Course Title: Linear Algebra	***Course Code: CS510***
Credits (L:T:P): 3:1:0	***Contact Hours (L: T: P): 39:26:0***
Type of Course: Lecture, Tutorials	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Basic Mathematics

Course Outcomes: After completing this course, students should be able to:

CO-1	Represent linear equations and the solution techniques.
CO-2	Analyze and apply the linear combinations of vectors to subspace analysis.
CO-3	Apply and evaluate the dimensionality reduction techniques.

Unit No.	Course Content	No. of Hours
1	**Introduction to vectors:** Vectors and linear combinations, lengths and dot products, vectors and linear equations. Idea of elimination.	07
2	**Solving linear equations:** Elimination using matrices, rules for matrix operations, inverse matrices, LU factorization, transposes and permutations.	08
3	**Vector spaces and subspaces:** Vector space, solving for Ax = 0, Rank and row reduced form, solution to Ax = Independence basis and dimension, dimensions of the 4 subspaces.	08
4	**Orthogonality and Determinants:** Orthogonality of the 4 subspaces, projections, least square approximations, Eigen values and Eigen vectors	08
5	**Introduction to Eigen Values and Eigen Vectors:** Eigen values, Diagonalizing a matrix, symmetric matrices, positive define matrices, similar matrices, singular value decompositions, least square methods.	08

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1.	Gilbert Strang	Introduction to Linear Algebra	5th edition, Wellesley Cambridge Press,2016

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	David C Lay	Linear Algebra and its application	5thedition, Pearson 2016
2	Ron Larson	Elementary Linear Algebra	8th edition, Cengage Learning 2016
3	Jim Hefferon	Linear algebra	4th edition, 2020
4	Gilbert Strang	Linear Algebra and its Applications	4th edition,2016

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/111/106/111106051/
2	https://nptel.ac.in/courses/111/108/111108066/

Tutorials:

Sl. No	Topics	No. of Hours
1	Exercises on Vector representation	02
2	Exercises on linear combinations	02
3	Solving linear equations and applications	02
4	Solving linear equations using Elimination	02
5	Exercises on Vector spaces	02
6	Exercises on subspaces	02
7	Problems on Vector Projections	02
8	Problems on Orthogonality	02
9	Applications on Eigen values	02
10	Applications on SVD	02
11	Applications Least square methods	02
12	Solving Symmetric and positive define matrices	02
13	Lab Test / Event	

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	3	3	3	3	2	1	2	1	0	0	3	2	2	1
CO-2	2	3	2	2	1	3	2	2	1	1	0	0	3	1	1	1
CO-3	2	3	2	2	2	1	2	1	1	-1	0	0	2	1	1	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course title: Software Engineering	***Course Code: CS520***
Credits(L:T:P):4:0:0	***Contact Hours(L: T: P): 52:0:0***
Type of Course: Lecture	***Core/Elective: Professional Core Course***
CIE Marks: 50	***SEE Marks:100***

Pre-requisite: Nil

Course Outcomes: After completion of the course, students are able to:

CO-1	Explore the concepts of software process models
CO-2	Analyze and model software requirements
CO-3	Apprise system design concepts and process
CO-4	Apprehend and apply software testing strategies
CO-5	Comprehend software project management activities

Unit No.	Course Content	No. of Hours
1.	**Software Process and Agile Development** The Nature of Software, The software Process, Software Engineering Practice, A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Agile development: Agility, agile process and principles, Extreme programming.	9
2.	**Requirement Analysis and Specification** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements, Requirements Analysis.	9
3.	**Software Design** Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model, Software Architecture, Architectural Styles, Architectural design, Component Concepts, Designing Class-Based Components.	12
4.	**Software Testing** Introduction to Quality, Software Quality, A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing, The Art of Debugging, Software Testing Fundamentals, White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.	12
5.	**Project Management** The management spectrum: The People, The Product and The Process. The project planning process, Project resources, Software Project Estimation, Decomposition techniques, Empirical Estimation Models. Project Scheduling: Basic concepts and Principles**,** Defining a task network, Scheduling.	10

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1.	Roger S Pressman	Software Engineering-A Practitioners approach	8th edition, McGraw-Hill Publication, 2017.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1.	Pankaj Jalote	An Integrated Approach to Software Engineering	3rd edition, 2019 Reprint, Narosa Publications.
2.	Ian Sommerville	Software Engineering	10th edition, Person Education Ltd, 2016.
3	Rajib Mall	Fundamentals of Software Engineering	4th edition PHI Publications, 2014.
4.	Hitesh Mohapatra, Amiya Kumar Rath	Fundamentals of Software Engineering	BPB Publications 2010.

Web Resources:

Sl. No.	Web link
1	http://nptel.ac.in/courses/106101061
2	https://nptel.ac.in/courses/106/105/106105182/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	2	1	1	1	2	2	1	2	3	2	2	2
CO-2	2	3	2	3	2	1	1	1	3	3	1	3	3	2	2	2
CO-3	2	2	3	2	2	1	1	1	2	3	1	3	3	2	2	2
CO-4	2	2	2	2	3	1	1	1	3	3	1	3	3	2	3	2
CO-5	2	2	2	2	2	1	1	1	2	3	1	3	3	1	3	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Database Systems	***Course Code: CS530***
Credits (L:T:P): 4:0:0	***Contact Hours(L:T:P): 52:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Data structures and algorithms.

Course Outcomes: After completing this course, students should be able to:

CO-1	Understand the fundamental concepts of database system environment.
CO-2	Implement a database schema for a given problem specifications and user-requirements.
CO-3	Use SQL language to create, populate, maintain, and query a database.
CO-4	Apply normalization theory to validate and revise the logical database design.
CO-5	Design and build a simple database system in line with transaction properties.

Unit No.	Course Content	No. of Hours
1	**Introduction to Database Concepts and Architecture:** Introduction; An example; Characteristics of Database approach; Database users, Advantages of using DBMS approach, Data models, schema and instances, Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of DBMS.	10
2	**Data Modeling Using the Entity-Relationship (ER) Model:** Using High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions, and Design Issues, Relationship Types of Degree Higher than Two, Relational Database Design Using ER-to-Relational Mapping **The Relational Data Model and Relational Database Constraints**: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations,	11
3	**The Relational Algebra:** Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations: Generalized Projection, Aggregate Functions and Grouping, OUTER JOIN Operations, Examples of Queries in Relational Algebra Basic SQL**:**SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, More Complex SQL retrieval Queries, Specifying Constraints as Assertions and Actions as Triggers, Views (Virtual Tables) in SQL.	11

4	**Database Design Theory and Normalization:** Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form, Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions	10
5	**Transaction Processing, Concurrency Control, and Recovery:** Introduction to Transaction Processing, Transactions, Database Items, Read and Write Operations and DBMS Buffers, Why Concurrency Control is Needed, Why Recovery Is Needed, Desirable Properties of Transactions, Two-Phase Locking Techniques for Concurrency Control	10

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Ramez Elmasri and Shamkant B. Navathe	Fundamentals of Database Systems	7th Edition, Pearson Education, 2016.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Raghu Ramakrishnan and Johannes Gehrke	Database Management Systems	3rd Edition, McGraw-Hill, 2015.
2	Silberschatz, Korth and Sudharshan	Data base System Concepts	6th Edition, Mc-GrawHill, 2016.
3	C.J. Date, A. Kannan, S. Swamynatham	An Introduction to Database Systems	8th Edition, Pearson Education, 2016.
4	Coronel, Morris, and Rob	Database Principles Fundamentals of Design, Implementation and Management	Cengage Learning 2012

Web Resources:

Sl. No.	Web link
1	http://nptel.ac.in/courses/106106093/
2	https://nptel.ac.in/courses/106/104/106104135/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	2	1	1	1	1	1	1	1	3	0	2	2
CO-2	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-3	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-4	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-5	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2

Course title: Computer Network	***Course Code: CS540***
Credits (L: T:P): 4:0:0	***Contact Hours (L: T: P): 52:0:0***
Type of Course: Lecture	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Data Communication.

Course Outcomes: After completion of the course, students are able to:

CO-1	Analyze the concept of virtual circuits and datagrams with real life scenarios.
CO-2	Design Routing algorithms and Congestion control policies.
CO-3	Apply TCP and UDP service primitives for creating new applications.
CO-4	Analyze different protocols and applications.
CO-5	Establish the need of Network security and related issues.

Unit No.	Course Content	No. of Hours
1.	**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 Subnets. **Routing algorithms:** The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Ad Hoc Networks	10
2.	**Congestion control algorithms:** Approaches to congestion control, Traffic Aware Routing, Admission Control, Traffic Throttling, Load Shedding, **Quality of Service:** Application Requirements, Traffic Shaping, Packet Scheduling, Admission Control, Integrated Services, Differentiated Services. **Internetworking:** How networks differ, How Networks can be connected, Tunneling, Internetwork Routing, Packet fragmentation.	12
3.	**The Network Layer in the Internet:** The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, OSPF, BGP, Internet Multicasting, Mobile IP. **Transport Layer:** The Transport Service: Services provided to the upper layers, Transport Service Primitives, Berkeley Sockets, **Elements of Transport Protocols:** Addressing, Connection establishment, Connection release, Error Control & Flow control Multiplexing and Crash recovery. Simple transport protocol, UDP, Remote Procedure Call, Real Time Transport Protocol,	10
4.	**The Internet Transport Protocols:** TCP, TCP service Model, TCP Protocol, TCP segment Header, TCP connection establishment, TCP connection release, TCP connection management, Transmission policy, Sliding window, Timer management, TCP congestion control, **The Application Layer**: DNS: The DNS Name Space, Resource Records, Name Servers. **Electronic Mail:** Architecture and Services, The User agent,	10

	message formats, message transfer, final delivery, **WWW:** Architectural overview, static web documents, dynamic web documents, HTTP	
5.	**Streaming Audio and Video:** Digital Audio, Digital Video, Streaming Stored Media, Streaming Live Media, Real Time Conferencing. **Network Security: Cryptography:** Introduction to cryptography, **Public Key Algorithm:** RSA **Communication Security:** IPsec, Firewalls, Virtual Private Networks, Wireless Security.	10

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Andrew S Tanenbaum, David J Wetherall,	Computer Networks	Fifth Edition, PHI/Pearson Publication, 2011

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Alberto Leon-Garcia and Indra Widjaja	Communication Networks – Fundamental Concepts and Key architectures,	2nd Edition Tata McGraw-Hill, 2004.
2	William Stallings	Data and Computer Communication	8th edition, PHI,2007
3	Behrouz A Forouzan	Data Communications and Networking	5th edition, Tata McGraw Hill,2013
4	James F. Kurose and Keith W. Ross	Computer Networking	7th Edition, Pearson, 2017

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106/105/106105081/
2	https://onlinecourses.swayam2.ac.in/cec19_cs07/preview

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	2	2	1	1	2	2	2	2	3	3	1	2
CO-2	3	2	2	2	2	2	1	1	2	2	2	2	2	3	1	2
CO-3	3	2	2	2	2	2	1	1	2	2	2	2	2	2	1	2
CO-4	3	2	2	2	2	2	1	1	2	2	2	2	2	2	1	2
CO-5	3	2	2	2	2	2	1	1	2	2	2	2	2	2	1	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Microprocessors and Microcontrollers	***Course Code: CS551***
Credits (L:T:P): 3:0:1	***Contact Hours (L: T: P): 39:0:26***
Type of Course: Lecture, Practical	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Computer Organization and Architecture.

Course Outcomes: After completing this course, students should be able to:

CO-1	Comprehend the architectural features and instructions of 8086 microprocessor.
CO-2	Apply the knowledge of assembly language programming for different applications.
CO-3	Demonstrate use of interrupt function calls and 8255 for interfacing hardware devices with 8086 microprocessors.
CO-4	Realize the architectural features and instructions of ARM microcontroller

Unit No.	Course Content	No. of Hours
1	**The Processors:8086-Architecture, Pin Diagrams and Timing Diagrams:** 8086 Microprocessor Family – An Overview, Register Organization of 8086, Architecture, Signal Descriptions of 8086, Physical Memory Organization, General Bus Operation, I/O Address Capability, Special Processor Activities, Minimum and Maximum Mode 8086 System and Timings.	08
2	**8086 Instruction Descriptions and Assembler Directives:** Instruction formats, addressing modes, Instruction Set of 8086, Assembler directives and operators.	08
3	**The art of Assembly Language Programming with 8086:** A few machines level Programs, Machine coding the Programs, Programming with an Assembler, Assembly Language Example Programs. Interrupts and Interrupt service routines, Interrupt cycle of 8086, NMI, Maskable Interrupt (INTR), BIOS (Basic Input/Output System) and DOS (Disk Operating System) function calls.	08
4	**Interfacing:** Semiconductor Memory interfacing, Interfacing I/O Ports, PIO82C55 (Programmable Input – Output Port)	07
5	**ARM Embedded Systems:** The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software; ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table.	08

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	K M Bhurchandi, A K Ray	Advanced Microprocessors and Peripherals	3rd Edition, TMH, 2013
2	Andrew N Sloss, Dominic Symes and Chris Wright	ARM system developers guide	Elsevier,Morgan Kaufman publishers, 2008

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Barry B Brey	The Intel Microprocessors	8th Edition, Pearson Education, 2009
2	K. Udaya Kumar & B.S. Umashankar	Advanced Microprocessors & IBM-PC Assembly Language Programming	TMH, 2017
3	Raghunandan G.H	Microcontroller (ARM) and Embedded System	Cengage learning Publication,2019
4	Steve Furber	ARM System-on-Chip Architecture	2nd, Pearson, 2015

Web Resources:

Sl. No.	Web link
1	https://swayam.gov.in/nd1_noc20_ee42/preview
2	https://nptel.ac.in/courses/108/105/108105102/

Lab Exercises:

Lab Session No.	Course Content
1	Write assembly program to find the sum and average of 'N' 8/16-bit hexadecimal numbers considering the carry. Write assembly program to add two 32-bit hexadecimal numbers. Write assembly program to sort a given set of N numbers in ascending and descending order using Bubble sort technique Write assembly program to perform • 32-bit X 16-bit number multiplication • 32-bit X 32-bit number multiplication
2	Write assembly program to find the largest number from a given set of N unordered 8/16 bit numbers. Write assembly program to find the presence of a key element in an unordered and unsigned array of 8/16 bit numbers. Store FFH in LOC if key is present else store 00 in LOC. Use • Linear search

	• Binary search Write assembly program to generate Fibonacci series up to N terms.
3	Write assembly program to add 'N' • 8-bit BCD numbers considering carry. • 16-bit BCD numbers considering carry Write assembly program to count the number of odd and even numbers in an array. Also store all the odd numbers in a separate array called ODDARRAY and all the even numbers in an array called EVENARRAY. Write assembly program to find the ASCII value of 8-bit hexadecimal value with and without using lookup table.
4	Write assembly programs to to read a string from keyboard, reverse the string, check the string is palindrome or not, search for the key presence in the string and display the position of the key, change uppercase to lowercase and vice versa, compare two strings, search substring in main string.
5	Write assembly programs to exercise DOS and BIOS interrupts: display system date, system time, simulate up/down counter, move the cursor to specified location.
6	Write assembly programs to handle file system: create a new file, delete existing file, copy one file to another
7	Write assembly programs using procedures and macros of modular approach.
8	Write assembly programs to solve specific problems using recursion; Factorial, Sum of natural numbers, Fibonacci series
9	Hardware interface programs to interface logic controller.
10	Hardware interface programs to interface stepper motor.
11	Hardware interface programs to interface 7-segment display and keyboard.
12	Hardware interface programs to interface keyboard.
13	**Lab Test/Event**

Course Outcomes	**Program Outcomes**												**PSO's**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	3	2	2	2	2	0	0	2	1	0	2	3	2	1	1
CO-2	3	3	2	2	2	2	0	0	2	1	0	2	3	2	1	1
CO-3	3	3	2	2	2	2	1	0	2	1	1	2	3	2	1	1
CO-4	3	3	2	2	2	2	1	1	2	1	1	2	3	2	1	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Image Processing	***Course Code: CS552***
Credits (L:T:P): 3:0:1	***Contact Hours (L: T: P): 39:0:26***
Type of Course: Lecture, Practical	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Basic mathematics, programming knowledge.

Course Outcomes: After completing this course, students should be able to:

CO-1	Understand, comprehend and appreciate the fundamental operations of digital image processing.
CO-2	Apply and analyze the effects of fundamental operations on digital images.
CO-3	Design and develop real world applications which uses digital images.

Unit No.	Course Content	No. of Hours
1.	**Introduction:** Digital Image Processing, The Origins of Digital Image Processing, Examples of Fields that Use Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Mathematical tools used in digital image processing.	08
2.	**Image Enhancement in the Spatial Domain:** Basic Gray Level Transformations: Image negatives, Log transformations, Power-Law transformations, Piecewise linear transformations, Histogram Processing: Histogram Equalization, Histogram Specification/Matching, Local Histogram processing, Histogram statistics for image enhancement, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	08
3	**Color Image Processing:** Color fundamentals, Color models, CMY, CMYK, HIS, Pseudo color Image Processing, Full color Image processing.	07
4.	**Morphological Image Processing and Image Segmentation:** Erosion and Dilation, opening and closing, Hit-or-Miss transformations, Basic morphological algorithms: Boundary extraction, Hole filling, Extraction of connected components, Convex Hull, Thinning, Thickening, Skeletons, and Pruning.	08
5.	**Image Segmentation:** Point, Line and Edge detection, Detection of discontinues, edge linking and boundary detection, Gradient operators in edge detection, holding, region –based segmentation	08

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Rafael C Gonzalez and Richard E Woods	Digital Image Processing	Pearson Education, 4th edition, 2017

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Wiley Vipul Singh,	Digital Image Processing with Matlab & LabView,	Reed Elsevier India Pvt Ltd, 2013
2	William K Pratt,	Digital Image Processing PIKS Scientific Inside,	4th Edition, Wiely Publication
3	Ralph Gonzalez, Richard Woods, Steven Eddins	Digital Image Processing Using MATLAB	McGraw Hill Education, 2017
4	Anil K Jain	Fundamental of Digital Image Processing,	Prentice Hall of India, 2004.

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106/105/106105032/
2	https://nptel.ac.in/courses/117/105/117105079/

Lab Exercises:

1.	Exploring Image processing packages in Matlab / Python/ Opencv
2.	Simple programs to understand reading and writing images.
3.	a. Program to enhance image using image arithmetic and logical operations b. Program for an image enhancement using pixel operation.
4.	a. Program for gray level slicing with and without background b. Program for image enhancement using histogram equalization c. Program to filter an image using averaging low pass filter in spatial domain and median filter
5.	a. Program to sharpen an image using 2-D Laplacian high pass filter in spatial domain. b. Program for detecting edges in an image using Roberts cross gradient operator and sobel operator.
6.	a. To create a vision program for Non-Linear Filtering technique using edge detection b. To create a vision program to determine the edge detection of an image using different operators.

7.	Programs for illustrating color image processing- converting RGB to Grey scale, RGB to HSV
8.	Programs for morphological image operations-Erosion, Dilation, Opening, Closing,
9.	Programs for morphological image operations-Thinning, Thickening, Skeletons and Pruning
10	Programs for Boundary extraction, Hole filling, Extraction of connected components
11	To create programs for segmentation of an image: To detect lines, edges.
12	To create programs for segmentation of an image: To detect boundaries.
13	**Lab Test/Event**

Course Outcomes	**Program Outcomes**												**PSO's**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	3	3	2	3	2	1	1	0	1	0	2	3	3	3	3
CO-2	3	3	3	2	3	2	1	1	0	1	0	2	3	3	3	3
CO-3	3	3	3	2	3	2	1	1	0	1	0	2	3	3	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Advanced Data Structures and Algorithms	***Course Code: CS553***
Credits (L:T:P): 3:0:1	***Contact Hours(L:T:P): 39:0:26***
Type of Course: Lecture, Practical	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Data Structures, Design and Analysis of Algorithms

Course Outcomes: After completing this course, students should be able to:

CO-1	Analyse the problem domain, use mathematical analysis model to estimate the running time efficiency of different algorithms
CO-2	Choose appropriate data structures and suitable design technique for developing efficient algorithms.
CO-3	Implement and analyse different algorithms for solving various problems

Unit No.	Course Content	No. of Hours
1.	**Review of Analysis Techniques:** Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, accounting and Potential Methods.	08
2.	**Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.	07
3	**Number -Theoretic Algorithms:** Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization.	08
4.	**String-Matching Algorithms:** Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.	08
5.	**Probabilistic and Randomized Algorithms:** Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.	08

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	T. H Cormen, C ELeiserson, R L Rivest and C Stein	Introduction to Algorithms	3rd Edition,Prentice-Hall of India, 2010

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Ellis Horowitz and Sartaj Sahni	Fundamentals of Data Structures in C	2nd edition, Universities Press,2014
2	Marks Allen Weiss	Data Structures and Algorithm Analysis in C++	3rd Edition, Pearson,2017
3	Anany Levitin	Introduction to the Design and Analysis of Algorithms	3rd Edition, Pearson,2017
4	Kenneth A. Berman, Jerome L. Paul	Algorithms	Cengage Learning, 2002.

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106/102/106102064/
2	https://www.youtube.com/playlist?reload=9&list=PL3pGy4HtqwD02GVgM96-V0sq4_DSinqvf

Lab exercises:

1.	Implementing algorithms for solving different problems and performing average case, best case, worst case and amortized analysis
2.	Implementation and analysis of DFT algorithm
3.	Implementation and analysis of FFT algorithm
4.	Implementation and analysis of RSA algorithm
5.	Implementation and analysis of Chinese remainder theorem algorithm
6.	Primality testing algorithms.
7.	Implementation and analysis of Rabin – Karp string matching algorithm
8.	Implementation and analysis of Knuth-Morris-Pratt string matching algorithm
9.	Implementation and analysis of Boyer – Moore string matching algorithm
10	Implementation and analysis of Probabilistic algorithms
11	Implementation and analysis of Monte Carlo
12	Implementation and analysis of Las Vegas algorithms
13	**Lab Test/Event**

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	3	2	1	1	0	1	0	2	3	3	3	3
CO-2	3	2	2	2	3	2	1	1	0	1	0	2	3	3	3	3
CO-3	3	2	2	2	3	2	1	1	0	1	0	2	3	3	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Web Technologies	***Course Code: CS554***
Credits (L: T: P): 3:0:1	***Contact Hours (L: T: P): 39:0:26***
Type of Course: Lecture, Practical	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Basics of OOPS with Java, Networks.

Course Outcomes: After completing this course, students should be able to:

CO-1	Design web pages using XHTML and CSS.
CO-2	Develop dynamic web pages using JavaScript.
CO-3	Build web applications using PHP.
CO-4	Implement a web-enabled information storage and retrieval system using PHP and MySQL.

Unit No.	Course Content	No. of Hours
1	**Fundamentals of Internet and Introduction to XHTML:** Introduction, URLs, MIME, HTTP, Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, list, table, images, frames, forms.	08
2	**Cascading Style Sheets:** Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags.	08
3	**Dynamic XHTML using JavaScript:** Overview of JavaScript, Object orientation and JavaScript, General Syntactic Characteristics, Primitives, Operations and Expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors, Pattern matching using regular expressions.	08
4	**Introduction to PHP:** Origins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, operations and expressions, Output, Control statements, Arrays, Functions, Pattern matching, Form handling, Files, Cookies, Session tracking.	08
5	**Database Access through the Web**: Relational Databases, Introduction to Structured Query Language. Architecture for Database access, The MySQL Database system, Database access with PHP and MySQL, Database Access with JDBC and MySQL.	07

Text Book:

Sl. No.	Author/s	Title	Publisher Details
1	Robert W. Sebesta	Programming the World Wide Web	8th Edition, Pearson education, 2015.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Randy Connolly, Ricardo Hoar	"Fundamentals of Web Development"	2nd Edition, Pearson Education India. 2017
2	Chris Bates	Web Programming Building Internet Applications	3rd Edition, Wiley India, 2009
3	Instructional Software Research and Development (ISRD) Group	Internet Technology and Web Design	Tata McGraw Hill, 2011
4	Jeffrey C. Jackson	Web Technologies- A Computer Science Perspective	Pearson Education, Eleventh Impression, 2012.

Web Resources:

Sl. No.	Web link
1	http://nptel.ac.in/courses/106105084/
2	https://nptel.ac.in/courses/106/106/106106156/

Lab exercises:

Week	List of Programs
1	Design web pages for your institute containing a description of the courses, departments, faculties, library etc, use href, list tags and add college image as a background picture for home page. Also create and display class timetable using table tag. Use additional features like spanning rows, columns and table borders.
2	a) Create a form to collect Student feedback. (Use textbox, text area, checkbox, radio button, select box etc.). b) Create a web page using frame. Divide the page into two parts with Navigation links on left hand side of page (width=20%) and content page on right hand side of page (width = 80%). On clicking the navigation Links corresponding content must be shown on the right-hand side.
3	a) Create a web page using frame. Divide the page into two parts with Navigation links on left hand side of page (width=20%) and content page on right hand side of page (width = 80%). On clicking the navigation Links corresponding content must be shown on the right-hand side. b) Write html code to develop a webpage having two frames that divide the webpage into two equal rows and then divide the row into equal columns fill each frame with a different background color
4	Create your resume using HTML tags also experiment with colors, text (Bold, italic and different headings), image, link, size and also other tags.
5	Design a web page using CSS with suitable design for the following: a. Demonstrate different font styles b. Control the repetition of image with background-repeat property c. Define style for links as a: link, a: active, a: hover, a: visited

	d. Demonstrate Element visibility property.
6	a) Design a web page of your institute (week-1) with an attractive background color, text color, an Image, font etc. (use internal CSS). Use External CSS to format the class timetable. b) Use External, Internal, and Inline CSS to format resume that you created in (week-4)
7	a) Develop simple calculator for addition, subtraction, multiplication and division operation using JavaScript. b) Create HTML Page that contains form with fields Name, Email, Mobile No, Gender, Favorite Color and a button. Write a JavaScript code to validate all the fields when the button is clicked, later combine and display the information in textbox.
8	Write an XHTML document which displays a form containing text elements to input register number, sub-code, marks in three tests and a button element. Also write java script code to compute average of two better tests on click of button and print average marks using alert. Validate all the fields using JavaScript.
9	Write an XHTML and java script to validate the following fields in a registration page a. User ID (must be of length 5 to 12) b. Name (only alphabets and the length should not be less than 15 characters) c. Password (must be eight characters including one uppercase letter, one special character and alphanumeric characters) d. E-mail (should not contain invalid addresses)
10	a) Write a PHP program to display today's date in dd-mm-yyyy format. b) Write a PHP program to check whether the number is prime or not when user input a valid number from client side.
11	Create HTML page that contain textbox, submit / reset button. Write PHP program to display this information and also store into text file.
12	Write a PHP Script for login authentication. Design an html form which takes username and password from user and validate against stored username and password in file.
13	**Lab Test/Event**

Course Outcomes	**Program Outcomes**												**PSO's**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	2	1	2	0	3	1	0	0	2	1	2	3	2	3	2	2
CO-2	2	1	3	0	3	1	2	0	2	2	2	3	2	3	2	2
CO-3	2	1	2	0	3	2	0	0	2	2	2	3	3	3	2	2
CO-4	3	2	3	2	3	2	2	0	3	1	3	3	3	3	2	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Advanced JAVA	***Course Code: CS555***
Credits (L:T:P): 3:0:1	***Contact Hours(L:T:P): 39:0:26***
Type of Course: Lecture, Practical	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: JAVA Programming.

Course Outcomes: After completing this course, students should be able to:

CO-1	Utilize Collection framework, Networks and develop Socket programming.
CO-2	Design applications using AWT and Swing components with event handling.
CO-3	Develop programs to perform transactions on databases.
CO-4	Use JSP to add Dynamic contents, data requests, handling and Session tracking.
CO-5	Develop a Simple Client/Server Application using RMI and utilize its methods of JNI.

Unit No.	Course Content	No. of Hours
1	**Collections and Networking:** *Collections:* Introduction to the Collection framework (Interfaces, Implementation and algorithms), Interfaces, collection classes: Set, List, Queue and Map, set: HashSet, TreeSet, and Linked HashSet, Interfaces such as Lists, Set, Vectors, LinkedList, Comparator, Iterator, hash tables. *Networking:* The java.net package, Connection oriented transmission – Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example.	08
2	**User Interface Components with AWT and Swing:** Introduction to AWT and Swing, AWT vs. Swing, The MVC Architecture and Swing, Layout Manager and Layouts, The JComponent class. Components - Buttons and Labels, Checkboxes and Radio Buttons, Lists and Combo Boxes along with the JScrollPane Class, Menu Classes, Scrollbars and Sliders, Dialogs and options, Event Handling: Event sources, Listeners, Adapters, Anonymous class.	08
3	**Database Programming:** The design of jdbc, jdbc configuration, Types of drivers, Executing sql statements, query execution, Scrollable and updatable result sets, rowset, Metadata, transactions.	08
4	**JSP and Servlet:** Getting Familiar with *JSP* Server, First JSP, Adding Dynamic contents via expressions, Scriptlets, Mixing Scriptlets and HTML, Directives, Declaration, Tags and Session. Introduction to *Servlet* (HTTP Servlet), Life Cycle of servlet, handling *get* and *post* request (HTTP), Data handling using servlet, Creating and cookies, Session tracking using HTTP servlet.	08

5	**Java Bean and RMI:** Introduction to Java Bean Components, Rules and Simple applications, Introduction to Remote Method Invocation with RMI Architecture, A Simple Client/Server Application using RMI	07

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Herbert Schildt	Java: The Complete Reference	11th Edition, by, December 2018 Release, Tata McGraw Hill, ISBN: 9781260440232
2	Steven Horlzner	Java 2, Swings, Servlets, JDBC and Java Beans Programming	Black book, First Edition, 2000. ISBN-13: 978-8177220568

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Jim Keogh	J2EE: The complete Reference	Paperback – 1 July 2017, Tata McGraw Hill
2	Kathy Sierra, Bert Bates	Head First Java	2nd Edition, O 'Reilly Publication.
3	Cay S. Horstmann, Gary Cornell	Core Java Volume-II-Advanced Features	Eighth Edition, Prentice Hall, Sun Microsystems Press.
4	Kogent Solution Inc.,	Java 6 Programming	Black Book, New Edition, Reprint 2009, Published by Dreamtech Press, New Delhi.

Web Resources:

Sl. No.	Web link
1	https://onlinecourses.nptel.ac.in/noc21_cs03/preview
2	https://www.youtube.com/watch?v=OEPaNB-X99Y

TENTATIVE LIST OF PROGRAMS FOR PRACTICAL SESSIONS:

Lab Session No.	Content
1 - 2	**Collections and Networking** Program to demonstrate "Collection Framework" (Interfaces, Implementation and algorithms) as follows: • Implement Vector class and its methods. • Implement searching/Sorting algorithms. • Create a doubly linked list and perform all possible operations. • Load names and phone numbers from a text file where the data is organized as one line per record and each field in a record are separated by tab(\t). It takes a name or phone number as input and prints the corresponding other value from the hash table (hint: use hash tables).
3 - 4	**User Interface Components with AWT and Swing** • Demonstrate Keyboard/Mouse event. • Demonstrate swing components using student registration form. • Present a set of choices for a user to select stationery products and Display the price of Product after selection from the list. • Develop an analog clock and a scientific calculator, using Swing features.
5 - 6	**Database Programming** • Demonstrate database connectivity using JDBC-ODBC drivers. • Insert data into Student DATABASE and retrieve info based on Particular queries (For example update, delete, search etc…). • Execute SQL queries, application using call back mechanism, to print the meta-data of a given table. • Execute a SQL statement with the Statement object, and returning a jdbc result Set. • Types of ResultSets, prepared statement with ResultSet, updatable result set.
7 - 8	**JSP and Servlet** • Implement a dynamic HTML using Servlet (username and Password should be accepted using HTML and displayed using a Servlet). • Create a servlet that uses Cookies to store the number of times a user has visited your servlet. • Auto Web Page Refresh (Consider a webpage which is displaying Date and time or stock market status. For all such types of pages, you would need to refresh your web page regularly; Java Servlet makes this job easy by providing refresh automatically after a given interval). • Remember user preferences using cookies. • Track HttpSession by accepting username and password using HTML and display the profile page on successful login. • Get student information through a HTML and create a JAVA Bean class, populate Bean and display the same information through another JSP. • Accept Registration Details from the user and store in a database table.
9 - 10	**Java Beanand RMI** • Create a simple java bean having bound and constrained properties.

	• Develop a Room Reservation System Application using Entity Beans. • Create Three-tier applications using Servlets, JSP, EJB. • Create a Remote Object for simple arithmetic operators. Use AWT/SWING to create user interface. • Develop a RMI application using a call back mechanism.
11	**Case Study**
12	**Lab Test/Event**

Course Outcomes	**Program Outcomes**												**PSO's**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	3	3	3	2	1	1	1	2	1	2	2	3	3	1	1
CO-2	3	3	3	2	2	1	1	1	2	1	2	2	3	3	1	1
CO-3	3	3	2	3	3	2	2	2	2	2	2	2	3	3	2	2
CO-4	3	2	3	3	3	2	2	2	2	2	2	2	3	3	2	2
CO-5	3	3	3	3	3	2	2	2	2	2	2	2	3	3	1	1

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Innovation, IP management and Entrepreneurship	***Course Code: CS561***
Credits (L:T:P): 3:0:0	***Contact Hours(L:T:P): 39:0:0***
Type of Course: Lecture	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: NIL

Course Outcomes: After completing this course, students should be able to:

CO-1	Develop skills and insights for evaluating, articulating, refining, and pitching a new product or service.
CO-2	Understand the process of filing IPR, patents and copyright.
CO-3	Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business.

Unit No.	Course Content	No. of Hours
1	**Introduction:** Creating new businesses, capturing new markets, enhancing organizational effectiveness occur through innovation, transforming processes - or both. New technologies, processes, competition and globalization compel entrepreneurs and existing firms to distance from the familiar and foster innovation and agility. Business model innovation, strategic leadership, human centered and design-driven innovation, knowledge and change management	08
2	**Intellectual Property Right**: Introduction and the need for IPR - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 Patents - Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps) and process. Copyrights: Nature of Copyright and Registration Procedure.	08
3	**Management:** Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art &Profession. **Planning:** Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making **Organizing and Staffing: Organization**-Meaning, Characteristics, Process	08

	of Organizing, Principles of Organizing, **Staffing**-Need and Importance**,** Recruitment and Selection Process	
4	**Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship **Family Business:** Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business	08
5	**Idea Generation and Feasibility Analysis-** Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Case Studies on Innovation, IP management and entrepreneurship.	07

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Schrage, Michael	The Innovator's Hypothesis	Boston: MIT Press; 2014
2	Nithyananda, K V	Intellectual Property Rights: Protection and Management.	Cengage Learning India Private Limited, 2019
3	P.C Tripathi, P.N Reddy	Principles of Management	McGraw Hill Education, 6th Edition, 2017.
4	Poornima M Charantimath	Entrepreneurship Development Small Business Enterprises	Pearson Education 2008

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Harold Koontz,Heinz Weihrich	Essentials of Management: An International, Innovation and Leadership perspective	McGraw Hill Education, 10th Edition 2016
2	Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd,	Entrepreneurship	Tata McGraw Hill Publishing Co.ltd 6th edition 2012

Web Resources:

Sl. No.	Web link
1	https://hbr.org/2015/06/innovation-isnt-the-answer-to-all-your-problems
2	https://nptel.ac.in/courses/110/106/110106141/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	3	3	2	3	2	2	3	2	3	2	2	2	2	3	3
CO-2	3	3	3	3	3	2	2	3	3	2	3	3	3	2	2	3
CO-3	3	3	2	3	3	3	2	3	3	3	3	3	3	3	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Block chain Technology	***Course Code: CS562***
Credits(L:T:P): 3:0:0	***Contact Hours (L: T: P): 39:0:0***
Type of Course: Lecture	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Data Structures

Course Outcomes: After completion of the course, students are able to:

CO-1	Understand the key concepts of block chain and basics of cryptography.
CO-2	Analyze the incentive structure in a block chain-based system and critically assess its functions, benefits and vulnerabilities.
CO-3	Comprehend various consensus models for different block chain applications.
CO-4	Develop smart contracts by using solidity programming language for block chain platform.
CO-5	Analyze the significance of Block chain governance and Block chain Adoption.

Unit No.	Course Content	No. of Hours
1	**Block chain Introduction:** What is block chain? Need for Distributed Records, Why Nakamoto Came up with Block chain based cryptocurrency? Categorization of block chain: Permission and permission less block chain, types of block chain: Public, Private and Hybrid block chain, Technologies Borrowed in Block chain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc., Applications of block chain	08
2	**Block chain Components:** Public key infrastructure, cryptographic hash functions, cryptographic nonce, transactions, key storage and exchange techniques, ledgers, creation of blocks, adding transactions into the blocks, address creation, chaining the blocks. Advantage and disadvantage of BC	08
3	**Consensus Models:** why do we require consensus? Types of consensus, proof of work, proof of stake, proof of authority and identity, delegated proof of stake(DPOS) and practical byzantine fault tolerance(PBFT), consensus comparison.	08
4	**Smart contracts and forking:** Need of Smart contracts, smart contracts life cycle, interacting with smart contracts: Solidity programming, Forking: soft forking and Hard forking	08
5	**Block chain limitation and misconception:** Immutability, 51% attack, user's involvement in BC governance, block chain death, cyber and network-based attack, malicious user, no trust, resource usage.	07

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1.	Dylan Yaga, Peter Mell, Nik Roby, Karen Scarfone	Blockchain Technology Overview	NIST publications, 2018.
2.	Josh Thompson	Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming	Create Space Independent Publishing Platform, 2017.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1.	S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan	Blockchain Technology: Cryptocurrency and Applications	Oxford University Press, 2019.
2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,	Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction	Princeton University Press (July 19, 2016).
3.	Kumar Saurabh, Ashutosh Saxena	Blockchain Technology: Concepts and Applications	Wiley; First Edition (9 September 2020); Wiley India Pvt Ltd. 1402, 14th Floor, World Trade Tower Plot No. C - 1, Sector – 16, Noida – 201301
4.	Andreas Antonopoulos and Andreas M. Antonopoulos	Mastering Bitcoin: Programming the Open Blockchain	Shroff/O'Reilly; Second edition (1 January 2017)

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106105184/
2	https://nptel.ac.in/courses/106104220/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	3	2	2	2	3	3	1	2	3	3	3	3
CO-2	3	3	3	3	2	2	2	2	2	2	1	3	3	3	3	3
CO-3	3	2	3	2	2	2	2	2	3	2	1	3	2	3	3	3
CO-4	3	3	3	3	3	2	2	2	2	3	1	3	3	3	3	3
CO-5	3	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3

Course Title: Design of Unix Operating System	***Course Code: CS563***
Credits (L:T:P): 3:0:0	***Contact Hours (L: T: P): 39:0:0***
Type of Course: Lecture	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Data structures

Course Outcomes: After completing this course, students should be able to:

CO-1	To familiarize with the concepts, design, and structure of the UNIX operating system.
CO-2	Understand the use of basic UNIX functionalities.
CO-3	Analyze the principles behind the UNIX operating system programming.

Unit No.	Course Content	No. of Hours
1	Introduction to the kernel: Architecture of the Unix operating system, introduction to the system concepts, kernel data structures system administration., The buffer cache: buffer header, structure of the buffer pool, scenarios for retrieval of a buffer, reading and writing disk block, advantages and disadvantages of the buffer cache	08
2	Internal Representation of Files: Inodes, Structure of a regular file, Directories, conversion of a path name to an inode, Super block, inode assignment to a new file, Allocation of disk blocks, other file types.	08
3	System Calls for the File System: Open, read, write, file and record locking, Adjusting the position of file I/O, lseek, close, file creation, creation of, special files, change directory and change root, change owner and change mode, stat and fstat, pipes, dup, mounting and unmounting file systems, link, unlink, file system maintenance.	08
4	The Structure of Processes: Process states and transitions, Layout of system memory, the context of a process, saving the context of a process, manipulation of the process address space, sleep.	08
5	Process control: process creation, signals, process termination, awaiting process termination. Process scheduling and time: process scheduling, system calls for time, clock	07

Text Book:

Sl. No.	Author/s	Title	Publisher Details
1	Maurice J. Bach	The Design of the Unix Operating System	**Pearson India, 1st Edition, January 2015.**

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Robert Love, O'Reilly	Linux System Programming	O'Reilly Media ,2nd edition 2013
2	Brian W. Kernighan and Rob Pike	The Unix programming Environment	2nd edition reprint, 2018
3	Daniel Pierre Bovet, Marco Cesati	Understanding the Linux Kernel	O'Reilly 2nd edition 2001
4	Grace Todino (Author), John Strang (Author), Jerry Peek (Author	Learning the UNIX Operating Syste	O'Reilly Media, 5thEdition,2002

Web Resources:

Sl. No.	Web link
1	https://www.digimat.in/nptel/courses/video/117106113/L01.html
2	http://www.infocobuild.com/education/audio-video-courses/computer-science/OperatingSystems-IIT-Delhi/lecture-01.html

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	1	3	1	3	1	1	1	2	2	2	1	2	3	3	2
CO-2	2	3	2	2	1	1	1	0	2	2	2	2	3	3	2	2
CO-3	2	3	2	2	1	1	1	1	2	2	2	3	2	3	1	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Optimization Techniques	***Course Code: CS564***
Credits (L:T:P): 3:0:0	***Contact Hours(L:T:P): 39:0:0***
Type of Course: Lecture	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Engineering Mathematics.

Course Outcomes: After completing this course, students should be able to:

CO-1	Interpret the mathematical formulations of Linear programming problems.
CO-2	Analyze the LP problems to apply optimal problem-solving techniques.
CO-3	Design and solve transportation and assignment problems for a given LP system.
CO-4	Apply various heuristic approaches and strategies to solve Decision and Game problem.

Unit No.	Course Content	No. of Hours
1	Introduction, Linear Programming Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation. Introduction to Linear Programming: Prototype example; The linear programming (LP) model. Assumptions of LP; Additional examples.	08
2	Simplex Method and Duality Theory: The essence of the simplex method; Setting up the simplex method; Algebra of the simplex method; The simplex method in tabular form; Tie breaking in the simplex method. Adapting to other model forms; The essence of sensitivity analysis; Applying sensitivity analysis. The essence of duality theory; Economic interpretation of duality. Primal dual relationship; Adapting to other primal forms. The role of duality in sensitive analysis; The dual simplex method;	08
3	Transportation and Assignment Problems: The transportation problem; A streamlined simplex method for the transportation problem; The assignment problem; A special algorithm for the assignment problem.	08
4	Game Theory, Decision Analysis Game Theory: The formulation of two persons, zero sum games; Solving simple games- a prototype example; Games with mixed strategies; Graphical solution procedure; Solving by linear programming, Extensions. Decision Analysis: A prototype example; Decision making without experimentation; Decision making with experimentation; Decision trees.	08
5	Meta heuristics The nature of Meta heuristics, Tabu Search, Simulated Annealing, Genetic Algorithms.	07

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Frederick S. Hillier and Gerald J. Lieberman	Introduction to Operations Research	Tata McGraw Hill, 10th Edition, 2015
2	S D Sharma, Himanshu Sharma	Operations Research	Kedar Nath Ram Nath, 2010.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Wayne L. Winston	Operations Research Applications and Algorithms	Thomson Course Technology, 4th Edition, 2003.
2	Hamdy A Taha	Operations Research: An Introduction	Pearson Education India, 8th Edition, 2013.
3	Edwin K. P. Chong & Stanislaw H. Zak	An Introduction to Optimization	Wiley India, 4th Edition, 2017
4	A. K. Malik , S. K. Yadav , S. R. Yadav	Optimization Techniques	I K International Publishing House Pvt. Ltd, 2013

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/112106134/
2	https://swayam.gov.in/nd1_noc19_ma29/preview

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	3	2	3	2	2	3	2	3	2	2	2	2	3	3
CO-2	3	3	3	3	3	2	2	3	3	2	3	3	3	2	2	3
CO-3	3	3	2	3	3	3	2	3	2	3	3	3	3	3	3	3
CO-4	2	2	2	2	3	3	3	2	3	3	3	3	2	2	3	3

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Principles of Programming Languages	***Course Code: CS565***
Credits (L:T:P): 3:0:0	***Contact Hours (L: T: P): 39:0:0***
Type of Course: Lecture	***Category: Professional Elective Course***
CIE Marks: 50	***SEE Marks: 100***

Pre-requisite: Nil

Course Outcomes: After completing this course, students should be able to:

CO-1	Comprehend and represent the real-world objects in programs.
CO-2	Analyze and apply suitable language for processing knowledge for various programming environments.
CO-3	Design and implement concurrency and synchronization for programming constructs.

Unit No.	Course Content	No. of Hours
1	Introduction: Names, Scopes, Bindings, Data Types: The art of language design; Programming language spectrum; why study programming languages? Compilation and interpretation; Programming environments. Names, scope, and bindings: The notion of binding time; Object lifetime and storage management; Scope rules; Implementing scope. The meaning of names within a scope; The binding of referencing environments;	08
2	Control Flow and Subroutine: Expression evaluation; Structured and unstructured flow; Sequencing; Selection; Iteration; Recursion; Non-determinacy Control Flow: Review of stack layout; Calling sequences; Parameter passing; Generic subroutines and modules; Exception handling; Co routines; Events.	08
3	Data Abstraction and Object Orientation: Object oriented programming; Encapsulation and Inheritance; Initialization and finalization; Dynamic method binding; Multiple inheritance; Object oriented programming revisited.	08
4	Functional Languages, and Logic Languages: Functional Languages: Origins; Concepts; A review/overview of scheme; Evaluation order revisited; Higher-order functions; Functional programming in perspective. Logic Languages: Concepts; Prolog; Logic programming in perspective.	08
5	Concurrency and Run time Program Management: Background and motivation; Concurrency programming fundamentals; Implementing synchronization; Language-level mechanisms; Message passing. Run time Programming: Virtual machines; Late binding of machine code; Inspection/introspection.	07

Text Book:

Sl. No	Author/s	Title	Publisher Details
1	Michael L. Scott	Programming Language Pragmatics	4th Edition, Elsevier,2016

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Ravi Sethi	Programming languages Concepts and Constructs	Pearson Education, reprint 2006
2	Allen Tucker, Robert Nonan	Programming Languages, Principles and Paradigms	2nd Edition, Tata McGraw-Hill, 2007
3	John C Mitchell	Concepts in Programming Languages	Cambridge University Press, 2003 ISBN:0521780985
4	Benjamin C. Pierce	Types and Programming Languages	The MIT Press, 2002 ISBN 0-262-16209-1

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106/102/106102067/
2	https://www.digimat.in/nptel/courses/video/106102067/L14.html

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	3	3	3	1	2	1	3	1	3	2	2	3	2	1	1
CO-2	3	3	3	1	2	1	1	3	2	2	3	2	3	2	1	1
CO-3	2	1	3	1	2	1	2	3	1	2	2	2	3	2	2	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Database Laboratory	***Course Code: CS57L***
Credits (L: T:P): 0:0:1.5	***Contact Hours (L: T: P): 0:0:39***
Type of Course: Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 50***

Pre-requisite: Data structures and Algorithms

Course Outcomes: After completing this course, students should be able to:

CO-1	Design and populate the database based on problem type.
CO-2	Demonstrate data manipulation operations for a database schema with integrity and key constraints.
CO-3	Analyze the normalization level given any schema design.
CO-4	Efficient retrieval and manipulation of database through procedures and functions.
CO-5	Select techniques and tools to design and implement a database suitable for any organization.

Lab Session No.	Content
1- 2	**Consider the schema for COMPANY Database:** EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo) DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate) DLOCATION (DNo,DLoc) PROJECT (PNo, PName, PLocation,DNo) WORKS_ON (SSN, PNo, Hours) **Write SQL queries for the following:** a) Make a list of all project numbers for projects that involve an employeewhose last name is 'Scott', either as a worker or as a manager of thedepartment that controls theproject. b) Show the resulting salaries if every employee working on the 'IoT' project isgiven a 10 percent raise. c) Find the sum of the salaries of all employees of the 'Accounts' department,as well as the maximum salary, the minimum salary, and the average salaryin this department d) Retrieve the name of each employee who works on all the projectscontrolled by department number 5 (use NOT EXISTS operator). For eachdepartment that has more than five employees, retrieve the departmentnumber and the number of its employees who are making more thanRs.6,00,000.
3 - 4	**Consider the following schema for a LIBRARY Database:** BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of_Copies)

	BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) **Write SQL queries for the following:** a) Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch,etc. b) Get the particulars of borrowers who have borrowed more than 3 books, but from Jan2017 to Jun2017. c) Delete a book in BOOK table. Update the contents of other tables to reflect this data Manipulationoperation. d) Partition the BOOK table based on year of publication. Demonstrate its working with asimplequery. e) Create a view of all books and its number of copies that are currently available in theLibrary.
5- 6	**Consider the following schema for ORDER Database:** SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City,Grade,Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id,Salesman_id) **Write SQL queries for the following:** a) Count the customers with grades above Bangalore'saverage. b) Find the name and numbers of all salesmen who had more than onecustomer. c) List all salesmen and indicate those who have and don't have customers in their cities (Use UNIONoperation.) d) Create a view that finds the salesman who has the customer with the highest order of a day. e) Demonstrate the DELETE operation by removing salesman with id 1000. All hisorders must also be deleted. **Allocation of Mini-Project**
7 - 8	**Consider the schema for MOVIE Database:** ACTOR (Act_id, Act_Name, Act_Gender) DIRECTOR (Dir_id, Dir_Name,Dir_Phone) MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang,Dir_id) MOVIE_CAST (Act_id, Mov_id, Role) RATING (Mov_id,Rev_Stars) **Write SQL queries for the following:** a) List the titles of all movies directed by'Hitchcock'. b) Find the movie names where one or more actors acted in two or moremovies. c) List all actors who acted in a movie before 2000 and also in a movieafter 2015 (use JOINoperation). d) Find the title of movies and number of stars for each movie that has atleast one rating and find the highest number of stars that movie received.Sort the result by movie title. e) Update rating of all movies directed by 'Steven Spielberg' to 5.
9 - 10	**Consider the schema for COLLEGE Database:**

	STUDENT (USN, SName, Address, Phone, Gender) SEMSEC (SSID, Sem, Sec) CLASS (USN, SSID) SUBJECT (Subcode, Title, Sem, Credits) IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) **Write SQL queries for the following:** a) List all the student details studying in fourth semester 'C'section. b) Compute the total number of male and female students in each semester and in each section. c) Create a view of Test1 marks of student USN '1BI15CS101' in allsubjects. d) Calculate the FinalIA (average of best two test marks) andupdate the corresponding table for allstudents. e) Categorize students based on thefollowingcriterion: ➢ If FinalIA = 17 to 20 thenCAT ='Outstanding' ➢ If FinalIA = 12 to 16 then CAT ='Average' ➢ If FinalIA< 12 then CAT ='Weak' Give these details only for 8th semester A, B, and C section students.
11 - 12	**Evaluation of Mini-Project**
13	**Lab Test/Event**

Text Book:

Sl. No.	Author/s	Title	Publisher Details
1	Ramez Elmasri and Shamkant B. Navathe	Fundamentals of Database Systems	7th Edition, Pearson Education, 2016.

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Raghu Ramakrishnan and Johannes Gehrke	Database Management Systems	3rd Edition, McGraw-Hill, 2015.
2	Silberschatz, Korth and Sudharshan	Data base System Concepts	6th Edition, Mc-GrawHill, 2016.
3	C.J. Date, A. Kannan, S. Swamynatham	An Introduction to Database Systems	8th Edition, Pearson Education, 2016.
4	Coronel, Morris, and Rob	Database Principles Fundamentals of Design, Implementation and Management	Cengage Learning 2012

Web Resources:

Sl. No.	Web link
1	http://nptel.ac.in/courses/106106093/
2	https://nptel.ac.in/courses/106/104/106104135/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	2	1	1	1	1	1	1	1	3	0	2	2
CO-2	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-3	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-4	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2
CO-5	3	3	3	2	3	2	1	1	1	1	1	2	3	0	2	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association

Course Title: Network Laboratory	***Course Code: CS58L***
Credits (L: T:P): 0:0:1.5	***Contact Hours (L: T: P): 0:0:39***
Type of Course: Practical	***Category: Professional Core Course***
CIE Marks: 50	***SEE Marks: 50***

Pre-requisite: Data Communication, Computer Networks.

Course Outcomes: After completion of the course, students are able to:

CO-1	Analyse and compare various networking protocols
CO-2	Demonstrate the working of different concepts of networking
CO-3	Implement, analyse and evaluate networking protocols in NS2 / NS3 and JAVA/Python programming language.

The Laboratory will consist of simulation experiments and experiments to be implemented using C++/ Java/ Python.

Lab Session No	Programs
PART-A: Implement the following using C++/Java/Python	
1	Write a program for error detecting code using CRC-CCITT (16- bits).
2	Write a program to find the shortest path between vertices using bellman-ford algorithm.
3	Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present.
4	Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.
5	Write a program for simple RSA algorithm to encrypt and decrypt the data.
6	Write a program for congestion control using leaky bucket algorithm.
PART-B: Simulation Experiments using NS2/ NS3/ NetSim or any other suitable simulation software	
7	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
8	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
9	Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination.
10	Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.

11	Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.
12	Implement and study the performance of CDMA on NS2/NS3 (Using stack called Call net) or equivalent environment.
13	**Lab Test/Event**

Text Books:

Sl. No.	Author/s	Title	Publisher Details
1	Andrew S Tanenbaum, David J Wetherall,	Computer Networks	Fifth Edition, PHI/Pearson Publication, 2011

Reference Books:

Sl. No.	Author/s	Title	Publisher Details
1	Alberto Leon-Garcia and Indra Widjaja	Communication Networks – Fundamental Concepts and Key architectures,	2nd Edition Tata McGraw-Hill, 2004.
2	William Stallings	Data and Computer Communication	8th edition, PHI,2007
3	Behrouz A Forouzan	Data Communications and Networking	5th edition, Tata McGraw Hill,2013
4	James F. Kurose and Keith W. Ross	Computer Networking	7th Edition, Pearson, 2017

Web Resources:

Sl. No.	Web link
1	https://nptel.ac.in/courses/106/105/106105081/
2	https://www.isi.edu/nsnam/ns/

Course Outcomes	Program Outcomes												PSO's			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P012	PSO1	PSO2	PSO3	PSO4
CO-1	3	2	2	2	2	2	1	1	2	2	2	2	3	3	1	2
CO-2	3	2	2	2	2	2	1	1	2	2	2	2	2	3	1	2
CO-3	3	2	2	2	2	2	1	1	2	2	2	2	2	2	1	2

0 -- No association 1---Low association, 2--- Moderate association, 3---High association