and achievement Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking al Management System (GO-WELL) – predictive care –personalized medicine

UNIT-V

SUSTAINABILITY DATA AND ANALYTICS : Sustainability Data and Analytics in Cloud-Base M2M Systems – potential stakeholders and their complex relationships to data and analyti applications – Social Networking Analysis - Building a useful understanding of a social network Leveraging Social Media and IoT to Bootstrap Smart Environments : lightweight Cyber Physic Social Systems - citizen actuation

Text Books:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and The Internet of Things Enterpri Information Architecture for A New Age”, Apress, 2015.

2. Dr. John Bates , “Thingalytics - Smart Big Data Analytics for the Internet of Things”, john Bate 2015.6) Web Hosting for Dummies, Peter Pollock, John Wiley Brand

Reference Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”,Cisco Press, 2017
2. Olivier Hersent, David Boswarthick ,OmarElloum,“The Internet of Things–Key applications and Protocols”, Wiley,2012.
3. Michael Miller,“The Internet of Things”,Pearson Education,2015.

III Year II Semester	**CLOUD COMPUTING**	**L**	**T**	**P**	**C**
		3	0	0	3

Course Objectives:
- To explain the evolving utility computing model called cloud computing.
- To introduce the various levels of services offered by cloud.
- To discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
- To emphasize the security and other challenges in cloud computing.
- To introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

UNIT–I
Introduction to Cloud Computing Fundamentals: Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

UNIT-II
Cloud Enabling Technologies: Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT-III
Virtualization and Containers: Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV
Cloud computing challenges: Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT–V

Advanced concepts in cloud computing : Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:

1. Mastering Cloud Computing, 2nd edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, Mc Graw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

III Year II Semester	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:
The objectives of the course is to
- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.
,
Course Outcomes: At the end of the course, student will be able to
- Enumerate the Fundamentals of Machine Learning
- Build Nearest neighbour based models
- Apply Models based on decision trees and Bayes rule
- Make use of Linear discriminants for machine Learning
- Choose appropriate clustering technique

UNIT-I

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML,Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II

Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance NearestNeighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.**The Bayes Classifier:**Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT-V

Clustering :Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1."Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1."Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017

2."Machine Learning in Action",Peter Harrington, DreamTech

3."Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

III Year II Semester	DEVOPS	L	T	P	C
		3	0	0	3

Course Objectives:

- Describe the agile relationship between development and IT operations.
- Understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
- Implement automated system update and DevOps lifecycle.

UNIT-I

Introduction to DevOps: Introduction to SDLC, Agile Model. Introduction to Devops. DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

UNIT-II

Source Code Management (GIT): The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. UNIT- TESTING - CODE COVERAGE: JUNIT-, nUNIT-& Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

UNIT-III

Build Automation - Continuous Integration (CI): Build Automation, What is CI Why Cl is Required, CI tools, Introduction to Jenkins (With Architecture), jenkins workflow, jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects & Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.

UNIT-IV

Continuous Delivery (CD): Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, DockerFile, Running containers, Working with containers and publish to Docker Hub.

Testing Tools: Introduction to Selenium and its features, JavaScript testing.

UNIT-V

Configuration Management - ANSIBLE: Introduction to Ansible, Ansible tasks, Roles, Jinjatemplating, Vaults, Deployments using Ansible.

CONTAINERIZATION USING KUBERNETES(OPENSHIFT): Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC &ConfigMaps, Deploying Apps on Openshift Container Pods. Introduction to Puppet master and Chef.

Text Books:

1. Joyner, Joseph.,Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1st Edition MihailsKonoplows, 2015.
2. Alisson Machado de Menezes., Hands-on DevOps with Linux,1st Edition, BPB Publications, India, 2021.

Reference Books:

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10
2. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016.
3. Verona, Joakim Practical DevOps, 1stEdition, Packt Publishing, 2016.
4. Joakim Verona. Practical Devops, Ingram short title; 2ndedition (2018). ISBN10: 1788392574
5. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952

III Year II Semester	IOT SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES
- To learn about the secwity issues in IoT and cloud computing.
- To learn about the cryptography solutions and issues in IoT.
- To learn about the security measures taken in IoT and Cloud systems to improve security.

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

COI- Understand the fundamental security issues in Intenet of things.
CO2- Demonstrate different Frameworks and Hardware Architecture of IoTD evice.
CO3- Analyze different loT Protocols and Layer Functioning.
CO4-Protect and secure the network connecting IoT devices to back-endsystems on the internet.
CO5-Demonstrate different authentication mechanism such as digital certificates, biometrics,etc.
CO6- Demonstrate collecting, aggregating, monitoring, and normalizing data from loT devices and providing actionable reporting and alerting on specific activities or whenactivities fall outside established policies.

UNIT-I

FUNDAM.ENTALSOFIoTECOSYSTEM
loTsecurity issues, howto design an IoTsystem,Hardware,softwareand networksecurity related to loT systems - Basicsof cryptogrnphic solutions to loT systems.

UNIT–II

OVERVIEWOFCLOUDCOMPUTINGANDITSSERVICES
CloudComputingFundamental:Cloudcomputingdefinition,private,publicandhybridcloud.Cloud types; IaaS, PaaS, SaaS.

UNIT–III

CHALLENGESINCLOUDCOMPUTING
Benefits andchallengesof cloud computing-Public vs. Privateclouds,Role ofvirtualizationinenabling thecloud.

UNIT-IV

SECURITYCONCEPTSINCONTEXTTOJoTDEVICES
Security Concepts, Confidentiality, privacy, integrity, authentication, non-repudiation,Virtualization

UNIT-VIoT SECURITYTHREATSANDCOUNTERMEASURES
System-Specific Attacks: Guest hopping, attacks on the VM (delete the **VM,** attack on the control of the **VM,** codeorfile injection into the virtualized file structure), **VM** migration attack, hyper jacking.

Text/ReferenceBooks:

1. David Etter, "loT Security: Practical guide book "Create Space,1st Edition, 2016.
2. Drew Van Duren, Brian Russell, "Practical Internet of Things Security", Packt, 1st Edition,2016.
3. Sean Smith, "The Internet of Risky Things",O'Reilly Media,1st Edition, 2017.
4. Brian Russell, Drew Van Duren,"Practical Internet of Things Security: Designa security framework for an Internet connected ecosystem", 2nd Edition, 2018.

III Year II Semester	MULTI AGENT SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

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

- Understand the fundamental concepts of agents, agent-based systems, and their applications.
- Analyze and design intelligent agent architectures.
- Explore multi-agent interactions, coordination, and communication mechanisms.
- Understand multi-agent decision-making, game-theoretic principles, and computational social choice.
- Apply logical foundations and practical approaches to multi-agent resource allocation and negotiation.

UNIT-I

 Introduction to Agent Systems: what is an agent? agents and objects; agents and expert systems; agents and distributed systems; typical application areas for agent systems

UNIT-II

 Intelligent Agents: Abstract Architectures for Agents, Tasks for Agents, Designing Intelligent Agents, Reasoning Agents, Reactive Agents, Hybrid Agents, Layered Agents.

UNIT-III

 Multi-Agent Systems and Communication: Ontologies: OWL, KIF, RDF. Interaction Languages and Protocols, Speech Acts, KQML/KIF, The FIPA Framework. Cooperation in Multi-Agent Systems- Cooperative Distributed Problem Solving (CDPS), Partial Global Planning, Coherence and Coordination, Applications of Multi-Agent Systems.

UNIT-IV

 Multi-Agent Decision-Making: Multi-Agent Interactions and Solution Concepts-Nash Equilibria (Pure and Mixed Strategies), Pareto Efficiency, Cooperative vs. Non-Cooperative Strategies, Zero-Sum and Other Interactions. Cooperation Models- The Prisoner's Dilemma and Axelrod's Experiments, Program Equilibria. Computational Social Choice-Voting Protocols, Arrow's Theorem, Gibbard-Satterthwaite Theorem, Strategic Manipulation and Complexity Prevention. Coalition Formation-The Core, The Shapley Valuem, Coalition Structure Generation.

UNIT-V

Resource Allocation, Bargaining, and Logical Foundations: Allocating Scarce Resources, Auction Types (English, Dutch, Vickrey), Combinatorial Auctions and Winner Determination, The VCG Mechanism, Bargaining Strategies- The Alternating Offers Protocol, Task-Oriented Negotiation, Resource Allocation via Bargaining. Logical Foundations of Multi-Agent Systems- Modal Logics for Epistemic Reasoning, Reasoning about Mental States, Cooperation Logics and Their Applications, Model Checking and Verification.

Textbooks:

1. **Michael Wooldridge** – An Introduction to Multi-Agent Systems, Wiley, 2009.
2. **Yoav Shoham, Kevin Leyton-Brown** – Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press, 2009.

Reference Books:
1. **Stuart Russell, Peter Norvig** – Artificial Intelligence: A Modern Approach, Pearson, 3rd Edition, 2015.
2. **Gerhard Weiss** – Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, MIT Press, 2000.
3. **Jeffrey S. Rosenschein, Michael Wooldridge** – Reasoning About Rational Agents, MIT Press, 2000.

III Year II Semester	AUTOMATA THEORY & COMPILER DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes

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

CO1. Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation

CO2. Design and develop lexical analyzers, parsers and code generators

CO3. Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.

CO4. Acquire fundamental understanding of the structure of a Compiler and Apply concepts automata theory and Theory of Computation to design Compilers

CO5. Design computations models for problems in Automata theory and adaptation of such model in the field of compilers

UNIT- I

Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA. **Introduction to Compiler Design:**Language Processors, Phases of Compilers

UNIT-II

Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Proving Languages Not to Be Regular. **Lexical Analysis Phase of compiler Design:**Role of Lexical Analyzer, Input Buffering, Specification of Token, Recognition of Token.

UNIT-III

Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring.**Syntax Analysis Phase of Compilers:part-1:**Role of Parser , Top-Down Parsing

UNIT- IV

Push Down Automata: Definition of the Pushdown Automata, The Languages of a PDA.
 Syntax Analysis Phase of Compilers: Part-2: Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers

UNIT-V

Introduction to Turing Machine: Problems that Computers Cannot Solve, The Turing machine, problems, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine**Undecidability :**A language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE.**Other Phases of**

Compilers: Syntax Directed Translation- Syntax-Directed Definitions, Evaluation Orders for SDD's. Intermediate-Code Generation- Variants of Syntax Trees, Three-Address Code.**Code Generation-**Issues in the Design of a Code Generator

Textbooks
1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman," Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson.
2. Alfred V.Aho, Monica S.Lam,RaviSethi, Jeffrey D. Ullman, " Compilers Principles, Techniques and Tools", Second Edition,Perason.

Reference:
1. Elain Rich, "Automata,Computability and complexity", 1st Edition, Pearson Education,2018.
2. K.L.P Mishra, N Chandrashekaran , 3rd Edition , 'Theory of Computer Science",PHI,2012.
3. Peter Linz, "An introduction to Formal Languages and Automata ", 3rd Edition, Narosa Publishers,1998.
4. K Muneeswaran, "Compiler Design", Oxford University Press 2013.

III Year II Semester	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:
1. To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium block chain.
3. Able to know the security issues of blockchain technology.

UNIT-I
Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.
Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.
Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II
Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.
Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT-III
Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.
Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.
Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT-IV
Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT– V
Blockchain Case Studies:
Case Study 1 – Retail,
Case Study 2 – Banking and Financial Services,
Case Study 3 – Healthcare,
Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.
Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text book:
1. "Block chain Technology", Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

Reference Books:
1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

III Year II Semester	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:
This course introduces the fundamental concepts and techniques of natural language processing (NLP).

- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.
- Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:
After completion of this course

- Demonstrate a given text with basic Language features
- To design an innovative application using NLP components
- Explain a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT- I

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT- II

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT- III

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT- IV

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT- V

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, 2nd Edition, Daniel Jurafsky, James H. Martin - Pearson Publication,2014.
2. Natural Language Processing with Python, First Edition, Steven Bird, Ewan Klein and Edward Loper, OReilly Media,2009.

Reference Books:

1. Language Processing with Java and Ling Pipe Cookbook, 1st Edition, Breck Baldwin, Atlantic Publisher, 2015.
2. Natural Language Processing with Java, 2nd Edition, Richard M Reese, OReilly Media,2015.
3. Handbook of Natural Language Processing, Second, Nitin Indurkhya and Fred J. Damerau, Chapman and Hall/CRC Press, 2010.Edition
4. Natural Language Processing and Information Retrieval, 3rd Edition, Tanveer Siddiqui, U.S. Tiwary, Oxford University Press,2008.

III Year II Semester	SECURITY ASSESSMENT AND RISK ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:
1. The course takes a software development perspective to the challenges of engineering software systems that are secure.
2. This course addresses design and implementation issues critical to producing secure software systems.
3. The course deals with the question of how to make the requirements for confidentiality, integrity, and availability integral to the software development process.
4. Secure software requirements gathering to design, development, configuration, deployment, and ongoing maintenance
5. Security of enterprise information systems.

Course Outcomes:
1. Understand various aspects and principles of software security.
2. Devise security models for implementing at the design level.
3. Identify and analyze the risks associated with s/w engineering and use relevant models to mitigate the risks.
4. Understand the various security algorithms to implement for secured computing and computer networks
5. Explain different security frameworks for different types of systems including electronic systems.

UNIT-I
Defining computer security, the principles of secure software, trusted computing base, etc, threat modeling, advanced techniques for mapping security requirements into design specifications. Secure software implementation, deployment and ongoing management.

UNIT-II
Software design and an introduction to hierarchical design representations.Difference between high-level and detailed design.Handling security with high-level design. General Design Notions. Security concerns designs at multiple levels of abstraction, Design patterns, quality assurance activities and strategies that support early vulnerability detection, Trust models, security Architecture & design reviews .

UNIT-III

Software Assurance Model: Identify project security risks & selecting risk management strategies, Risk Management Framework, Security Best practices/ Known Security Flaws, Architectural risk analysis, Security Testing & Reliability (Penn testing, Risk- Based Security Testing

UNIT-IV

Security in Enterprise Business: Identification and authentication, Enterprise Information Security, Symmetric and asymmetric cryptography, including public key cryptography, data encryption standard (DES), advanced encryption standard (AES), algorithms for hashes and message digests. Authentication, authentication schemes , access control models, Kerberos protocol, public key infrastructure (PKI), protocols specially designed for e-commerce and web applications, firewalls and VPNs.

UNIT-V

Security development frameworks. Security issues associated with the development and deployment of information systems, including Internet-based e-commerce, e-business, and e-service systems.

Text Books:

1. W. Stallings, Cryptography and network security: Principles and practice, 5 th Edition, Upper Saddle River, NJ: Prentice Hall., 2011
2. C. Kaufman, r. Perlman, & M. Speciner, Network security: Private communication in a public world, 2 nd Edition, Upper Saddle River, NJ:PrenticeHalL, 2002
3. C. P. Pfleeger, S. L. Pfleeger, Security in Computing, 4 th Edition, Upper Saddle River, NJ:Prentice Hall, 2007
4. T. M. Merkow, & J. Breithaupt, Information security: Principles and practices. Upper Saddle River, NJ:Prentice Hall, 2005

Reference Books:

1. Gary McGraw, Software Security: Building Security In, Addison-Wesley, 2006

III Year II Semester	ANDROID APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives: This course provides a thorough understanding of mobile platforms, including attack surfaces, risk landscape & more.

Course Outcomes:
1. Understand common mobile application security vulnerabilities.
2. Define the security controls of multiple mobile operating systems.
3. Understand and analyze Blue tooth technology.
4. Understand and analyze over view of SMSsecurity and Enterprise security.

UNIT-I
Top Mobile Issues and Development Strategies: Top Issues Facing Mobile Devices, PhysicalSecurity , Secure Data Storage (on Disk), Strong Authentication with Poor Keyboards , Multiple-UserSupport with Security, Safe Browsing Environment , Secure Operating Systems, Application Isolation, Information Disclosure, Virus, Worms, Trojans, Spyware, and Malware , Difficult Patching/Update Process, Strict Use and Enforcement of SSL, Phishing, Cross-Site Request Forgery(CSRF), Location Privacy/Security, In secure Device Drivers, Multi Factor Authentication,Tips for Secure Mobile Application Development.

UNIT-II
WAP and Mobile HTML Security WAP and Mobile HTML Basics, Authenticationon WAP/Mobile HTML Sites, Encryption, Application Attacks on Mobile HTML Sites, Cross-Site Scripting, SQL Injection,Cross-Site Request Forgery, HTTP Redirects, Phishing, Session Fixation, Non-SSL Login, WAP andMobile Browser Weaknesses, Lack ofHTTPOnly Flag Support, Lack of SECURE Flag Support, Handling Browser Cache, WAPLimitations.

UNIT-III
Bluetooth Security Overview of the Technology, History and Standards, Common Uses, Alternatives, Future, Bluetooth Technical Architecture, Radio Operation and Frequency, Bluetooth Network Topology , Device Identification , Modes of Operation , Bluetooth Stack ,Bluetooth Profiles, BluetoothSecurity Features , Pairing , Traditional Security Services in Bluetooth, Security "Non-Features" ,Threats to Bluetooth Devices and Networks, Bluetooth Vulnerabilities, Bluetooth Versions Priortov1.2, Bluetooth Versions Priortov2.1.

UNIT-IV

SMSSecurity Overview ofShort MessageService, Overview of Multimedia MessagingService,Wireless Application Protocol (WAP), Protocol Attacks, Abusing Legitimate Functionality, AttackingProtocol Implementations, Application Attacks, iPhone Safari, Windows Mobile MMS, Motorola RAZRJPG Over flow,Walk throughs,Sending PDUs,Converting XML toWBXML.

UNIT-V

Enterprise Security on the Mobile OS Device Security Options, PIN, Remote, 346 Secure Local Storage, Apple iPhone and Keychain, Security Policy Enforcement, Encryption, Full Disk Encryption, E-mail Encryption, File Encryption, Application Sand boxing, Signing, and Permissions, ApplicationS and boxing, Application Signing, Permissions, Buffer Over flow Protection, Windows Mobile, iPhone, Android, BlackBerry, Security Feature Summary.

Text Book:

1.Mobile Application Security, Himanshu Dwivedi, Chris Clark,David Thiel, TATA McGraw Hill.

ReferenceBooks:

1. Mobile and Wireless Network Security and Privacy,Kami S.Makki,etal,Springer.
2. Android Security Attacks Defenses, AbhishekDubey, CRCPress.

III Year II Semester	CLOUD COMPUTING LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:
- To introduce the various levels of services offered by cloud.
- To give practical knowledge about working with virtualization and containers.
- To introduce the advanced concepts such as serverless computing and cloud simulation.

Course Outcomes: At the end of the course, the student should be able to
- Demonstrate various service types, delivery models and technologies of a cloud computing environment.
- Distinguish the services based on virtual machines and containers in the cloud offerings.
- Assess the challenges associated with a cloud-based application.
- Discuss advanced cloud concepts such as serverless computing and cloud simulation.
- Examine various programming paradigms suitable to solve real world and scientific problems using cloud services.

List of Experiments:
1. Lab on web services
2. Lab on IPC, messagaging, publish/subscribe
3. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows8 or above.
4. Install a C compiler in the virtual machine created using VirtualBox and execute Simple Programs.
5. Create an Amazon EC2 instance and set up a web-server on the instance and associate an IP address with the instance. In the process, create a security group allowing access to port 80 on the instance.
6. OR
7. Do the same with OpenStack
8. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
9. Start a Docker container and set up a web-server (e.g. apache2 or Python based Flask micro web framework) on the instance. Map the host directory as a data volume for the container.
10. Find a procedure to transfer the files from one virtual machine to another virtual machine. Similarly, from one container to another container.
11. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
12. Install Hadoop single node cluster and run simple applications like word count.
13. Utilize OpenFaaS – Serverless computing framework and demonstrate basic event driven function invocation.
14. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

Text Books:

1. Mastering Cloud Computing, 2nd edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, McGraw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Cloud Computing: Principles and Paradigms by RajkumarBuyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
3. Online documentation and tutorials from cloud service providers (e.g. AWS, Google App Engine)
4. Docker, Reference documentation, https://docs.docker.com/reference/
5. OpenFaaS, Serverless Functions Made Simple, https://docs.openfaas.com/

		L	T	P	C
III Year II Semester	**IOT DATA ANALYTICS LAB**	0	0	3	1.5

Software Requirements:

1. **Hadoop:** https://hadoop.apache.org/release/2.7.6.html
2. **Java :**https://www.oracle.com/java/technologies/javase/javase8u211-later-archive-downloads.html
3. **Eclipse:** https://www.eclipse.org/downloads/

List of Experiments:

Experiment 1: Week 1, 2:
1. Implement the following Data structures in Java
   a)Linked Lists b) Stacks c) Queues d) Set e) Map

Experiment 2: Week 3:
   2.(i)Perform setting up and Installing Hadoop in its three operating modes:
Standalone,   Pseudo distributed,   Fully distributed
(ii)Use web based tools to monitor your Hadoop setup.

Experiment 3: Week 4:
3.Implement the following file management tasks in Hadoop:
   • Adding files and directories
   • Retrieving files
   • Deleting files
Hint: A typical Hadoop workflow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

Experiment 4: Week 5:
   4. Run a basic Word Count MapReduce program to understand MapReduce Paradigm**.**

Experiment 5: Week 6:
   5.   Write a map reduce program that mines weather data.
Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

Experiment 6: Week 7:
   6.   Use MapReduce to find the shortest path between two people in a social graph.
Hint: Use an adjacency list to model a graph, and for each node store the distance from the original node, as well as a back pointer to the original node. Use the mappers to propagate the distance to the original node, and the reducer to restore the state of the graph. Iterate until the target node has been reached.

Experiment 7: Week 8:
    7. Implement Friends-of-friends algorithm in MapReduce.
Hint: Two MapReduce jobs are required to calculate the FoFs for each user in a social network .The first job calculates the common friends for each user, and the second job sorts the common friends by the number of connections to your friends.

Experiment 8: Week 9:
    8. Implement an iterative PageRank graph algorithm in MapReduce.
Hint: PageRank can be implemented by iterating a MapReduce job until the graph has converged. The mappers are responsible for propagating node PageRank values to their adjacent nodes, and the reducers are responsible for calculating new PageRank values for each node, and for re-creating the original graph with the updated PageRank values.

Experiment 9: Week 10:
    9. Perform an efficient semi-join in MapReduce.
Hint: Perform a semi-join by having the mappers load a Bloom filter from the Distributed Cache, and then filter results from the actual MapReduce data source by performing membership queries against the Bloom filter to determine which data source records should be emitted to the reducers.

Experiment 10: Week 11:
    10. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter
        your

data.

Experiment 12: Week 12:
    11. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes

III Year II Semester	SOFT SKILLS or IELTS	L	T	P	C
		0	1	2	2

Course Objectives:

- To encourage all-round development of the students by focusing on soft skills.
- To make the students aware of critical thinking and problem-solving skills.
- To develop leadership skills and organizational skills through group activities.
- To function effectively with heterogeneous teams.

Course Outcomes:

- Memorize various elements of effective communicative skills.
- Interpret people at the emotional level through emotional intelligence.
- Apply critical thinking skills in problem-solving.
- Analyze the needs of an organization for team building.
- Judge the situation and take necessary decisions as a leader.
- Develop social and work-life skills as well as personal and emotional well-being.

UNIT-I

Soft Skills & Communication Skills

Introduction, meaning, significance of soft skills – definition, significance, types of communication skills – Intrapersonal & Interpersonal skills – Verbal and Non-verbal Communication.

Activities:

- Intrapersonal Skills – Narration about self, strengths, and weaknesses – clarity of thought – self-expression – articulating with felicity.
- Interpersonal Skills – Group Discussion – Debate – Team Tasks – Book and film Reviews by groups – Group leader presenting views (non-controversial and secular) on contemporary issues or on a given topic.
- Verbal Communication – Oral Presentations – Extempore – Brief addresses and speeches – Convincing – Negotiating – Agreeing and disagreeing with professional grace.
- Non-verbal communication – Public speaking – Mock interviews – Presentations with an objective to identify non-verbal clues and remedy the lapses on observation.

UNIT-–II

Critical Thinking : Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking.

Activities:

- Gathering information and statistics on a topic – Sequencing – Assorting – Reasoning – Critiquing issues.
- Placing the problem – Finding the root cause – Seeking viable solutions – Judging with rationale – Evaluating the views of others – Case Study, Story Analysis.

UNIT-–III

Problem Solving & Decision Making : Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Methods of decision-making – Effective decision-making in teams – Methods & Styles.

Activities:

- Placing a problem that involves conflict of interests, choice, and views – Formulating the problem – Exploring solutions by proper reasoning – Discussion on important professional, career, and organizational decisions and initiating debate on the appropriateness of the decision.
- Case Study & Group Discussion.

UNIT-–IV

Emotional Intelligence & Stress Management: Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips.

Activities:

- Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, confidence, and compassion in the form of written or oral presentations.
- Providing opportUNIT-ies for the participants to narrate certain crisis and stress-ridden situations caused by failure, anger, jealousy, resentment, and frustration in the form of written and oral presentations.
- Organizing Debates.

UNIT-–V

Leadership Skills Team-Building – Decision-Making – Accountability – Planning – Public Speaking – Motivation – Risk-Taking – Time Management.

Activities:

- Forming groups with a consensus among the participants – Choosing a leader – Encouraging the group members to express views on leadership, democratic attitude, sense of sacrifice, sense of adjustment, vision, and accommodating nature.
- Eliciting views on successes and failures of leadership using the past knowledge and experience of the participants.
- Public Speaking, Activities on Time Management, Motivation, Decision Making, Group Discussion, etc.

Textbooks:

1. Personality Development and Soft Skills (English, Paperback, Mitra Barun K.), Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012).
2. Personality Development and Soft Skills: Preparing for Tomorrow, Dr. Shikha Kapoor, Publisher: IK International Publishing House; 0 edition (February 28, 2018).

Reference Books:

1. Soft Skills: Personality Development for Life Success by Prashant Sharma, BPB Publications, 2018.
2. Soft Skills by Alex K., Published by S. Chand.
3. Soft Skills: An Integrated Approach to Maximize Personality by Gajendra Singh Chauhan, Sangeetha Sharma, Published by Wiley.
4. Communication Skills and Soft Skills (Hardcover, A. Sharma), Publisher: Yking Books.
5. Soft Skills for a BIG IMPACT (English, Paperback, Renu Shorey), Publisher: Notion Press.
6. Life Skills (Paperback, English, Dr. Rajiv Kumar Jain, Dr. Usha Jain), Publisher: Vayu Education of India.

Online Learning Resources:

- https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
- https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
- https://youtu.be/-Y-R9hDl7lU
- https://youtu.be/gkLsn4ddmTs
- https://youtu.be/2bf9K2rRWwo
- https://youtu.be/FchfE3c2jzc

III Year II Semester	**TECHNICALPAPERWRITING & IPR**	L	T	P	C
		2	0	0	0

Course Objective : The course will explain the basic related to writing the technical reports and understanding the concepts related to formatting and structuring the report. This will help students to comprehend the concept of proofreading, proposals and practice

UNIT- I
Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.
Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

UNIT- II
Drafting report and design issues: The use of drafts, Illustrations and graphics.
Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

UNIT- III
Proofreading and summaries: Proofreading, summaries, Activities on summaries. **Presenting final reports:** Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

UNIT- IV
 Using word processor:
Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes , Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros,

UNIT- V
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of **Patenting and Development:** technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property

Text Books:
1. Kompal Bansal &Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Ed., BS Publications, 2016.
2. William S. Pfeiffer and Kaye A. Adkins, "Technical Communication: A Practical Approach", Pearson.
3. Ramappa,T., "Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015.

Reference Books:
1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press(2006)

E-resources:
1. https://www.udemy.com/course/reportwriting/
2. https://www.udemy.com/course/professional-business-english-and-technical-report-writing/
3. https://www.udemy.com/course/betterbusinesswriting/

	Java Programming	L	T	P	C
		3	0	0	3

Course Objectives:
The learning objectives of this course are to:
- Identify Java language components and how they work together in applications
- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java APIs for program development

UNIT I
Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.
Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of
Variables,DataTypes,TypeCasting,ScopeofVariableIdentifier,LiteralConstants,Symboli c Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final,**Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. **Control Statements**: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator ?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II
Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded ConstructorMethods, NestedClasses, FinalClassandMethods, Passing ArgumentsbyValue and by Reference, Keyword this. **Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III
Arrays: Introduction, Declaration and Initialization of Arrays, Storage ofArray in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Valuesin Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. **Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of ClassUsing Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.**Interfaces:** Introduction, Declaration of Interface, Implementation ofInterface, Multiple Interfaces, Nested Interfaces, Inheritance of Inter faces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNITIV
Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto- boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.
JavaI/OandFile: JavaI/OAPI, standard I/Ostreams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

UNITV
String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.
 MultithreadedProgramming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication-Suspending, Resuming, and Stopping of Threads .**Java Database Connectivity:**Introduction, JDBCArchitecture, Installing MySQL and MySQLConnector/J, JDBC Environment Setup, Establishing JDBC Database Connections, Result SetI nterface. **Java FX GUI:** Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:
1) JAVAonestepahead, AnithaSeth, B.L.Juneja,Oxford.
2) Joy with JAVA,Fundamentals of ObjectOrientedProgramming,DebasisSamanta, Monalisa Sarma, Cambridge, 2023.
3) JAVA9forProgrammers,PaulDeitel,HarveyDeitel,4thEdition,Pearson.

References Books:
1) ThecompleteReferenceJava,11thedition,HerbertSchildt,TMH
2) IntroductiontoJavaprogramming, 7thEdition, YDanielLiang, Pearson

Online Resources:
1) https://nptel.ac.in/courses/106/105/106105191/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01288046454 7618816347_shared/overview

	OPERATINGSYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

UNIT-I

Operating Systems Overview: Introduction, Operating systemfunctions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT-II

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT– III

Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT-IV

Memory-Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Pagereplacement, Allocationofframes, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

UNIT-V

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File- System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Text Books:
1. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.
2. ModernOperating Systems,TanenbaumAS,4thEdition,Pearson,2016

Reference Books:
1. OperatingSystems-InternalsandDesignPrinciples,StallingsW,9thedition, Pearson, 2018
2. OperatingSystems:AConceptBasedApproach,D.MDhamdhere,3rdEdition, McGraw- Hill, 2013

OnlineLearningResources:
1. https://nptel.ac.in/courses/106/106/10610 6144/
http://peterindia.net/OperatingSystems.html

		L	T	P	C
	DATABASEMANAGEMENT SYSTEMS	3	0	0	3

Course Objectives:

The main objectives of the course is to

- Introduce database management systems and to give a good formal foundationon the relational model of data and usage of Relational Algebra
- Introduce the conceptsofbasic SQLasa universal Database language
- Demonstrate the principles behind systematicdatabase designapproaches by covering conceptual design,logical design through normalization
- Provide an overview ofphysicaldesign ofa database system, bydiscussing Databaseindexing techniques and storage techniques

UNIT-I

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and datain dependence; Threetier schema architecturefor data independence; Database system structure, environment, Centralized and Client Serverarchitecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes,entityset, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT-II

Relational Model: Introduction to relational model, concepts of domain, attribute,tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra,RelationalCalculus.BASICSQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT-III

SQL: BasicSQLquerying(select andproject)usingwhere clause, arithmetic& logical operations,SQLfunctions(DateandTime,Numeric,Stringconversion).Creatingtables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable andnon-updatable), relational set operations.

UNIT-IV

Schema Refinement (Normalization):Purpose of Normalization or schema refinement, conceptof functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition,(1NF,2NFand3NF), concept of surrogatekey, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form(5NF).

UNIT-V

Transaction Concept: Transaction State, ACID properties, Concurrent Executions,Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification,Storage, Recovery and Atomicity, Recovery algorithm. Introduction to Indexing Techniques: B+Trees, operations on B+Trees, Hash Based Indexing:

Text Books:

1) Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke,TMH (For Chapters 2, 3, 4)
2) Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

ReferenceBooks:

1) Introduction to Database Systems, 8th edition, CJ Date, Pearson.
2) Database Management System, 6th edition, Ramez Elmasri, Shamkant B. Navathe, Pearson
3) Database Principles Fundamentals of Design Implementation and Management, CorlosCoronel, Steven Morris, Peter Robb, Cengage Learning.

Web-Resources:

1) https://nptel.ac.in/courses/106/105/106105175/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667 282022456_shared/overview

	COMPUTER NETWORKS	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:
- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OSI model and the functions of layered structure.
- To explain networking protocols, algorithms and design perspectives.

CourseOutcomes(CO): After completion of the course, students will be able to
- Identify the software and hardware components of a Computer network.(L1)
- Explain the functionality of each layer ofa computer network.(L2)
- Identify and analyze flow control, congestion control, and routing issues.(L4)
- Analyze and interpret the functionality and effectiveness of the routing protocols. (L4)
- Choose the appropriate transport protocol based on the application requirements.(L3)

UNIT-I
Introduction: Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship ofServices to Protocols ,Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

UNIT-II
The Data Link Layer: Guided Transmission Media, Persistent Storage, Twisted Pairs, CoaxialCable, PowerLines, Fiber Optics, Data Link Layer DesignIssues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet,40- And 100-Gigabit Ethernet, Retrospective On Ethernet.

UNIT-III

The Network Layer: Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, Traffic Management at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internet working, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes:Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

UNIT-IV

The Transport Layer: The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Band width Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols,The Internet Transport Protocols:TCP, IntroductionToTCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

UNIT-V

The Application Layer: Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.

Text book:
   1.Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6thEdition, Global Edition.

Reference Books:
1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2017.
2. JamesF.Kurose,Keith W.Ross,"Computer Networking: A Top-Down Approach",6th edition, Pearson, 2019.
3. Youlu Zheng, Shakil Akthar, "Networks for Computer Scientists and Engineers",Oxford Publishers, 2016.

Online Learning Resources:
https://nptel.ac.in/courses/106105183/25
http://www.nptelvideos.in/2012/11/computer-
networks.html https://nptel.ac.in/courses/106105183/

IV Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	Professional Core	IoT Applications development on Cloud Platform	3	0	0	3
2	Management Course- II	Software Project management	2	0	0	2
3	Professional Elective-IV	Ad-hoc and Sensor Networks/ Malware Analysis and Reverse Engineering Crypto Currency Technologies Designing IOT Architectures 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
4	Professional Elective-V	Cyber Physical Systems Intrusion Detection and Prevention System Industry IOT Augmented Reality & Virtual Reality 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	Open Elective-III		3	0	0	3
6	Open Elective-IV		3	0	0	3
7	Skill Enhancement Course	Ethical Hacking	0	1	2	2
8	Audit Course	Constitution of India	2	0	0	0
9	Internship	Evaluation of Industry Internship	-	-	-	2
	Total		**19**	**01**	**02**	**21**

IV Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Internship & Project Work	Full Semester Internship & Project Work	0	0	24	12

Minor Courses & Honor Courses

S.No.	Category	L	T	P	Credits
1	Minor Course (Student may select from the specialized minors pool)	3	0	3	4.5
2	Honors Course through SWAYAM/NPTEL (minimum 12week, 3 credit course)	3	0	0	3
3	Course (Student may select from the honors pool)	3	0	0	3

Open Electives & Minor

Note: *To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.*

For Minor in CSE (IOT):   **L -T-P-C**
1. Machine Learning   3-0-0-3
2 .Introduction to IOT   3-0-0-3
3. Blockchain technology   3-0-0-3
4. Cloud computing   3-0-0-3
5. Cyber Security   3-0-0-3
6. IOT Lab Using Python   0-0-3-1.5
7. Machine learning with python Lab   0-0-3-1.5

Open Electives, offered to other department students:
Open Elective-I   : Java Programming
Open Elective-II   : Operating Systems
Open Elective-III   : Data Base Management Systems
Open Elective-IV   : 1. Computer Networks 2. Quantum Science and Technology

COURSES OFFERED FOR HONOURS DEGREE IN BTech CSE(IoT)

S.No.	Code	Course Name	Contact Hours per week			Credits
			L	**T**	**P**	
1		Social Media Security	3	0		3
2		Cloud Computing Security	3	0		3
3		Machine Learning for Cyber security	3	0		3
4		IOT security	3	0		3
5		Cyber Physical Systems and Security	3	0		3
6		IOT security Lab			3	1.5
7		Cyber Physical Systems and Security Lab			3	1.5
Total						**18**

IV Year I Semester	IOT APPLICATIONS DEVELOPMENT ON CLOUD PLATFORM (Professional Core)	L	T	P	C
		3	0	0	3

Course Objectives:

- Vision and Introduction to IoT.
- Understand IoT Market perspective.
- Data and Knowledge Management and use of Devices in IoT Technology.
- Understand State of the Art – IoT Architecture.
- Real-World IoT Design Constraints, Industrial Automation, and Commercial Building Automation in IoT.

UNIT–I

IoT & Web Technology : The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization.

UNIT-II

M2M to IoT - An Architectural Overview: Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, Standards considerations, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **M2M to IoT – A Market Perspective:** Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

UNIT-III

IoT Applications for Value Creations: Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth. **Cloud Computing:** Cloud Enabling Technologies, Characteristics of Cloud Computing, Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure, Cloud Challenges, Understanding IaaS - Improving performance through Load balancing, Server Types within IaaS solutions, Utilizing cloud-based NAS devices, Understanding Cloud-based data storage, Cloud-based backup devices.

UNIT-IV

Cloud Infrastructure: Cloud Storage - Overview, Cloud Storage Providers. Virtualization - Understanding Virtualization, History, Leveraging Blade Servers, Server Virtualization, Data Storage Virtualization. Developing Applications - Google, Microsoft, Cast Iron Cloud, Bungee Connect, Development. Migrating to the Cloud - Cloud Services for Individuals, Cloud Services Aimed at the Mid-Market, Enterprise-Class Cloud Offerings, and Migration. Designing Cloud-Based Solutions - System Requirements, Design is a Give-and-Take Process. Coding Cloud-Based Applications - Creating a Simple Yahoo Pipe, Using Google App Engine and creating a Windows

Azure Application. Application Scalability - Load-Balancing Process, Designing for Scalability, Capacity Planning Versus Scalability, Scalability and Diminishing Returns, and Performance Tuning.

UNIT-V

Internet of Things & Cloud Privacy, Security, and Governance: Introduction, Overview of Governance, Privacy, and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT - Data Platforms for Smart Cities, First Steps Towards a Secure Platform, Data Aggregation for the IoT in Smart Cities, Security, Securing the Cloud - General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery.

Books & References:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Cuno Pfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 978-1-4493-9357-1.
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
5. Cloud Computing: A Practical Approach by Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, 2010, McGraw-Hill.
6. Cloud Computing: SaaS, PaaS, IaaS, Virtualization and More by Dr. Kris Jamsa.

IV Year I Semester	SOFTWARE PROJECT MANAGEMENT (Management Course-II)	L	T	P	C
		3	0	0	3

Course Objectives:
At the end of the course, the student shall be able to:
- To describe and determine the purpose and importance of project management from the perspectives of planning, tracking and completion of project
- To compare and differentiate organization structures and project structures
- To implement a project to manage project schedule, expenses and resources with the application of suitable project management tools

- **UNIT-I**
Conventional Software Management: The waterfall model, conventional software Management performance.**Evolution of Software Economics:** Software Economics, pragmatic software cost estimation.**Improving Software Economics:** Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.**The old way and the new:** The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

UNIT-II
Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.**Artifacts of the process:** The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT- III
Model based software architectures: A Management perspective and technical perspective.**Work Flows of the process:** Software process workflows, Iteration workflows.**Checkpoints of the process: Major** mile stones, Minor Milestones, Periodic status assessments.**Iterative Process Planning:** Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

UNIT- IV
Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.**Process Automation:** Automation Building blocks, The Project Environment.**Project Control and Process instrumentation:** The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

UNIT-V
Agile Methodology, ADAPTing to Scrum, Patterns for Adopting Scrum, Iterating towards Agility.**Fundamentals of DevOps**: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

Text Books:

 1.Software Project Management, Walker Royce, PEA, 2005.

2.Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley.

3.The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim , John Willis , Patrick Debois , Jez Humb,1st Edition, O'Reilly publications, 2016.

Reference Books:

1**.**Software Project Management, Bob Hughes,3/e, Mike Cotterell, TMH

2.Software Project Management, Joel Henry, PEA

3.Software Project Management in practice, Pankaj Jalote, PEA, 2005,

4.Effective Software Project Management, Robert K.Wysocki, Wiley,2006.

5.Project Management in IT, Kathy Schwalbe, Cengage

IV Year I Semester	AD-HOC AND SENSOR NETWORKS (Professional Elective-IV)	L	T	P	C
		3	0	0	3

Course Objectives:
- To understand the concepts of sensor networks
- To understand the MAC and transport protocols for ad hoc networks
- To understand the security of sensor networks
- To understand the applications of adhoc and sensor networks

Course Outcomes:
- Ability to understand the state-of-the-art research in the emerging subject of Ad Hoc and Wireless Sensor Networks
- Ability to solve the issues in real-time application development based on ASN.
- Ability to conduct further research in the domain of ASN

UNIT - I
Introduction to Ad Hoc Networks - Characteristics of MANETs, Applications of MANETs and Challenges of MANETs.
Routing in MANETs - Criteria for classification, Taxonomy of MANET routing algorithms, Topology- based routing algorithms-**Proactive**: DSDV; **Reactive**: DSR, AODV; Hybrid: ZRP; Position-based routing algorithms-**Location Services**-DREAM, Quorum-based; **Forwarding Strategies:** Greedy Packet, Restricted Directional Flooding-DREAM, LAR.

UNIT - II
Data Transmission - Broadcast Storm Problem, **Rebroadcasting Schemes**-Simple-flooding, Probability-based Methods, Area-based Methods, Neighbor Knowledge-based: SBA, Multipoint Relaying, AHBP. **Multicasting: Tree-based:** AMRIS, MAODV; **Mesh-based:** ODMRP, CAMP; **Hybrid:** AMRoute**,** MCEDAR.

UNIT - III
Geocasting: Data-transmission Oriented-LBM; Route Creation Oriented-GeoTORA, MGR**.** TCP over Ad Hoc TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT – IV Basics of Wireless, Sensors and Lower Layer Issues: Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer, Routing Layer.

UNIT - V
Upper Layer Issues of WSN: Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, Sensor Networks and mobile robots.

Text Books:

1. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P. Aggarwal, World Scientific Publications, March 2006, ISBN – 981–256–681–3.
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman).

IV Year I Semester	**MALWARE ANALYSIS AND REVERSE ENGINEERING** **(Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:
- To learn fundamentals of malware analysis which includes analysis of JIT compilers for malware detection in legitimate code.
- To explore the techniques for detecting, analyzing, reverse engineering and eradicating
- malware.
- Employ network and system-monitoring tools to examine how malware interacts with the file system, registry, network, and other processes in a Windows environment.
- Assess the threat associated with malicious documents.
- Build an isolated, controlled laboratory environment for analyzing the code and behaviour of malicious program.

Course Outcomes:

After completion of this course, the students would be able to

CO1 : Demonstrate the concept of malware and reverse engineering. [K2]

CO2 : Apply various tools and techniques of malware analysis to examine malicious software. [K3]

CO3 : Analyse and evaluate various techniques for used in malware analysis & reverse engineering to identify vulnerabilities. [K4]

CO4 : Utilize the python language for development & analysis of anti-malwares. [K4]

CO5 : Setup an environment for malware analysis & recognize common malware characteristics. [K1]

UNIT–I

Fundamentals of Malware Analysis (MA), Reverse Engineering Malware (REM) Methodology, Brief Overview of Malware analysis lab setup and configuration, Introduction to key MA tools and techniques, Behavioural Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining Clam AV Signatures, Creating Custom Clam AV Databases.

UNIT–II

Malware Forensics Using TSK for Network and Host Discoveries, Using Microsoft Offline API to Registry Discoveries, Identifying Packers using PEiD, Registry Forensics with Reg Ripper Plugins, Bypassing Poison Ivy's Locked Files, Bypassing Conficker's File System ACL Restrictions, Detecting Rogue PKI Certificates.

UNIT–III

Malware and Kernel Debugging Opening and Attaching to Processes, Configuration of JITDebugger for Shellcode Analysis, Controlling Program Execution, Setting and Catching Breakpoints, Debugging with Python Scripts and Py Commands, DLL Export Enumeration, Execution, and Debugging, Debugging a VMware Workstation Guest (on Windows), Debugging a Parallels Guest (on Mac OS X).

UNIT-IV

Memory Forensics and Volatility Memory Dumping with MoonSols Windows Memory Toolkit, Accessing VM Memory Files Overview of Volatility, Investigating Processes in Memory Dumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA.

UNIT-V

Researching and Mapping Source Domains/IPs Using WHOIS to Research Domains, DNS Hostname Resolution, Querying Passive DNS, Checking DNS Records, Reverse IP Search New Course Form, Creating Static Maps, Creating Interactive Maps.

Text Books:

1. Sikorski, M., & Honig, A. (2012). Practical malware analysis: the hands-on guide to dissecting malicious software. No starch press.
2. Eilam, E. (2005). Reversing, Secrets of Reverse Engineering Wiley Publishing.
3. Malin, C. H. (2013). Linux Malware Incident Response: A Practitioner's Guide to Forensic Collection and Examination of Volatile Data: An Excerpt from Malware Forensic Field Guide for Linux Systems. Elsevier.

Reference Books:

1. Shashidhar, N., & Cooper, P. (2016, April). Teaching malware analysis: The design philosophy of a model curriculum. In 2016 4th International Symposium on Digital Forensic and Security (ISDFS) (pp. 119-125). IEEE.
2. Singh, A. (Ed.). (2009). Identifying malicious code through reverse engineering (Vol. 44). Springer Science & Business Media.

IV Year	CRYPTOCURRENCY TECHNOLOGIES	L	T	P	C
I Semester	(Professional Elective-IV)	3	0	0	3

Course Objectives:
- To understand the importance of digital money through crypto mechanisms
- To be able to explain the different components involved within Blockchain
- To understand how the block chain createseconomic incentives
- To know the system worksand how can they utilize and what application can be build using cryptocurrency

Course Outcomes:

CO1:Understand emerging abstract models for Blockchain Technology

CO2: Familiarise the functional/operational aspects of cryptocurrency ecosystem

CO3:Familiarize with Ethereum,smartcontracts and related technologies,and solidity language

CO4:Demonstrate how cryptographic primitives can be leveraged to construct secure electronic currencies like Bitcoin

CO5:Enumerate the Bitcoin features and its alternative options

CO6:Build their own application using the learned concepts.

UNIT- I

DIGITALMONEYANDCRYPTOGRAPHY: Physical Money and Digital Money History of Money:Forms of Money,Fiat Currencies,Currency Pages,Quantitative Easing-Interbank Payment Mode: Same Bank,Different Bank,Correspondent Bank,Central Bank,International Payment, Cryptography :Encryption and Decryption, Hashed, Digital Signature.

UNIT-II

CRYPTOGRAPHY AND BLOCKCHAIN TECHNOLOGY: Cryptography:Hash function-Digital Signature-ECDSA-Memory Hard Algorithm-Zero Knowledge Proof. Blockchain:Introduction-Advantage over conventional distributed database-Blockchain Network-Mining Mechanism-Distributed Consensus-Merkle PatriciaTree-Gas Limit-Transactions and Fee-Anonymity-Reward-Chain

UNIT-III

CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLGOY: Introduction to crypto and cryptocurrency-Primitives of crypto-Bitcoin-Point of Bitcoin-WorkingofBitcoin-Bitcoininpractice-BitcoinPredecessor-BitcoinDecentralization-Store and use of Bit coin-Bit coin Mining-Ethereum:Ethereum Eco system-CaseStudy:Bitcoin cash.

UNIT-IV

ETHEREUM AND SOLIDITY: Alternative approaches to mining and consensus-Bitcoin and anonymity-Overview of Altcoins-Overview of Ethereum-Programming smart contracts on Ethereum-Solidity Language. **Crypto currencies & the real world:** Smart property,data feeds,and public and omnessApplications of cryptocurrencies and blockchains.

UNIT-V
CRYPTOCURRENCY REGULATION AND BLOCKCHAIN APPLICATIONS: Crypto currency Regulation:Stakeholders-Roots of Bitcoin-Legal Aspects-Crypto currency Exchange-Black Market and Global Economy.Block chain Applications: Internet of Things- Medical Record Management System-Domain Name Service- future of Blockchain.

Text/Books:
1.AntonyLewis,"The Basics of Bitcoin and Block chains:An Introduction to Cryptocurrencies and Technology that powers them"20 18
2. Wiley,"Crypto currencies and Block chain Technology Applications",Wiley2020

Reference Books:
1. Arvind Narayanan, Joseph Bonneau, Edward Felten, And rew Miller and Steven Goldfeder, "Bit coin and Crypto currency Technologies: A Comprehensive Introduction ", Princeton University Press (July19, 2016).
2. Antono poulos, "Mastering Bit coin: Unlocking Digital Crypto currencies" ,O'Reilly(2014)
3. Arvind Narayanan, Joseph Bonneau, Edward Felten, And rew Miller, and Steven Gold feder. Bit coin and crypto currency technologies: a comprehensive introduction. Princeton University Press,2016

IV Year I Semester	**DESIGNING IOT ARCHITECTURES** **(Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives: Knowledge on concepts of IoT applications and IoT architectures, Event driven analysis and security testing IoT systems

Course Outcomes:
CO1: Understand IoT applications and IoT Architectures.
CO2: Learn about IoT devices and event driven analysis
CO3: Understand and analyze IIoT.
CO4: Understand safety and security testing of IoT systems

UNIT- I
The IoT Landscape: What Is IoT? Applications, Architectures, Wireless Networks, Devices, Security and Privacy, Event-Driven Systems. **IoT System Architectures:** Introduction, Protocols Concepts, IoT- Oriented Protocols, Databases, Time Bases, Security.

UNIT - II
IoT Devices & Event-Driven System Analysis: The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption, Platform Design. **Event-Driven System Analysis:** Introduction, Motivating Example, IoT Network Model, Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis, Event Populations, Stochastic Event Populations, Environmental Interaction Modeling, Event Transport and Migration.

UNIT - III
Industrial Internet of Things: Introduction, Industry 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

UNIT - IV
Security and Safety: Introduction, Systems Security, Network Security, Generic Application Security, Application Process Security and Safety, Reliable-and-Secure-by-Design IoT Applications, Run-Time Monitoring, The ARMET Approach, Privacy and Dependability.

UNIT - V
Security Testing IoT Systems: Introduction, Fuzz Testing for Security, White-Box Fuzzing, Black-Box Fuzzing, Fuzzing Industrial Control Network Systems, Fuzzing Modbus, The Modbus Protocol, Modbus/TCP Fuzzer.

Text Books:

1. Dimitrios Serpanos, Marilyn Wol, Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies, ISBN 978-3-319-69714-7.

Reference Books:

1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
3. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
4. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

IV Year I Semester	**CYBER PHYSICAL SYSTEMS** **(Professional Elective-V)**	L	T	P	C
		3	0	0	3

Course Objectives:
The main objectives of the course are to understand the core principles behind Cyber Physical Systems, Identify Security mechanisms of Cyber physical system, Understand Synchronization in Distributed Cyber-Physical Systems

UNIT- I
Symbolic Synthesis for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of Symbolic Models, Continuous-Time Controllers, Software Tools

UNIT- II
Security of Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

UNIT- III
Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture, Related Technology, Advanced Techniques

UNIT- IV
Real-Time Scheduling for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty

UNIT- V
Model Integration in Cyber-Physical Systems: Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

Text Books:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional, 2016
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press

Reference Books:

1. E.A.Lee, Sanjit Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press
2. Andre Platzer, Logical Foundations of Cyber-Physical Systems, (2e), Springer Publishing, 2018

IV Year	INTRUSION DETECTION AND PREVENTION SYSTEM	L	T	P	C
I Semester	(Professional Elective-V)	3	0	0	3

Course Objectives:
1. Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
2. Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems
3. Analyze intrusion detection alerts and logs to distinguish attack types from false alarms

Course Outcomes:
1. Explain the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets.
2. Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.

UNIT-I
History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

UNIT-II
Intrusion Prevention Systems, Network IDs protocol based IDs ,Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis , techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis

UNIT-III
Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

UNIT-IV
Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL

UNIT-V
Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.

Text Books:

1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.

References:

1. Christopher Kruegel,FredrikValeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.

2. Carl Endorf, Eugene Schultz and Jim Mellander" Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.

3. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002.

4. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition, KhannaPublihsers, 2012.

IV Year I Semester	INDUSTRY IOT	L	T	P	C
	(Professional Elective-V)	**3**	**0**	**0**	**3**

Course Objective: To provide students with a good depth of knowledge of Designing Industrial IoT Systems for various applications.Knowledge for the design and analysis of Industry 4.0 Systems for Electronics Engineering students.

Course Outcome:

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

- Gain knowledge of theory and practice related to Industrial IoT Systems.
- Identify, formulate, and solve engineering problems by using Industrial IoT.
- Implement real field problems by applying gained knowledge of Industrial applications with IoT capability.

UNIT-I

Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions**,** Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry**,**Industry 4.0 Revolutions**,** Support System for Industry 4.0**,**Smart Factories

UNIT-II

Implementation Systems for IIoT: Sensors and Actuators for Industrial Processes**,** Sensor Networks**,** Process Automation and Data Acquisitions on IoT Platform**,** Microcontrollers and Embedded PC roles in IIoT**,** Wireless Sensor Nodes with Bluetooth, WiFi, and LoRa Protocols**,**IoT Hub Systems

UNIT-III

 IoT Data Monitoring & Control: IoT Gateway, IoT Edge Systems and Its Programming**,** Cloud Computing**,** Real-Time Dashboard for Data Monitoring**,** Data Analytics and Predictive Maintenance with IIoT Technology

UNIT-IV

Cyber-Physical Systems: Next Generation Sensors**,** Collaborative Platform and Product Lifecycle Management**,** Augmented Reality and Virtual Reality**,** Artificial Intelligence**,**Big Data and Advanced Analysis

UNIT-V

Industrial IoT – Applications: Healthcare**,** Power Plants**,** Inventory Management & Quality Control**,** Plant Safety and Security (Including AR and VR Safety Applications)**,** Facility Management

List of References:

1. "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist, Apress Publications.
2. "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics" by Christoph Jan Bartodziej, Springer Publications.
3. "Embedded System: Architecture, Programming and Design" by Rajkamal, TMH Publications.
4. "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems" by Dr. Ovidiu Vermesan and Dr. Peter Friess, River Publishers.

IV Year I Semester	AUGMENTED REALITY & VIRTUAL REALITY (Professional Elective-V)	L	T	P	C
		3	0	0	3

Objectives:

- Provide a foundation to the fast growing field of AR and make the students aware of the various AR concepts.
- To give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

UNIT- I

Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields. **Displays:** Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays. **Tracking:** Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors

UNIT- II

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking. **Interaction:** Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction. **Software Architectures:** AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs

UNIT- III

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception. **The Geometry of Virtual Worlds:** Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations. **Light and Optics:** Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT- IV

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR. **Visual Perception:** Visual Perception - Perception of Depth, Perception of Motion, **Perception of ColorVisual Rendering:** Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT- V

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection. **Interaction:** Motor Programs and Remapping, Locomotion, Social Interaction. **Audio:** The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

Text Books:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India;First edition (12 October 2016),ISBN-10: 9332578494
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

Reference Books:
1. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN:9781491962381
5. SanniSiltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
6. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005

IV Year	ETHICAL HACKING	L	T	P	C
I Semester	(Skill Enhancement Course)	0	1	2	2

Course Objectives:
The main objective of this course is to render every database based transaction safe, secure and simple. We aim to transform the internet security industry by infusing professionalism and a never before seen efficiency.

Course Outcomes:
By the end of the course students will

- Learn various hacking methods.
- Perform system security vulnerability testing.
- Perform system vulnerability exploit attacks.
- Produce a security assessment report
- Learn various issues related to hacking.

UNIT-I
Hacking Windows: BIOS Passwords, Windows Login Passwords, Changing Windows Visuals, Cleaning Your Tracks, Internet Explorer Users, Cookies, URL Address Bar, Netscape Communicator, Cookies URL History, The Registry, Baby Sitter Programs.

UNIT-II
Advanced Windows Hacking: Editing your Operating Systems by editing Explorer.exe, The Registry, The Registry Editor, Description of .reg file, Command Line Registry Arguments, Other System Files, Some Windows & DOS Tricks, Customize DOS, Clearing the CMOS without opening your PC, The Untold Windows Tips and Tricks Manual, Exiting Windows the Cool and Quick Way, Ban Shutdowns: A Trick to Play, Disabling Display of Drives in My Computer, Take Over the Screen Saver, Pop a Banner each time Windows Boots, Change the Default Locations, Secure your Desktop Icons and Settings.

UNIT-III
Getting Past the Password: Passwords: An Introduction, Password Cracking, Cracking the Windows Login Password, The Glide Code, Windows Screen Saver Password, XOR, Internet Connection Password, Sam Attacks, Cracking Unix Password Files, HTTP Basic Authentication, BIOS Passwords, Cracking Other Passwords.

UNIT-IV
The Perl Manual: The Basics, Scalars, Interacting with User by getting Input, Chomp() and Chop(), Operators, Binary Arithmetic Operators, The Exponentiation Operator(**), The Unary Arithmetic Operators, Other General Operators, Conditional Statements, Assignment Operators. The?: Operator, Loops, The While Loop, The For Loop, Arrays, THE FOR EACH LOOP: Moving through an Array, Functions Associated with Arrays, Push() and Pop(), Unshift() and Shift(), Splice(), Default Variables, $_, @ARGV, Input Output, Opening Files for Reading, Another Special VariableS.

UNIT-V

How does a Virus Work? What is a Virus?, Boot Sector Viruses (MBR or Master Boot Record), File or Program Viruses, Multipartite Viruses, Stealth Viruses, Polymorphic Viruses, Macro Viruses, Blocking Direct Disk Access, Recognizing Master Boot Record (MBR) Modifications, Identifying Unknown Device Drivers, How do I make my own Virus?, Macro Viruses, Using Assembly to Create your own Virus, How to Modify a Virus so Scan won‟t Catch it, How to Create New Virus Strains, Simple Encryption Methods.

Text Books:

1. Patrick Engbreston: "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy",1st Edition, Syngress publication,2011.
2. Ankit Fadia : "Unofficial Guide to Ethical Hacking", 3rd Edition , McMillan India Ltd,2006.

References:

1. Simpson/backman/corley, "HandsOn Ethical Hacking & Network Defense International", 2nd Edition,Cengageint,2011.

IV Year I Semester	CONSTITUTION OF INDIA	L	T	P	C
	(Audit Course)	2	0	0	0

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-I

History of Making of the Indian Constitution: History, Drafting Committee,(Composition & Working)**Philosophy of the Indian Constitution-** Preamble, Salient, Features

UNIT-II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, **Executive-** President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT-IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-V

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. The Constitution of India, 1st Edition, (Bare Act), Government Publication, 1950
2. Framing of Indian Constitution, 1st Edition, Dr. S. N. Busi, Dr. B. R. Ambedkar 2015

   Reference Books:

1. Indian Constitution Law, 7th Edition, M. P. Jain, Lexis Nexis, 2014

MINORS

	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

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Course Outcomes: At the end of the course, student will be able to

- Enumerate the Fundamentals of Machine Learning
- Build Nearest neighbour based models
- Apply Models based on decision trees and Bayes rule
- Make use of Linear discriminants for machine Learning
- Choose appropriate clustering technique

UNIT-I

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML,Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II

Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures ,K-Nearest Neighbor Classifier, Radius Distance NearestNeighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression. **The Bayes Classifier:**Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT-V

Clustering: Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1.“Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1.“Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017
2.“Machine Learning in Action”,Peter Harrington, DreamTech
3.“Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

	INTRODUCTION TO IOT	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Outcome(s):
This course will help students understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies. Students will get an overview of an end to endIoT system encompassing the edge, cloud and application tiers. This course will build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own. The lab exercises will consist of hands-on experiments that will lead to building an IoT application end-to-end. Some of the specialized topics will be covered via student seminars where students are expected to research and present their findings in a seminar format.

UNIT– I
Introduction to IoT and Use cases: Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.

UNIT- II
Architecture: IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing.

UNIT-III
Sensors and Industrial Systems: Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.

UNIT–IV
Networking and Communication for IoT: Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications (web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers).

UNIT –V
IoT Data Processing and Storage: Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.
IoT Seminars: Selected topics in IoTshould be handled via student seminars. Recommended that students form a group do research on at least one of the following topics and present it through seminars. They are expected to do a literature survey of the topic and present their survey paper to the class.

The suggested topics are –

   a) **IoT Applications**
   - Smart Cities
   - Connected Vehicles and Telematics
   - Smart Grids
   - Smart Homes

   b) **IoT data visualization**
   c) **Survey of cloud based IoT platforms**
   d) **Low power wide area networks for IoT**
   e) **IoT device management**
   f) **Survey of chips, embedded modules and development boards for IoT devices**
   g) **Embedded and real-time operating systems for IoT**
   h) **IoT Security**
      - Security risks in IoT
      - Securing IoT endpoint devices and secure communication protocols for IoT
      - Security and Privacy of IoT data

Text Books:

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

Reference Books / Links:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzi, O Reilly Media
7. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

	BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the fundamentals of Block Chain and various types of block chain and consensus mechanism.
2. To understand public block chain system, Private block chain system and consortium block chain.
3. Able to know the security issues of blockchain technology.

UNIT – I
Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.
Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.
Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II
Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.
Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT-– III
Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.
Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.
Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.
UNIT – IV Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT– V

Blockchain Case Studies:

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services,

Case Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text book:
 1. "Block chain Technology", Chandramouli Subramanian, Asha A.George, Abhilasj K A and Meena Karthikeyan , Universities Press.

Reference Books:
  1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
  2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley

	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:
- To explain the evolving utility computing model called cloud computing.
- To introduce the various levels of services offered by cloud.
- To discuss the fundamentals of cloud enabling technologies such as distributed computing, service-oriented architecture and virtualization.
- To emphasize the security and other challenges in cloud computing.
- To introduce the advanced concepts such as containers, serverless computing and cloud-centric Internet of Things.

UNIT-I

Introduction to Cloud Computing Fundamentals: Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

UNIT-II

Cloud Enabling Technologies: Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT-III

Virtualization and Containers: Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV

Cloud computing challenges: Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT-V

Advanced concepts in cloud computing: Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:
1. Mastering Cloud Computing, 2nd edition, RajkumarBuyya, Christian Vecchiola, ThamaraiSelvi, ShivanandaPoojara, Satish N. Srirama, Mc Graw Hill, 2024.

2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

	CYBER SECURITY	L	T	P	C
		3	0	0	3

Course Objectives: The aim of the course is to

- identify security risks and take preventive steps
- understand the forensics fundamentals
- understand the evidence capturing process
- understand the preservation of digital evidence

UNIT-I

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

UNIT-II

Tools and Methods : Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

UNIT-III

Cyber Crime Investigation: Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT-IV

Computer Forensics and Investigations: Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

UNIT-V

Cyber Crime Legal Perspectives: Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario.

Text Books:

1. Sunit Belapure Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY, 2011.
2. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

Reference Books:

1. Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hacking and Network Defence", Cengage, 2019.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
3. Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar "Cyber Security and Cyber Laws" , Cengage,2018.

E-Resources:

1. CERT-In Guidelines- http://www.cert-in.org.in/
2. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks [Online Course]
3. https://computersecurity.stanford.edu/free-online-videos [Free Online Videos]
4. Nickolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu License: Creative Commons BY-NC-SA.

	IOT LAB USING PYTHON	L	T	P	C
		0	0	3	1.5

Course Objectives: This Course focuses on hands-on IoT concepts such as sensing, actuation and communication. This Course focuses on Internet of Things (IoT) prototypes—including devices for sensing, actuation, processing, and communication—to help you develop skills and experiences. This Course focuses on real world applications of IoT.

Course Outcomes:
Upon successful completion of the course/Lab the students will be able to
- After the completion of the course, the students will be able design some IOT based prototypes.
- The student will able to learn about embedded OS used for IoT application.
- Able to learn about communication protocol of IoT.
- Develop knowledge of IoT hardware and software.
- Develop knowledge of sensors and actuators.
- Study of some real world IoT applications.

List of Experiments:
1. Setting up the Arduino Development Environment, connecting analog sensors to an Arduino Boarding and reading analog sensor data
2. Digital Input and Output reading using an Arduino board and Arduino Development Environment
3. Integrate an Arduino Board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi
4. Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language
5. Connect an R Pi Camera module to the Raspberry Pi and, using Python programming, capture still images and video
6.   Set up a TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication
7. Set up an MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol
8. Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send a Message from PC to R Pi via MQTT protocol. On receipt of the message, toggle the LED lights on the Arduino
9. Set up an account on a cloud service (such as Google / AWS or Azure). Set up a simple HTTP server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file
10. Develop a mobile application to view the images captured by the R Pi camera

Text Books:

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series,

Reference Books / Links:

1. Industrial Internet Reference Architecture - http://www.iiconsortium.org/IIRA.htm
2. World Economic Forum Report on Industrial Internet of Things - https://www.weforum.org/reports/industrial-internet-things
3. 50 Sensor Applications for a Smarter World - http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
4. Visualizing Data-Exploring and Explaining Data with the Processing Environment, By Ben Fry, Publisher: O'Reilly Media
5. Raspberry Pi Computer Architecture Essentials, by Andrew K Dennis
6. Getting Started with Arduino, M. Banzi, O Reilly Media
7. GSMA IoT Security Guidelines & Assessment - https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/

	MACHINE LEARNING WITH PYTHON LAB	**L**	**T**	**P**	**C**
		0	0	3	1.5

Course Objectives:
- To learn about computing central tendency measures and Data preprocessing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

Software Required: Python/R/Weka

Lab should cover the concepts studied in the course work, sample list of Experiments:

1. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion:

   Variance, Standard Deviation.

2. Apply the following Pre-processing techniques for a given dataset.

   a. Attribute selection   b. Handling Missing Values   c. Discretization

   d. Elimination of Outliers

3. Apply KNN algorithm for classification and regression

4. Demonstrate decision tree algorithm for a classification problem and perform   parameter tuning for better results

5. Demonstrate decision tree algorithm for a regression problem

6. Apply Random Forest algorithm for classification and regression

7. Demonstrate Naïve Bayes Classification algorithm.

8. Apply Support Vector algorithm for classification

9. Demonstrate simple linear regression algorithm for a regression problem

10. Apply Logistic regression algorithm for a classification problem

11. Demonstrate Multi-layer Perceptron algorithm for a classification problem

12. Implement the K-means algorithm and apply it to the data you selected. Evaluate

    performance by measuring the sum of the Euclidean distance of each example from

    its class center. Test the performance of the algorithm as a function of the parameters K.

13. Demonstrate the use of Fuzzy C-Means Clustering

14. Demonstrate the use of Expectation Maximization based clustering algorithm

OPEN ELECTIVES

	JAVA PROGRAMMING	L	T	P	C
	(OPEN ELECTIVES-I)	3	0	0	3

Course Objectives:
The learning objectives of this course are to:

- identify Java language components and how they work together in applications
- learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- learn how to extend Java classes with inheritance and dynamic binding and how to use exception handling in Java applications
- understand how to design applications with threads in Java
- understand how to use Java APIs for program development

UNIT I

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators. **Control Statements**: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator ?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this. **Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors. **Inheritance:** Introduction, Process of Inheritance, Types of

Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance. **Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT IV

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class. **Exception Handling:** Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.
Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java (Text Book 2)

UNIT V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.
Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread- Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads. **Java Database Connectivity:** Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface.
Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:
1) JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2) Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3) JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

References Books:
1) The complete Reference Java, 11th edition, Herbert Schildt, TMH
2) Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:
1) https://nptel.ac.in/courses/106/105/106105191/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

	OPERATING SYSTEMS	L	T	P	C
	(Open Electives-II)	3	0	0	3

Course Objectives:

The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

UNIT - I

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT - II

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT – III

Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT – IV Memory-Management Strategies: **Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping.** Virtual Memory Management: **Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.** Storage Management: **Overview of Mass Storage Structure, HDD Scheduling.**

UNIT - V

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File-System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Text Books:

1. Operating System Concepts, Silberschatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.
2. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson , 2016

Reference Books:

1. Operating Systems -Internals and Design Principles, Stallings W, 9th edition, Pearson, 2018
2. Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Edition, McGraw-Hill, 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/106/106/106106144/ http://peterindia.net/OperatingSystems.html

DATABASE MANAGEMENT SYSTEMS (Open Electives-III)	L	T	P	C
	3	0	0	3

Course Objectives:
The main objectives of the course is to

- Introduce database management systems and to give a good formal foundation on therelational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by coveringconceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Databaseindexing techniques and storage techniques

UNIT -I

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecturefor data independence; Database system structure, environment, Centralized and Client Serverarchitecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT -II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints)and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Databaseschema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT -III

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable andnon-updatable), relational set operations.

UNIT -IV

Schema Refinement (Normalization):Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF),Fifth Normal Form (5NF).

UNIT -V

Transaction Concept: Transaction State, ACID properties, Concurrent Executions,Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification,Storage, Recovery and Atomicity, Recovery algorithm.
Introduction to Indexing Techniques: B+ Trees, operations on B+Trees, Hash Based Indexing:

Text Books:

1) Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke,TMH (For Chapters 2, 3, 4)
2) Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

Reference Books:

1) Introduction to Database Systems, 8th edition, C J Date, Pearson.
2) Database Management System, 6th edition, Ramez Elmasri, Shamkant B. Navathe,Pearson
3) Database Principles Fundamentals of Design Implementation and Management, CorlosCoronel, Steven Morris, Peter Robb, Cengage Learning.

Web-Resources:

1) https://nptel.ac.in/courses/106/105/106105175/
2) https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672 820 22456_shared/overview

	COMPUTER NETWORKS	L	T	P	C
	(Open Electives-IV)	3	0	0	3

Course Objectives:
- To understand the different types of networks
- To discuss the software and hardware components of a network
- To develop an understanding the principles of computer networks.
- To familiarize with OSI model and the functions of layered structure.
- To explain networking protocols, algorithms and design perspectives.

Course Outcomes (CO): After completion of the course, students will be able to
- Identify the software and hardware components of a Computer network. (L1)
- Explain the functionality of each layer of a computer network. (L2)
- Identify and analyze flow control, congestion control, and routing issues. (L4)
- Analyze and interpret the functionality and effectiveness of the routing protocols. (L4)
- Choose the appropriate transport protocol based on the application requirements. (L3)

UNIT-I
Introduction: Types of Computer Networks, Broadband Access Networks, Mobile and Wireless Access Networks, Content Provider Networks, Transit networks, Enterprise Networks, Network technology from local to global, Personal Area Networks, Local Area Networks, Home Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network Protocols, Design Goals, Protocol Layering, Connections and Reliability, Service Primitives, The Relationship of Services to Protocols ,Reference Models, The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model and Protocols.

UNIT-II
The Data Link Layer: Guided Transmission Media, Persistent Storage, Twisted Pairs, Coaxial Cable, Power Lines, Fiber Optics, Data Link Layer Design Issues, Services Provided To The Network Layer, Framing Error Control, Flow Control, Error Detection And Correction, Error-Correcting Codes, Error-Detecting Codes, Elementary Data Link Protocols, Initial Simplifying Assumptions Basic Transmission And Receipt, Simplex Link-Layer Protocols, Improving Efficiency, Bidirectional Transmission, Multiple Frames In Flight, Examples Of Full-Duplex, Sliding Window Protocols, The Channel Allocation Problem, Static Channel Allocation, Assumptions For Dynamic Channel Allocation, Multiple Access Protocols, Aloha, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited-Contention Protocols, Wireless LAN Protocols, Ethernet, Classic Ethernet Physical Layer, Classic Ethernet Mac Sublayer Protocol, Ethernet Performance, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet,40- And 100-Gigabit Ethernet, Retrospective On Ethernet.

UNIT-III
The Network Layer: Network Layer Design Issues, Store-And-Forward Packet Switching, Services Provided To The Transport Layer, Implementation Of Connectionless Service, Implementation Of Connection-Oriented Service, Comparison Of Virtual-Circuit And Datagram Networks, Routing Algorithms In A Single Network, The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical

Routing Within a Network, Broadcast Routing, Multicast Routing, Anycast Routing, TrafficManagement at The Network Layer, The Need for Traffic Management: Congestion, Approaches To Traffic Management, Internetworking, Internetworks: An Overview, How Networks differ, Connecting Heterogeneous Networks, Connecting Endpoints Across Heterogeneous Networks, Internetwork Routing: Routing Across Multiple Networks Supporting Different Packet Sizes: Packet Fragmentation, The Network Layer In The Internet, The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF—An Interior Gateway Routing Protocol, BGP—The Exterior Gateway Routing Protocol, Internet Multicasting.

UNIT-IV

The Transport Layer: The Transport Service, Services Provided To The Upper Layers, Transport Service Primitives, Berkeley Sockets, An Example Of Socket Programming: An Internet File Server, Elements Of Transport Protocols, Addressing, Connection Establishment, Connection Release, Error Control And Flow Control, Multiplexing, Crash Recovery, Congestion Control, Desirable Bandwidth Allocation, Regulating The Sending Rate, Wireless Issues, The Internet Transport Protocols: UDP, Introduction To UDP, Remote Procedure Call, Real-Time Transport Protocols, The Internet Transport Protocols: TCP, Introduction To TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release.

UNIT-V

The Application Layer: Electronic Mail, Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, The World Wide Web, Architectural Overview, Static Web Objects, Dynamic Web Pages and Web Applications, HTTP and HTTPS, Web Privacy, Content Delivery, Content and Internet Traffic, Server Farms and Web Proxies, Content Delivery Networks, Peer-To-Peer Networks, Evolution of The Internet.

Textbook:
1. Andrew Tanenbaum, Feamster Wetherall, Computer Networks, 6th Edition, Global Edition.

Reference Books:
1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, McGraw Hill Publication, 2017.
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 6th edition, Pearson, 2019.
3. YouluZheng, ShakilAkthar, "Networks for Computer Scientists and Engineers", Oxford Publishers, 2016.

Online Learning Resources:
https://nptel.ac.in/courses/106105183/25
http://www.nptelvideos.in/2012/11/computer-networks.html https://nptel.ac.in/courses/106105183/

IV Year – I Semester	QUANTUM SCIENCE AND TECHNOLOGY	L	T	P	C
		3	0	0	3

Prerequisites: Basic Physics, Linear Algebra, and Introduction to Modern Physics

Course Objectives:
1. To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
2. To explore quantum computing and communication principles and technologies.
3. To understand the physical implementation and limitations of quantum systems.
4. To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
5. To familiarize students with the emerging trends in quantum technologies.

Course Outcomes:
After completing this course, students will be able to:
CO1. Explain core principles of quantum mechanics and their technological implications.
CO2. Analyze quantum phenomena like superposition and entanglement.
CO3. Apply mathematical tools to model and solve quantum systems.
CO4. Demonstrate understanding of quantum algorithms and quantum circuits.
CO5. Evaluate potential applications and challenges in quantum communication and sensing.

Unit 1: Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

Unit 2: Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

Unit 3: Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, and Shor's 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview)

Unit 4: Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise)

Unit 5: Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, D-Wave, IonQ, India's NQM; Ethical concerns and future prospects

Text Books:
1. **"Quantum Computation and Quantum Information"** by Michael A. Nielsen and Isaac L. Chuang
2. **"Quantum Mechanics: Concepts and Applications"** by Nouredine Zettili

Online Learning Resources:

1. https://nptel.ac.in/courses/104104082
2. https://nptel.ac.in/courses/115104096
3. https://nptel.ac.in/courses/122106034

B.Tech. – IV Year II Semester

S.No.	Category	Title	L	T	P	Credits
1	Internship & Project Work	Full semester Internship &Project Work	0	0	24	12