SEMESTER - V

Course Code:	UCSC0501		L	T	P	Credit
Course Name:	Database Engineering		3			3

Course Prerequsites

Data Structures

Course Description:

This course introduces database design and creation using a DBMS product. Emphasis is on data dictionaries, normalization, data integrity, data modelling, and creation of simple tables and queries. Upon completion, students should be able to design and implement normalized database structures by creating simple database tables and queries.

Course Outcomes:

CO1	Define basic functions and features of DBMS & RDBMS.
CO2	Apply normalization techniques on given database to assure data integrity and consistency.
CO3	Make use of SQL queries to implement user defined applications.
CO4	Interpret file organization, indexing and hashing techniques for faster and efficient system performance.
CO5	Distinguish transaction management and concurrency control methods for system reliability and security

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1 Introduction to Database — **8 Hours**

Purpose of Database Systems, View of Data, Data Models, Database Architecture, Roles in Database Environment, The Entity-Relationship Model, Entity-Relationship Diagrams, Reduction to Relational Schemas, Introduction to Relational Model, Relational Query Languages- The Relational Algebra

Unit 2 Relational Database Design — **5 Hours**

The purposes of Normalization, Data Redundancies and Update Anomalies, Functional Dependencies, The Process of Normalization, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form, Fifth Normal Form.

Unit 3 Relational Model and Structured Query Language — **7 Hours**

Structure of Relational Databases, SQL Data Definition Language, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database, Join Expressions, Views, Integrity Constraints, Accessing SQL from a Programming Language

Unit 4	File Structure, Indexing and Hashing	8 Hours
Overview of Physical Storage Media, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer. Basic Concepts of Indexing and Hashing, Ordered Indices, B+-Tree Index Files, B-Tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Bitmap Indices, Index Definition in SQL.		
Unit 5	**Transactions and Concurrency Control**	**7 Hours**
Transaction Concept, Simple Transaction Model, Serializability, Concurrency Control- Lock-Based Protocols, Two-phase locking protocols, Graph-based protocols, Multiple Granularity, Timestamp-Based Protocols,		
Unit 6	**Recovery System**	**5 Hours**
Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, checkpoint, Shadow paging, Failure with Loss of Non-volatile Storage, Remote Backup Systems		
Text Books:		
1. Database System Concept by Henry F. Korth, Abraham Silberschatz, Sudarshan (McGraw Hill Inc.) Sixth Edition. 2. Database Systems- A practical approach to Design, Implementation and Management by Thomos Connolly,		
Reference Books:		
1. Fundamentals of Database Systems – by Ramez Elmasri and Shamkant Navathe Publisher -Pearson Education, 5 th Edition. 2. Database Systems: Design, Implementation and management. - PeterRof, Carlos Coronel (7th Edition), Publisher - Cengage Learning. 3. Principles of Database Systems by J.D. Ullaman (Galgotia Publications).		

Course Code:	UCSC0502	L	T	P	Credit
Course Name:	Machine Learning	3			3

Course Prerequsites:

Discrete Mathematics, Mathematics for Computer Science, Probability and Statistics.

Course Description:

This course provides an introduction to machine learning and covers the key concepts, algorithms, and techniques used in the field. Topics include supervised and unsupervised learning, linear and logistic regression, decision trees, clustering, and neural networks. Emphasis is placed on both theoretical understanding and practical applications.

Course Outcomes: After the completion of the course the student should be able to –

CO1	Explain various concepts and terminology used in machine learning.
CO2	Explain the applications and limitations of different types of machine learning algorithms.
CO3	Analyze the different types of machine learning models.
CO4	Evaluate the performance of different machine learning algorithms.
CO5	Design custom machine learning algorithms to solve specific problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	Introduction to Machine Learning	7 Hours

Introduction to machine learning – definition, terminology. Types of machine learning – supervised learning, unsupervised learning, semi-supervised learning, reinforcement learning. Machine learning process. Performance metric in machine learning. Tools and frameworks. Data preprocessing (overview). Data visualization.

Unit 2	Regression	6 Hours

Simple linear regression – hypothesis, cost function, parameter learning with gradient descent, learning rate, gradient descent for linear regression, examples. Simple linear regression in matrix form. Multivariate linear regression – multiple features, hypothesis functions. Gradient descent for multiple variables, feature scaling, polynomial regression.

Unit 3	Classification – Logistic Regression & Neural Network	7 Hours

Logistic regression – definition, hypothesis representation, decision boundary, cost function, gradient descent for logistic regression. Multiclass classification. Regularization – overfitting & underfitting, cost function, regularized linear regression, regularized logistic Regression.
Neural networks – neuron representation and model, hypothesis for neuron, cost function, solution of a problem using single neuron, gradient descent for a neuron. Multiclass classification with neural network. Learning in neural networks – feedforward neural network, backpropagation algorithm. Loss function – support vector machines (SVMs), softmax regression.

Unit 4	Classification – Decision Trees and Naïve Bayes	8 Hours

Decision trees – definition, terminology, the need, advantages, and limitations. Constructing and understanding decision trees. Common problems with decision trees. Decision tree algorithms – ID3, CART, random forest, examples. Naïve Bayes classifier. Instance-based classifier – K–Nearest Neighbour classifier.

Unit 5	Unsupervised Learning and Reinforcement Learning	7 Hours

Unsupervised learning: Introduction to clustering, K Means clustering, Hierarchical clustering, Association rule mining. Introduction to reinforcement learning – Q learning.		
Unit 6	**Applications of Machine Learning**	**4 Hours**
Introduction to machine learning libraries, applications in structured data, applications in unstructured data – Image, Text, Speech.		
Text Books:		
1. Machine Learning with Python - an approach to applied ML, by Abhishek Vijayvargia, BPB publications 2. Practical Machine Learning by Sunila Gollapudi Packt Publishing Ltd 3. Machine Learning by Tom M. Mitchell, McGraw Hill Education; First edition		
Reference Books:		
1. Machine Learning for dummies John Paul Muller, Wiley Publication 2. Ethem Alpaydin - Introduction to Machine Learning, PHI 2nd Edition-2013 3. http://neuralnetworksanddeeplearning.com		
Note: *- The syllabus is subject to minor changes depending on how the course proceeds.* *- The inclusion of neural networks can be optional, depending on how the course progresses.*		

Course Code:	UCSC0503		L	T	P	Credit
Course Name:	Operating Systems		3			3

Course Prerequsites:

Fundamentals of Electronics and Computer

Course Description:

This is one of the core course of Computer Science & Engineering Programme. In this course you will become familiar with the core concepts of OS - how OS work, how a **processes & threads** are created, **inter-process communication & synchronisation**, the various **scheduling** algorithms, **memory management** & memory allocation strategies, etc. This course will be also helpful for exams like GATE.

Course Outcomes: After the completion of the course the student will be able to -

CO1	describe the basic concepts of operating systems.
CO2	evaluate the performance of various scheduling & page replacement algorithms.
CO3	distingush techniques of inter process communication and synchronization.
CO4	identify potential deadlock situations and propose appropriate strategies to handle or avoid deadlocks.
CO5	interpret internal representation of file and buffer cache management.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1 Introduction — **5 Hours**

Introduction to OS, OS Structure, Types of OS, OS Kernel, OS Services, Users Prespective of OS, System Boot Process, Architecture of UNIX OS

Unit 2 Process, Threads & Scheduling — **7 Hours**

Process: Concept, States and Transitions, Context, Creation (fork), Termination (exit), Signals (signal, kill), Awaiting Process Termination(wait, waitpid), Invoking other programs (exec), Threads (pthreads)
Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Unit 3 Synchronization and Communication (Process & Thread) — **8 Hours**

Inter-Process Communication - Pipe, Shared Memory, Message Passing
Inter-Process Synchronization: The Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classical Problems of Synchronization

Unit 4 Deadlocks — **5 Hours**

Deadlock: System Model; Deadlock Characterization; Methods for Handling Deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from Deadlock

Unit 5 Buffer Cache and Internal Representation of Files — **7 Hours**

Buffer Cache: Buffer Headers, Structure of the Buffer Pool, Scenarios for Retrieval of a Buffer, Reading and Writing Disk Blocks, Advantages and Disadvantages of Cache. Internal Representation of Files: I-nodes, Structure of a Regular File, Directories, Conversion of a pathname to i-node

Unit 6 Memory Management — **8 Hours**

Memory background, Hierarchy, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.
Text Books:
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8th edition, Wiley India, 2009. 2. The Design of Unix Operating System - Maurice J. Bach (PHI)
Reference Books:
1. Operating Systems –Concepts and design –Milan Milenkovic (TMGH) 2. Operating Systems: Internals and Design Principles (8th Edition)- by William Stallings (Pearson Education) 3. Modern Operating Systems by Andrew S. Tanenbaum (Pearson Education International) 4. Unix concepts and administration – 3rd Edition – Sumitabha Das (TMGH).

Course Code:	UCSC0504	L	T	P	Credit
Course Name:	Database Engineering Lab			2	1

Course Prerequsites:

Data Structures, Programming Language

Course Description:

This course is designed to develop SQL programming expertise. Upon completion, students should be able to write programs for database connectivity. Emphasis is on data definition, data manipulation, and data control statements.

Course Outcomes

After completion of the course, students shall be able to -

CO1	Design conceptual models of a database using ER modelling for real life applications and also construct queries in Relational Algebra
CO2	Apply Normalization to generate good database design
CO3	Develop a database for any specified domain according to well-known design principles

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	33%	Assignment, Test, Quiz, Seminar, Presentation,etc.
2	End Semester Examination (ESE)	67%	Practical Performance & Viva

Course Contents:

Assessment No. 1- Entity - Relationship Diagrams	**2 Hours**
Aim and Objectives: Draw ER diagrams for different organizations using any suitable software & Convert them into tables. Theoretical Background: Study of Entity-Relationship Diagrams, Reduction to Relational Schemas Experimentation: 1. Install Dia software 2. Use E-R sheet to draw E-R diagram. 3. Convert each E-R diagram to relational schema.	
Assessment No. 2 - Convert E-R Diagram in Relational Tables	**2 Hours**
Aim and Objectives: Convert the above designed E-R Diagrams in Relational Schemas. Theoretical Background: Reduction of E-R schema to Relational Schema Experimentation: 1. Consider E-R diagrams constructed in experiment No.1 2. Apply rules such as combination of table, redundncy of tables and generate relational shemas.	
Assessment No. 3 - Normalisation / Functional Dependencies	
Aim and Objectives: Convert the given un-normalized relations into normalized form with 1NF, 2Nf and 3NF Theoretical Background: Normalization and Functional Dependencies. Experimentation: 1. Make use of normalization tools and convert the given un-normalized relations into normalized form	
Assessment No. 4 - Installation of Database software (PostgreSQL/ MySQL/Oracle/SQL Server - any one of these)	**2 Hours**

Aim and Objectives: Installing Database Software, Administrating it and Creating Users, Connecting to Database Software. Theoretical Background: Structured Query Language Experimentation: 1. Installing Database Software 2. Create Database 3. Create user with password 4. create schema	
Assessment No. 5 - Data Definition Language	**2 Hours**
Aim and Objectives: Use DDL Queries to create, alter and drop tables with respect to all types constraints (key, referential, not null) Theoretical Background: Data Definition Language Experimentation: 1. Execute DDL command to create, alter and drop tables in SQL, 2. Apply all types of constraints such as primary key, foreign key, not null, etc.	
Assessment No. 6 - Data Manipulation Language	**2 Hours**
Theoretical Background: Modification of the Database Experimentation: 1. Execute DML command on the table created in experiment no.5	
Assessment No. 7 - SQL Query Processing	**2 Hours**
Aim and Objectives: Display the records using group by, order by, having and between clauses. Theoretical Background: Basic Structure of SQL Queries, groupby, orderby clause. Experimentation: 1. Execute SQL queries SQL Queries, groupby, orderby clauses	
Assessment No. 8 - SQL Query Processing	**2 Hours**
Aim and Objectives: Display the results of union, intersection, set difference, Cartesian product and Join operations. Theoretical Background: SQL set operations and join operations Experimentation: 1. Execute SQL queries for set operations and join operations.	
Assessment No. 9 - SQL Query Processing	**2 Hours**
Aim and Objectives: Display the records using Aggregate functions and Create Indexes & Views for the table. Theoretical Background: SQL aggregate functions, index, and views. Experimentation: 1. Execute SQL queries for aggregate functions, index, and views	
Assessment No. 10 - Database Connectivity	**2 Hours**
Aim and Objectives: Connect database with Java using eclipse. Theoretical Background: Embedded and dynamic SQL. Experimentation: 1. Write Java program in eclipse for Database Connectivity 2. Execute SQL queries through java eclipse.	
Assessment No. 11 - Static Hashing	**2 Hours**
Aim and Objectives: Write a program to implement Static Hashing. Theoretical Background: Indexing and Hashing Experimentation: 1. Consider any one table as input created in experiment no.4 2. Select search key 3. Apply hash function 4. Find hash value and put record in appropriate bucket.	
Assessment No. 12 - Concurrency Control	**2 Hours**
Aim and Objectives: Write a program to simulate any one concurrency control protocol. Theoretical Background: Concurrency Control- Lock-Based Protocols Experimentation: 1. Consider any one table as input created in experiment no.5 2. Create two programs one for shared lock and another for exclusive lock 3. Show result of compatibility matrix.	
Assessment No. 12 - Database Logs	**2 Hours**
Aim and Objectives: Write program to create logs of the different activities. Theoretical Background: Recovery and Atomicity Experimentation: 1. Consider any one transaction with basic operation 2. Create deferred and immediate logs.	

Course Code:	UCSC0505	L	T	P	Credit
Course Name:	Machine Learning Lab	–	–	1	1

Course Prerequsites:

Mathematics – Discrete Mathematics, Mathematics for Computer Science.
Machine Learning Concepts.
Programming Skills – Basic knowledge of Python.

Course Description:

This machine learning lab course is designed to give students practical experience in implementing and evaluating various machine learning algorithms using real-world datasets. Students will gain hands-on experience with popular algorithms such as linear regression, logistic regression, decision trees, random forests, neural networks, support vector machines, k-means clustering, association rule mining, and more.

Course Outcomes: After the completion of the course the student should be able to –

CO1	Analyze the different types of machine learning algorithms.
CO2	Apply the different types of machine learning algorithms to real-world data sets.
CO3	Evaluate the performance of different machine learning algorithms using appropriate metrics and techniques.
CO4	Make use of modern tools to design and implement machine learning algorithms to solve specific problems.
CO5	Interpret the results.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Marks	
1	In Semester Evaluation (ISE)	33%	25	Practical performed/ Quiz/ Project (PBL)/ Mini-Project/ Presentation/ Group Discussion/ Internal Oral etc
2	End Semester Examination (ESE)	67%	50	Oral Examination (OE)

Suggested List of Experiments:

Experiment No. 1 – Linear Regression
Implement a linear regression algorithm to predict a continuous target variable based on one or more predictor variables. E.g. Implement a linear regression model on a housing prices dataset to predict the prices of houses based on their features.

Experiment No. 2 – Logistic Regression
Implement a logistic regression algorithm to classify data into two or more classes based on predictor variables.

Experiment No. 3 – Neural Networks
Implement a neural network algorithm to classify data into multiple classes based on predictor variables.

Experiment No. 4 – Basic two layered artificial neural networks
Implement and train a two-layered artificial neural network to classify images of handwritten digits from the MNIST dataset.

Experiment No. 5 – Support Vector Machines
Implement a support vector machine algorithm to classify data into multiple classes based on predictor variables.

Experiment No. 6 – Decision Trees
Implement a decision tree algorithm to classify data into multiple classes based on predictor variables.

Experiment No. 7 – K-Nearest Neighbour Classifier
Implement a K-Nearest Neighbors classifier on a breast cancer dataset to predict whether a tumor is malignant (cancerous) or benign (non-cancerous).

Experiment No. 8 – Random Forest
Implement a random forest algorithm to classify data into multiple classes based on predictor variables.

Experiment No. 9 – Naïve Bayes Classifier
Implement and evaluate a Naïve Bayes classifier on a dataset of email messages

Experiment No. 10 – K-Means Clustering
Implement a k-means clustering algorithm to cluster data into multiple groups based on similarity of features.

Experiment No. 11 – Association Rule Mining
Implement Apriori algorithm, to mine frequent itemsets and generate association rules from a dataset of retail transactions.

Suggested References:

1. Hands–On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron
2. Introduction to Machine Learning with Python by Andreas Müller and Sarah Guido
3. Mastering Machine Learning Algorithms by Bonzanini Giuseppe and Weideman Manohar
4. Machine Learning for dummies John Paul Muller, Wiley Publication

Course Code:	UCSC0506		L	T	P	Credit
Course Name:	Advanced Programming		**2**		**2**	**3**

Course Prerequsites:

Basic Concepts of Programing - variable, conditional statements, loops. Basic Knowledge of Networking & Operating System concepts.

Course Description:

Course Description :In this course students will be introduced to strict oop programming environment of Java programming language. Students will learn advanced feature of Java, such as platform independent architecture, JVM, JIT components. The course will also enable students to develop GUI based computer applications which will make use of advanced computer features, for example multi threaded application, networking based applications.

Course Outcomes:

CO1	Use knowledge of fundamental and oop concepts for programming.
CO2	Apply knowledge of various concepts of computer science and design solutions for different subjects like computer algorithm, threading, networking.
CO3	Develop programming solutions to given problem.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Marks	Remark
1	In Semester Evaluation 1 (ISE)	25	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	End Semester Examination (ESE)	50	Practical & Viva Exam on 100% of course contents

Course Contents:

Unit 1	**Unit 1:--- Fundamental Programming in Java :**	**4 Hours**

The Java Buzzwords, The Java Programming Environment- JVM, JIT Compiler, Byte Code Concept, HotSpot, A Simple Java Program, Source File Declaration Rules, Comments, Data Types, Variables, Operators, Strings, Input and Output, Control Flow, Big Numbers, ArraysJagged Array. Objects and Classes: Object-Oriented Programming Concepts, Declaring Classes, Declaring Member Variables, Defining Methods, Constructor, Passing Information to a Method or a Constructor, Creating and using objects, Controlling Access to Class Members, Static Fields and Methods, this keyword, Object Cloning, Class Design Hints.

Unit 2	**Interface, Inheritance and Packaging :**	**4 Hours**

Interfaces: Defining an Interface, Implementing an Interface, Using an Interface as a Type, Evolving

Interfaces, Default Methods. Inheritance: Definition, Superclasses, and Subclasses, Overriding and Hiding Methods, Polymorphism, Inheritance Hierarchies, Super keyword, Final Classes and Methods, Abstract Classes and Methods, casting, Design Hints for Inheritance, Nested classes & Inner Classes, finalization and garbage collection. Packages: Class importing, Creating a Package, Naming a Package, Using Package Members, Managing Source and Class Files. Developing and deploying (executable) Jar File.

Unit 3	**Lambda Expressions**	**4 Hours**

Lambdas in nutshell, How to use Lambdas-Functional Interfaces, Type Checking , type interfaces, Method References, Lambda Expressions

Unit 4	**Files IO & Exception Handling**	**6 Hours**

Exception: Definition, Dealing with Errors, The Classification of Exceptions, Declaring Checked Exceptions, Throw an Exception, Creating Exception Classes, Catching Exceptions, Catching Multiple Exceptions, Re-throwing and Chaining Exceptions, finally clause, Advantages of Exceptions, Tips for Using Exceptions. I/O Streams: Byte Stream – InputStream, OutputStream, DataInputStream, DataOutputStream, FileInputStream, FileOutputStream, Character Streams, BufferedStream, Scanner, File, RandomAccesFile.

Unit 5	**Networking and Multithreading:**	**3 Hours**

Networking: Overview of Networking, Networking Basics, Working with URLs, Creating a URL, Parsing a URL, Reading Directly from a URL, Connecting to a URL, Reading from and Writing to a URL Connection, Sockets, Reading from and Writing to a Socket, Writing the Server Side of a Socket, Datagrams, Writing a Datagram Client and Server. Multithreading: Processes and Threads, Runnable Interface and Thread Class , Thread Objects, Defining and Starting a Thread, Pausing Execution with Sleep, Interrupts, Thread States, Thread Properties, Joins, Synchronization

Unit 6	**Collection and Parallel Data Processing & Performance**	**4 Hours**

Collections: Collection Interfaces, Concrete Collections- List, Queue, Set, Map, the Collections Framework. Parallel Streams - turning sequential streams into parallel streams, stream performance, recursive tasks, splitting processes.

Experiment List	At least 12 experiments shall be performed from list below	ours/experim
1	Create a class called Employee that includes three pieces of information as instance variables- first name, a last name and a monthly salary. Your class should have a constructor that initializes the three instance variables. Provide a set and a get method for each instance variable. If the monthly salary is not positive, set it to 0.0. Write a test application named EmployeeTest that demonstrates class Employee's capabilities. Create two Employee objects and display each object's yearly salary. Then give each Employee a 10% raise and display each Employee's yearly salary again.	

2	Create class SavingsAccount. Use a static variable annualInterestRate to store the annual interest rate for all account holders. Each object of the class contains a private instance variable savingsBalance indicating the amount the saver currently has on deposit. Provide method calculateMonthlyInterest to calculate the monthly interest by multiplying the savingsBalance by annualInterestRate divided by 12this interest should be added to savingsBalance. Provide a static method modifyInterestRate that sets the annualInterestRate to a new value. Write a program to test class SavingsAccount. Instantiate two savingsAccount objects, saver1 and saver2, with balances of Rs 2000.00 and Rs 3000.00, respectively. Set annualInterestRate to 4%, then calculate the monthly interest and print the new balances for both savers. Then set the annualInterestRate to 5%, calculate the next month's interest and print the new balances for both savers.
3	Create Vehicle Interface with name, maxPassanger, and maxSpeed variables. Create LandVehicle and SeaVehicle Inteface from Vehicle interface. LandVehicle has numWheels variable and drive method. SeaVehicle has displacement variable and launch method. Create Car class from LandVehicle, HoverCraft from LandVehicle and SeaVehicle interface. Also create Ship from SeaVehicle. Provide additional methods in HoverCraft as enterLand and enterSea. Similarly provide other methods for class Car and Ship. Demonstrate all classes in a application.
4	Develop a mathematical package for Statistical operations like Mean, Median, Average, Standard deviation. Create a sub package in the math package -convert. In “convert” package provide classes to convert decimal to octal, binary, hex and vice-versa. Develop application program to use this package, and build executable jar file of it.
5	Develop a class Expr to create and evaluate given expression. Constructor accepts the expression as String. For example, Expr("x^2") or Expr("sin(x)+3*x"). If the parameter in the constructor call does not represent a legal expression, then the constructor throws an IllegalArgumentException. The message in the exception describes the error. Provide eval (double num) and eval(int num) method to evaluate given expression and return evaluated answer. For example, if Expr represents the expression 3*x+1, then func.value(5) is 3*5+1, or 16.Finally, getDefinition() returns the definition of the expression. This is just the string that was used in the constructor that created the .expression object.
6	Write a class to represent Roman numerals. The class should have two constructors. One constructs a Roman numeral from a string such as "XVII" or "MCMXCV". It should throw a NumberFormatException if the string is not a legal Roman numeral. The other constructor constructs a Roman numeral from an int. It should throw a NumberFormatException if the int is outside the range 1 to 3999.In addition, the class should have two instance methods. The method toString() returns the string that represents the Roman numeral. The method toInt() returns the value of the Roman numeral as an int.
7	Take file name as input to your program, If file is existing the open and display contents of the file. After displaying contents of file ask user – do you want to add the data at the end of file. If a user gives yes as response, then accept data from user and append it to file. If file in not existing then create a fresh new file and store user data into it. User should type exit on new line to stop the program.
8	Take Student information such as name, age, weight, height, city, phone from user and store it in the file using DataOutputStream and FileOutputStream and Retrive data using DataInputStream and FileInputStream and display the result.
9	Write a program to remove whitespaces from a text file. Name of the file is given using command line.

10	Write a Swing GUI based network server program. The program is a simple file server that makes a collection of files available for transmission to clients. When the server starts up, it needs to know the name of the directory that contains the collection of files. Specify this directory name through JFileChooser Dialog. You can assume that the directory contains only regular files (that is, it does not contain any sub-directories). When a client connects to the server, the server first reads a one-line command from the client. The command can be the string "index". In this case, the server responds by sending a list of names of all the files that are available on the server. Or the command can be of the form "get <file>", where <file> is a file name. The server checks whether the requested file actually exists. If so, it first sends the word "ok" as a message to the client. Then it sends the contents of the file and closes the connection. Otherwise, it sends the word "error" to the client and closes the connection.
11	Fill a HashMap with key-value pairs. Print the results to show ordering by hash code. Extract the pairs, sort by key, and place the result into a LinkedHashMap. Show that the insertion order is maintained.
12	Write a program to read a text file one line at a time. Read each line as a String and place that String object into a LinkedList. Print all of the lines in the LinkedList in reverse order.

Text Books:

1. Core Java- Volume I Fundamentals: Cay Horstmann and Gary Cornell, Pearson, Eight edition (Unit 1 to U
2. Core Java- Volume II Advanced Features: Cay Horstmann and Gary Cornell ,Pearson, Eight edition(Unit

Reference Books:

1] The Java Tutorials From ORACLE Java Documentation URL: http://docs.oracle.com/javase/tutorial/ (R
2]The Java Tutorial: A Short Course on the Basics by Raymond Gallardo, Scott Hommel, Sowmya Kannan,
3]JAVA-The Complete Reference: Herbert Schildt, Oracle Press, Mcgraw Hill,(9th Edition).
4]JAVA™ HOW TO PROGRAM, By Deitel Paul , Deitel Harvey. Publisher: PHI Learning..(10th Edition)
5]Thinking in Java by Bruce Eckel, Prentice Hall,(4th Edition)
6]A Programmer's guide to JAVA SCJP Certification: Khaleed Mughal and Rolf W. Rasmussen, Addison Wes

Course Code:	UCSC0507		L	T	P	Credit
Course Name:	Mini Project-II		0	0	2	1

Course Prerequsites

Data structures, Algorithms, Procedural Programming, Object-Oriented Programming, Software

Course Description:

In this course, students will apply the concepts they have learned in the Second Year as well as this semester. Students will learn to design a project as per the software engineering techniques. They will create a repository of the project on the Web.

Course Outcomes: After completing the course, students will be able to

CO1	Identify data structures and algorithms required to solve a real world problem
CO2	Apply software engineering techniques to design and develop a project
CO3	Write cases to test the code
CO4	Create and maintain a repository of their project on the Web.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1	50%	Problem identification and Design
3	In Semester Evaluation 2 (ISE2	50%	Coding, Testing and Creating Repository

Course Contents:

Guidelines for Mini-Project-II

1. The course Instructors should form the project teams of 3 to 4 students

2. The course coordinators should help students to select projects from the domains like Algorithms, Networking, Databases

3. The course coordinators should show students a demo project developed following software engineering phases

4. The course coordinators should guide students to create repositories on the web

5. The course coordinators should inculcate in students the significance of testing the code

6.The course coordinators should share a common project report format to all batches

7. It is recommended to share a common evaluation scheme for the project

8.The two phases of evaluation :

I. In ISE 1, the students shall be graded based on the skills demonstrated to identify and define the problem statement and to design a solution

II. In ISE 2, students shall be graded based on working model of the project, test cases defined and repository maintained for the project

Course Code:	UCSC0508		L	T	P	Credit
Course Name:	Operating Systems Lab				2	1

Course Prerequsites:

Fundamentals of Electronics and Computer

Course Description:

This is one of the core course of Computer Science & Engineering Programme. In this course you will become familiar with the core concepts of OS - how OS work, how a **processes & threads** are created, **inter-process communication & synchronisation**, the various **scheduling** algorithms, **memory management** & memory allocation strategies, etc. This course will be also helpful for exams like GATE.

Course Outcomes: After the completion of the course the student will be able to -

CO1	design and implement programs using system calls with process & thread management.
CO2	implement process/thread synchronization mechanism to prevent race conditions.
CO3	acquire hands-on experience with inter-process communication
CO4	write programs to evaluate the performance of various scheduling, page replacement & disk scheduling algorithms.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	50%	Lab Assignments, Test, Quiz, Presentation, etc.
2	End Semester Examination (ESE)	50%	External Practical Oral Examination

Course Contents:

Assignment 1: Process Management

System Calls - fork(), exit(), exec(), wait(), waitpid(), getpid(), getppid()

Assignment 2: Thread Management

POSIX threads. pthread_create(), pthread_join(), pthread_exit(), pthread_self()

Assignment 3: Process Scheduling

Evaluate performance of scheduling algorithms-FCFS, SJF, SRTN, RR, Priority Scheduling in terms of turnaround time, response time.

Assignment 4: Process Synchronization

Inter-process Synchronization using semaphores.

Assignment 5: Classical problems of Process Synchronization

Classical problems of Synchronization-Bounded Buffer, Dining Philosopers Problem, and The Reader and Writer Problem.

Assignment 6: Interprocess Communication

Inter-process Communication using pipes, shared memory, and message passing.

Assignment 7: Bankers Algorithm

Banker's Algorithm to find a safe sequence of process execution.

Assignment 8: Implementation of namei algorithm

Conversion of pathname to inode

Assignment 9: Page Replacement Algorithms

Page Replacement Algorithms-FIFO, LRU, OPR

Assignment 10: Disk Scheduling Algorithms

Simlation of disk scheduling algorithms such as - FCFS, SSTF, SCAN, C-SCSN, LOOK, C-LOOK using aa program.

Course Code:	UCSA0501		L	T	P	Credit
Course Name:	Presentation_and_Report_Writing		2			0

Course Prerequsit

Course Descriptio

Course Outcomes:

CO1	Use appropriate charts, tables and figures in presentation and report
CO2	Compare and identify suitable tools towards practicing write-up and presentation
CO3	Create effective report and presentations of the technical work

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	In Semester Evaluation 2 (ISE2)	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.

Course Contents:

Part-I	A Technical Report Writing	8 Hours

1. Experiment 1: Writing technical reports using proper Tense and grammar.
2. Experiment 2: Study of various types of technical Reports
Project report, Conference paper, Journal Paper, Intellectual Property Rights (IPR),
Selection of paper type for possible publication.
3. Experiment 3: Study of technical report Structure - I
Preamble, Abstract, Literature review/survey, Problem statement, Objectives
4. Experiment 4: Study of technical report Structure – II
Methodologies, Results, Discussions, Conclusion, Acknowledgements
5. Experiment 4: Use of Bibliographies/references and proper citations in reports.
6. Experiment 5: Use of Citations, referring style and method of using citations.
7. Experiment 6: Study of Plagiarism
a. Checking plagiarism, b. Minimizing plagiarism

Part-I	Presentation	6 Hours

8. PPT's and Animations
9. Presentation structure, Number of slides and Time management
10. Presentation styles
11. Figures and Tables for data representations

Part -	Tolls and Practices	8 Hours

12. MS Office, Open Office, Latex, Beamer, Flash, GNU Plot etc.
13. End Note; Mendeley, Grammarly, Ginger, 1 Checker, Turnitin etc.

Text Books:

Kothari C. R, “Research Methodology”, 2nd Edition, New Age International, 1990.

Chopra Deepak and Sondhi Neena, “Research Methodology : Concepts and cases”, 2 nd Edition,Vikas Publishing House, New Delhi, 2015

Reference Books:

Melville Stuart and Goddard Wayne, “Research Methodology: An Introduction For Science & Engineering Students”, 1st Edition, Kenwyn Juta & Co. Ltd.,1996

G. Ramamurthy, “Research Methodology”, 2nd Edition, Dream Tech Press, New Delhi, 2015

Course Code:	UCSPE501		L	T	P	Credit
Course Name:	Project Management		3			3

Course Prerequsit

Software Engineering

Course Descriptio

This course develops a foundation of concepts and solutions that supports the planning, scheduling, controlling, resource allocation, and performance measurement activities required for successful
Completion of a project.
This course develops a foundation of concepts and solutions that supports the planning, scheduling, controlling, resource allocation, and performance measurement activities required for successful

Course Outcomes:

CO1	Explain basic concept of project management.
CO2	Make use of tools and techniques for project activities.
CO3	Inspect reason for project failures.
CO4	Design project management plan for real world problem.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE	50%	100% course contents

Course Contents:

Unit 1	Introduction to Project Management	6 Hours

Project and Project Management (PM), Role of project Manager, System view of PM, Organization, Stakeholders, Project phases and lifecycle, Context of IT projects, process groups, mapping groups to Knowledge areas

Unit 2	Project Integration and Scope Management	8 Hours

Strategic planning and project selection, Developing a Project Management Plan, Directing and Managing Project Work, Monitoring and Controlling Project Work, Performing Integrated Change Control, Closing Projects or Phases Planning Scope Management, Collecting Requirements, Defining Scope, Creating the Work Breakdown
Structure, Validating Scope, Controlling Scope

Unit 3	**Project Time Management**	**4 Hours**
Planning Schedule Management, Defining Activities, Sequencing and Estimating Activity, Resources & Duration, Developing & Controlling Schedule		
Unit 4	**Project Cost and Risk management**	**6 Hours**
Basic Principles of Cost Management, Planning Cost Management, Estimating Costs, Determining the Budget, Controlling Costs Importance, risk management planning, sources of risk, risk identification, qualitative and quantitative risk analysis, risk response planning, risk monitoring and control.		
Unit 5	**Project Procurement Management**	**7 Hours**
The Importance of Project Procurement Management , Planning Procurements , Tools and Techniques for Planning Procurements , Procurement Management Plan ,Statement of Work , Procurement Documents , Source Selection Criteria , Conducting Procurements Administering Procurements , Closing Procurements , Using Software to Assist in Project Procurement Management		
Unit 6	**Using OpenProject software for project management**	**6 Hours**
Introduction and Overview of New Features of OpenProject software, getting started with OpenProject 2010 ,Using the Help Feature ,Main Screen Elements , Project 2010 Views , Project 2010 Filters, Developing a Work Breakdown Structure, Gantt Charts,Network Diagrams ,Critical Path Analysis.		
Text Books:		
Information Technology Project Management, 7E, Kathy Schwalbe, Cengage Learning https://opensource.com/article/17/11/how-install-and-use-openproject		
Reference Books:		
1. The principles of project management by MERI WILLIAMS		

Course Code:	UCSPE502	L	T	P	Credit
Course Name:	Mobile Technology	3			3

Course Prerequsites

Data Communication & Networking, TCP/IP Protocol Suite

Course Description:

Mobile Technology subject mainly deals with the science of mobile communication. It covers layered approach of mobile communication covering layers such as – data link, network and transport layer. It also introduces the 5G technology.

Course Outcomes:

CO1	Explain the basic physical and technical functioning of mobile communications systems
CO2	Describe the basic principles of mobile communication system and summarize the working of network and transport layer in the context of mobility
CO3	Compare principles of the modern mobile and wireless communication systems such as 5G with
CO4	Illustrate the principles and applications of wireless systems and standards

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation,
2	Mid Semester Examination (MSE	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation,
4	End Semester Examination (ESE	50%	100% course contents

Course Contents:

Unit 1	Introduction	6 Hours

Introduction to Wireless Networks, Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, Types of handoff and their characteristics

Unit 2	Medium Access Control (MAC) & GSM Telecommunication System	8 Hours

MAC, Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems,
GSM: Architecture, Location tracking and call setup, Mobility management, Handover, Security, GSM SMS, International roaming for GSM, call recording functions, subscriber and service data management.

Unit 3	Mobile Network Layer:	6 Hours

IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP.

Unit 4	**Mobile Transport Layer**	**6 Hours**
Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit / Fast recovery, Transmission / Timeout freezing, Selective retransmission, Transaction Oriented TCP.		
Unit 5	**Mobile Ad hoc Networks (MANETs) :**	**6 Hours**
Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc. , Mobile Agents, Service Discovery.		
Unit 6	**5G Mobile Network – Future of Mobile Communication**	**6 Hours**
10 Pillars of 5G, concept of small cell, Cognitive radio -overview, spectrum optimization literature, key requirements and challenges for 5G cognitive terminal. Wireless spectrum white spaces – Background, TV white space technology, white space spectrum opportunities and challenges.		
Text Books:		
Textbooks: 1. Jochen Schiller, \Mobile Communication", Pearson Education. 2. Theodore & S. Rappaport, \Wireless Communications, Principles, Practice", PHI. 3. William Stallings, \Wireless Communications and Networks", Pearson Education. 4.Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, First Edition 2015 John Wiley & Sons, Ltd P		
Reference Books:		
References: 1. Wireless telecommunications systems and networks / Gary J. Mullett. Cengage Publication.		

Course Code:	UCSPE503		L	T	P	Credit
Course Name:	Professional Elective-I (Principles of Artificial Intelligence Data Science)		3	0	0	3

Course Prerequsites:

Computer Science concepts, Mathematics and statistics.

Course Description:

This course provides a comprehensive introduction to the fundamentals of artificial intelligence and data science.

Course Outcomes: After the completion of the course the student should be able to

CO1	Explain various concepts and terminology used in artificial intelligence and data science.
CO2	Explain the applications of artificial intelligence and data science. .
CO3	Analyze and use problem-solving and search algorithms to solve specific problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Tutorial, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Tutorial, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1 Introduction to Artificial Intelligence — **5 Hours**

Introduction, History, Application, Approaches, Types of AI, Intelligent Agents, Agents & environment, Ethical considerations and societal impact of AI.

Unit 2 Problem Solving and Search Algorithms — **8 Hours**

Problem formulation and representation: Defining the problem as state space search, production system, problem characteristics and issues in the design of search programs. Problem solving agents, searching for solutions.
Search algorithms: Informed Search & Uninformed search strategies - breadth first search, depth first search, depth limited search, bidirectional search. Heuristic search strategies.

Unit 3 Knowledge Representation, Logic, and Reasoning — **7 Hours**

Propositional Logic, Inference rules, First Order Logic, Rule based systems, Reasoning with uncertainty, Fuzzy reasoning, Bayes networks. Expert Systems: ES Characteristics, Architecture, Rule based ES, Rule Induction, Introduction to Natural Language Processing.

Unit 4 Introduction to Data Science — **6 Hours**

Introduction, Terminology and key concepts, Types of data: Structured and unstructured, quantitative and qualitative, Levels of data: Nominal, ordinal, interval, and ratio, Data science case studies.

Unit 5 The Data Science Process — **6 Hours**

Overview of the data science process, The five steps of data science: Explore the data, obtain the data, model the data, communicate and visualize the results.

Unit 6 Concepts & Applications of Data Science — **7 Hours**

Concepts: Traits of Big data, Web Scraping, Analysis vs Reporting, Introduction to Programming, Tools for Data Science, Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK, Applications: Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

Text Books:

1. Kevin Night and Elaine Rich, Nair B, “Artificial Intelligence(SIE)”, McGraw Hill.
2. Dan W.Patterson, “Introduction to AI and ES”, Pearson Education.
3. Sinan Ozdemir, “Principles of Data Science”, Packt.
4. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi

References:

1. Rich E, Knight K,Nair S B, ArtificialIntelligence, Tata McGraw-Hill.
2. Luger George F, Artificial Intelligence: Structures and Strategies for Complex Problem solving, Pearson Education.
3. Carter M, Minds and Computers: An Introduction to the Philosophy of Artificial Intelligence, Edinburgh University Press.
4. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers

Course Code:	UCSPE503		L	T	P	Credit
Course Name:	Modern Information Retrieval		3			3

Course Prerequsite:

Database systems

Course Description:

This is one of the core course of Computer Science & Engineering Programme. In this course you will become familiar with infromation retrieval . It focuses on the working of Information Retrieval systems like search engines which includes study of underlying mathematics and algorithmic techniques. It focuses on indexing based on statistical models of language, processing, storage and querying of textual data. It also deals with multimedia data.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Describe various functionalities and capabilities of Information Retrieval System.
CO2	Acquire knowledge on pre-processing of text and web page.
CO3	Understand the concepts of information visualization, multimedia IR.
CO4	Compare Parallel and Distributed IR

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	INTRODUCTION TO INFORMATION RETRIEVAL	7 Hours

Information versus Data Retrieval,Information Retrieval at the Center of the Stage, The Retrieval Process,A Taxonomy of Information Retrieval Models,A Formal Characterization of IR Models,Classic Information Retrieval,Structured Text Retrieval Models,Models for Browsing,Retrieval Performance Evaluation-Recall and Precision,Alternative Measures

Unit 2	TEXT AND WEBPAGE PRE-PROCESSING	7 Hours

Pre-processing Technique ,Inverted index and its comparison , Latent Semantic Indexing, Web Search ,Web Spamming, Sentiment Analysis – Privacy Issues , NLTK (Natural Language Toolkit).

Unit 3	WEB RETRIEVAL AND WEB CRAWLING	6 Hours

Search Engine Architectures , Cluster based Architecture – Distributed Architectures ,Search Engine Ranking , Link based Ranking ,Simple Ranking Functions,Learning to Rank ,Evaluations Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler - Evaluation.

Unit 4	USER INTERFACES AND VISUALIZATION	7 Hours

How People Search,Search Interfaces Today, Visualization in Search Interfaces , Design and Evaluation of Search Interfaces

Unit 5	PARALLEL AND DISTRIBUTED IR	6 Hours

Parallel Computing,Performance Measures,Parallel IR-MIMD Architectures,SIMD Architectures, Distributed IR-Collection Partitioning,collection Selection,Query Processing,Web Issues

Unit 6	MULTIMEDIA IR	7 Hours

Introduction to multimedia IR,,challenges,content based image retrieval,Audio and music retrieval,Retrieving and Browsing Video,Fusion Models: Combining it All

Text Books:

1.Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.

2.C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2012.

Reference Books:

1. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010

Course Code:	UCSCO0501		L	T	P	Credit
Course Name:	Software Engineering		3			3

Course Prerequsites:

Fundamentals of programming

Course Description:

This is one of the important course of Computer Science & Engineering Programme. It is a subject that emerged as a result of the need to manage software projects that are rising in demand day by day. Software is developed in diverse areas and the fact that a systematic approach is required to manage their development spawns this interesting subject of study. The software engineering principles and techniques are explained which are used in developing quality software products.

Course Outcomes: After the completion of the course the student will be able to -

CO1	learn and understand the Concepts of Software Engineering
CO2	describe Software Development Life Cycle
CO3	apply the project management and analysis principles to software project development.
CO4	Illustrate the design & testing principles to software project development.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1 Introduction — **4 Hours**

What is software?.Types of software,Characteristics of Software,Attributes of good software,What is software engineering? Software engineering costs ,key challenges,Systems engineering & software Engineering

Unit 2 Software Development Process Models — **8 Hours**

software process,software process model,The waterfall model,Evolutionary development Component-Based Software Engineeri Process Iteration,Incremental delivery,Spiral development,Rapid software development,Agile methods,Extreme programming,R Software prototyping,Computer Aided Software Engineering (CASE),Overview of CASE approach,Classification of CASE tools

Unit 3 Software Requirement Analysis and Specification — **8 Hours**

System and software requirements,Types of software requirements,Functional and non-functional requirements,Domain requirements,User requirements,Elicitation and analysis of requirements,Overview of techniques, Viewpoints,Interviewing, Scenarios,Use-cases,Process modeling with physical and logical DFDs ,Entity Relationship Diagram,Data Dictionary, Requirement validation,Requirement specification,Software requirement Specification (SRS),Structure and contents,SRS format

Unit 4 Software Design — **8 Hours**

Design concepts,Abstraction,Architecture,Patterns,Modularity,Cohesion,Coupling,Information hiding,Functional independence, Design of input and Control,Design of User Interface design, Elements of good design Design issues Features of modern GUI - Me Buttons, icons, panels, error Messages etc.

Unit 5 Software Testing and Quality Assurance — **8 Hours**

Verification and validation Techniques of testing, Black-box and White-box testing, Inspections Levels of testing ,Unit testing , Integration Testing ,Interface testing ,System testing, Alpha and beta testing, Regression testing ,Design of test cases, Quality management activities ,Product and process quality Standards ,ISO9000, Capability Maturity Model (CMM)

Unit 6	Current trends in Software Engineering	4 Hours

Software Engineering for projects and products. Introduction to Web Engineering and Agile process

Text Books:

1.Software Engineering: A practitioner's approach by Roger S. Pressman, 7th edition, McGraw-Hill International edition
2. Software Engineering: A precise Approach - Pankaj Jalote (Wiley India)

Reference Books:

1. Software Engineering by Ian Sommerville, 7th edition, Addison-Wesley.
2. Fundamentals of Software Engineering by Rajib Mall

SEMESTER - VI

Course Code:	UCSC0601		L	T	P	Credit
Course Name:	Data Analytics (Theory)		3	0	0	3

Course Prerequsites:

Basic mathematics, statistics, programming, critical thinking, basic machine learning

Course Description:

This course provides an opportunity to discover the power of data analytics and learn how to extract meaningful insights from raw data. Gain hands-on experience in data collection, preprocessing, statistical analysis, and visualization using industry-standard tools and techniques.

Course Outcomes: After the completion of the course the student should be able to

CO1	Explain various concepts and terminology used in data analytics.
CO2	Analyze statistical data analysis techniques for data preparation and exploration.
CO3	Apply appropriate tools for data acquisition, preprocessing, analysis, and visualization.
CO4	Identify the appropriate methods and tools to solve business problems using data analytics.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Tutorial, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Tutorial, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1 Introduction — **5 Hours**

Overview of data analytics, Applications, Data analytics process, Types of data analytics, Business intelligence, Decision support system, Data mining

Unit 2 Data Collection and Preprocessing — **7 Hours**

Data acquisition methods and sources, Exploratory data analysis (EDA) techniques, Data cleaning techniques: handling missing values, outliers, and noise, Data validation, Data transformation, Data reduction, Normalization Techniques.

Unit 3 Statistical Analysis: Descriptive statistics — **8 Hours**

Descriptive statistics: measures of central tendency, variability, and correlation, Measures of central tendency – mean, median and mode, Measures of dispersion – standard deviation, variance, range, IQR (interquartile range), Measure of symmetricity/ shape – skewness and kurtosis, Data visualization principles and techniques.

Unit 4 Statistical Analysis: Inferential Statistics — **7 Hours**

Hypothesis testing, parametric and nonparametric, Parametric tests: t-test, z-test, f-test, ANOVA, regression, Non-parametric tests: Chi-square test.

Unit 5 Data Analytics Tools — **7 Hours**

Understanding application scenarios and visualization with DA tools – Microsoft Excel, Python, R, SQL, Microsoft Power BI, Tableau

Unit 6 Case Studies — **5 Hours**

Five to ten case studies to be discussed. Sample case studies areas – retail, entertainment industry, travel industry, social media, healthcare, etc. Ethics in data analytics.

Text Books:

1. Runkler, Thomas A. Data analytics. Wiesbaden: Springer Fachmedien Wiesbaden, 2020.
2. Python for Data Analysis, By Wes McKinney, 2017

References:

1. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers
2. The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 2014.
3. Spiegelhalter, D. (2019). The art of statistics: Learning from data. Penguin UK.
4. Kothari, C. "Research methodology methods and techniques" Published by New Age International (P) Ltd., Publishers 91 (2017).
5. Tool links to be updated

Course Code:	CSC0602		L	T	P	Credit
Course Name:	Compiler Construction		3			3

Course Prerequsites:

Automata Theory, Data Structures

Course Description:

Course Description: This course explores the principles, algorithms, and data structures involved in the design and construction of compilers which includes Language processors, lexical analysis, context-free grammars, Types of parsers and parsing techniques, introduction to intermediate code generation and code optimization.

Course Outcomes:

CO1	Define basic concepts of Languages and Language processors in Language processing.
CO2	Explain phases and processes for system program execution in detail from program Analysis to Exec
CO3	Analyse different phases of compiler in detail.
CO4	Explain modules for different processes in code generation.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	7 Hours

Language Processes & Assembler: Introduction, language processing activities, Fundamentals of language processing, Fundamentals of language Specification,**Assemblers:** Elements of assembly language programming, a simple assembly scheme, pass structure of assemblers, design of a two pass assembler.

Unit 2	6 Hours

Macros and Macro Processors: Macro definition and call, Macro expansion, Nested macro calls, Advanced macro facilities, Design of macro pre-processor.

Unit 3	8 Hours

Phases in Compilers-Lexical Analysis& Syntax Analysis: Role of a Lexical analyzer, input buffering, specification and recognition of tokens, Role of Parser, Writing grammars for context free environments, Top-down parsing- Recursive descent and predictive parsers (LL), Bottom-Up parsing- Operator precedence parsing, LR parsers.

Unit 4	8 Hours

Syntax Directed Translation and Intermediate Code Generation: Syntax directed definitions, construction of syntax tree, S-attributed definitions, L-attributed definitions, Intermediate languages, assignment statements.		
Unit 5		**8 Hours**
Code Optimization & Code Generation: Sources of optimization, Peephole optimization and basic blocks, loops in flow graphs, Data flow analysis and equations.Issues in design of a code generator and target machine, Run time storage management, Basic blocks and flow graphs, Next use information and simple code generator.		
Unit 6		**8 Hours**
Linker & Loader: Relocation and linking concepts, design of a linker, Self-relocating programs, Loaders.		
Text Books:		
1."Systems Programming and Operating Systems"D.M. Dhamdhere, Second revised Edition, 2005, Tata McGraw- Hill Publishing Company limited, New Delhi. 2. "Compilers - Principles, Techniques and Tools", A.V. Aho, R. Shethi and J.D. Ullman, Pearson Education.		
Reference Books:		
1. System Programming -- J. J. Donovan (Mc-Graw Hill).2. "Compilers - Principles, Techniques and Tools", A.V. Aho, R. Shethiand J.D. Ullman, Addison Wesley Publishing Company		

Course Code:	UCSC0603		L	T	P	Credit
Course Name:	Information Security		3			3

Course Prerequsites: Computer Network, Data Communication, Engg. Mathematics

Course Description:

Course Description: This course gives you practical survey of both the principles and practice of cryptography and network security. In the first part of course, the basic issues to be addressed by a network security capability are explored by providing a tutorial and survey of cryptography and network security technology. The later part of course deals with the practice of network security: practical applications that have been implemented and are in use to provide network security.

Course Outcomes:

CO1	Explain the use of Cryptographic algorithms to ensure data protection and integrity
CO2	Apply the knowledge of cryptographic techniques to solve the problems on security
CO3	Illustrate the different Network and Internet security protocols in TCP/IP stack
CO4	Analyze the security facilities designed to provide system security

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE1	10%	
2	MSE	30%	
3	ISE2	10%	
4	ESE	50%	

Course Contents:

Unit 1	Introduction to Information Security	5 Hours

Overview: (2)
Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security

Classical Encryption Techniques: (3)
Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machines, Steganography

Unit 2	Symmetric and Asymmetric Key Cryptography	8 Hours

Block Ciphers and the Data Encryption Standard (4)
Block Cipher Structure, Data Encryption Standard (DES), A DES Example, Strength of DES, Block Cipher Design Principles, AES Structure, Multiple Encryption and Triple-DES

Public Key Cryptography (4)
Principles of Public-Key Cryptosystems, RSA Algorithm, Other Public key Cryptosystems - Diffie-Hellman Key Exchange, ElGamal Cryptographic system

Unit 3	Cryptographic Authentication Functions	8 Hours

Cryptographic Hash Functions: (3)
Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA)
Message Authentication Codes: (3)
Message Authentication Requirements, Message Authentication Functions, Requirements for MAC and Security of MACs, MACs Based on Hash Functions: MAC, MACs Based on Block Ciphers: DAA and CMAC
Digital Signatures: (2)
Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS)

Unit 4	**Key Management and User Authentication**	**6 Hours**

Key management (3)
Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure

User Authentication Protocol (3)
Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption.

Unit 5	**Internet security Protocols**	**8 Hours**

Transport-Level Security (2)
Web Security Issues, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, SSH

Electronic Mail Security (3)
Pretty Good Privacy (PGP), S/MIME, SET

IP Security (3)
IP Security Overview, IP Security Policy, Encapsulating Security Payload

Unit 6	**Firewall and Intrusion detection system**	**7 Hours**

Firewalls (2)
Introduction, Types of firewall, Firewall configuration, VPN, Types of VPN
IDS (2)
Overview of IDS, IDS Components, Approaches of IDS
SIEM(3)
Introduction to SIEM,SIEM Scenario and process flow, SIEM architecture, SIEM features

Text Books:

Textbooks:
1. Williams Stallings – Cryptography and Network Security Principles and Practices (Unit 1 to 5) Pearson Education (LPE), 7th Edition
2. Network Security, Firewalls, and VPNs, 3rd Edition by J. Michael Stewart, Denise Kinsey (Unit 6)

References:
2. Cryptography & Network Security B.A. Forouzan McGrawHill
3. Cryptography and network security – Atul Kahate (TMGH)
4. Handbook of Applied Cryptography - Menezes, an Oorschot, and S.A. Vanstone

Course Code:	UCSC0604		L	T	P	Credit
Course Name:	Data Analytics Lab		–	–	1	1

Course Prerequsites:

Mathematics for computer science, machine learning concepts, programming skills.

Course Description:

This data analytics lab course is designed to provide practical experience in extracting meaningful insights from data and presenting them through interactive visualizations and dashboards. It covers a wide range of techniques and tools for exploring, cleaning, transforming, and visualizing real datasets. Students will gain proficiency in using some of the tools like Microsoft Excel, Python, SQL, Microsoft Power BI, and Tableau for tasks like descriptive statistics, data cleaning, feature engineering, predictive modeling, text analytics, and social network analysis.

Course Outcomes: After the completion of the course the student should be able to –

CO1	Obtain, clean, and preprocess data from various sources, ensuring the data is ready for analysis.
CO2	Apply various libraries in Python to solve data analytics problems.
CO3	Implement various statistical analysis methods to any dataset.
CO4	Perform data analysis and visualization of results.
CO5	Make use of modern DA tools to solve real-world problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark	
1	In Semester Evaluation (ISE)	33%	25	Practical performed/ Quiz/ Project (PBL)/ Mini-Project/ Presentation/ Group Discussion/ Internal Oral etc
2	End Semester Examination (ESE)	67%	50	Oral Examination (OE)

Suggested List of Experiments:

Lab experiments cover various aspects of data analytics using tools like – Microsoft Excel, Python, R, SQL, Microsoft Power BI, and Tableau. It includes data exploration, cleaning, transformation, visualization, statistical analysis, predictive modeling, and specialized areas like text analytics or social network analysis. It should provide hands-on experience working with real datasets and applying different techniques to extract meaningful insights.

Experiment No. 1 – Exploratory Data Analysis (EDA)
a) Perform descriptive statistics on a dataset to understand its central tendency, dispersion, and distribution.
b) Generate visualizations like histograms, scatter plots, or box plots to explore relationships and patterns in the data.

Experiment No. 2 – Data Cleaning
a) Handle missing values in a dataset using techniques like imputation or deletion.
b) Identify and handle outliers using methods such as z-score or interquartile range.

Experiment No. 3 – Data Transformation and Feature Engineering
a) Apply feature transformation techniques like log transformation or scaling to normalize the data.
b) Engineer new features by combining existing ones or extracting relevant information.

Experiment No. 4 – Data Visualization
a) Create interactive visualizations using libraries like Matplotlib, Seaborn, or Tableau to present insights from a dataset.
b) Design a dashboard with multiple visualizations to showcase key metrics and trends.

Experiment No. 5 – Statistical Analysis
a) Perform hypothesis testing using t-tests or chi-square tests to analyze relationships between variables.
b) Conduct regression analysis to model and predict outcomes based on independent variables.

Experiment No. 6 – Predictive Modeling a) Build a predictive model (e.g., linear regression, decision tree, or logistic regression) to make predictions. b) Evaluate the model's performance using metrics like accuracy, precision, recall, or ROC curves.
Experiment No. 7 – Text Analytics a) Perform text preprocessing techniques (tokenization, stemming, stop word removal) on textual data. b) Apply sentiment analysis or topic modeling techniques to extract insights from text.
Experiment No. 8 – Clustering and Segmentation a) Implement clustering algorithms (e.g., k-means or hierarchical clustering) to identify natural groupings in a dataset. b) Use segmentation techniques to divide a customer base into distinct groups based on their characteristics.
Experiment No. 9 – Time Series Analysis a) Analyze time series data by visualizing trends, seasonality, and identifying outliers. b) Apply forecasting techniques (e.g., ARIMA or exponential smoothing) to predict future values.
Experiment No. 10 – Social Network Analysis a) Analyze network data to identify influential nodes, communities, or detect patterns of interaction. b) Calculate centrality measures (degree, betweenness, or closeness) to understand network dynamics.

References:
1. Python for Data Analysis, By Wes McKinney, 2017 **Other books / links to be use as required.

Course Code:	UCSC0605	L	T	P	Credit
Course Name:	Information Security Lab			2	1

Course Prerequsites:

Computer Network and Programing Language like Java/Python

Course Description:

This course is to designed to do the practical implementation of Cryptographic algorithms and have the hands-on experience on open source/free tools available to demonstrate the security concepts.

Course Outcomes	
After completion of the course, students shall be able to -	
CO1	Demonstrate encryption and authentication mechanisms
CO2	Implement various cryptographic algorithms using various prgramming languages
CO3	Make use of various security tools to analyze the security concepts

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation (ISE)	25	Assignment, Test, Quiz, Seminar, Presentation,etc.
2	End Semester Examination (OE)	25	Oral Exam

Course Contents:

Assessment No. 1 :Classical Encryption Techniques : Substitution Ciphers	**2 Hours**
To implement the program of substitution ciphers like Caesar Cipher, Playfair Cipher, Hill Cipher	
Assessment No. 2 : Classical Encryption Techniques : Transposition Ciphers	**2 Hours**
To implement the program of Transposition ciphers like Rail fence technique, Columnar transposition	
Assessment No. 3 : Symmetric Ciphers : DES	**2 Hours**
Implement a program to perform Encryption and Decryption using DES cipher	
Assessment No. 4 : Symmetric Ciphers : AES	**2 Hours**
Implement a program to perform Encryption and Decryption using AES cipher	
Assessment No. 5 : Asymmetric Ciphers : RSA Algorithm	**2 Hours**
Implement a program to perform Encryption and Decryption using RSA algorithm	
Assessment No. 6 : Key Exchange Algorithm: Diffie Hellman Algorithm	**2 Hours**
To implement a program using Diffie Hellman key exchange algorithm	
Assessment No. 7 : Message Integrity using Hash function	**2 Hours**
To implement the program on Hash functions –SHA, MD5 etc to show the integrity check on the files transferred	
Assessment No. 8 :Digital Signature algorithm using RSA or DSS Approach	**2 Hours**
Implement the Digital Signature algorithm using RSA approach (SHA256withRSA) or DSS approach (SHA256with DSA)	
Assessment No. 9 : Demonstration of Creation of Digital Signature & Digitally Signed Certificate	**2 Hours**

To implement a program to show encryption and decryption using RSA algorithm in	
Assessment No. 10 : Demonstration of SSL protocol	**2 Hours**
Working of SSL protocol using Network analyzer tools like Wireshark	
Assessment No. 11 : Demonstration of User Authentication Tools	**2 Hours**
Use any of the user authentication tool like Kerberos, NTLM, LDAP, RADIUS	
Assessment No. 12 :Demonstration of Firewall & IDS/ IPS Systems	**2 Hours**
Use any of the Windows and Linux based firewall for demonstration	
Assessment No. 13 : Demonstration and Implementation of Malicious Softwares	**2 Hours**
Assessment No. 14 : Demonstration of VAPT Tools	**2 Hours**
TextBook:	
1. Williams Stallings – Cryptography and Network Security Principles and Practices Pearson Education	

Course Code:	UCSC0606		L	T	P	Credit
Course Name:	Mobile App Programming with Dart		2		2	3

Course Prerequsites:

Basic Kowledhe of programming concepts, Object Oriented Programming

Course Description:

The aim of this course is to familiarize students with Flutter, an open-source UI software development kit, used to develop applications for Android, iOS, Linux, Mac, Windows. This course covers the key concepts of app development using flutter and dart.

Course Learning Objectives:

1. Understand the fundamentals of Flutter and Dart, including the syntax, structure, and features of both languages.
2. Understand and Build visually appealing and responsive user interfaces using Flutter's built-in widgets and layout elements.
3. Understand in detail the Material Design and Motion-Rich Widgets.
4. Understand the Firebase services and features.

Course Outcomes:

After the completion of the course the student will be able to,
able to

CO1	Install and use Flutter and Dart from the ground up, step-by-step.
CO2	Use Dart Programming Language - Fundamentals and intermediate topics
CO3	Build a robust apps with Flutter using Flutter widgets.
CO4	Design, build, debug Flutter Android and iOS Apps with Material Design Guidelines and Widgets.
CO5	Get Flutter apps to communicate with a realtime database - Firebase.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	Dart Programming	8 Hours

Introduction, Importance of Flutter, Introduction to Dart, Dart Pad, Installing Dart SDK,, Dart Variables,Data Types, Input of Information to Dart Program, Writing Comments, Operators, flow control statements. **Advanced Dart Programming**: Functions: Creating a Function, Function Return Data Types, Void Function, Function Returning Expression, Functions and Variable Scope, **Object-Oriented Programming (OOP)**, Objects and Classes, Creating a Class, Adding Methods to Classes, Providing Constructors for Your Classes, Getters and Setters, Inheritance, Abstract Class, Dart Project Structure and Dart Libraries

Unit 2	Introduction to Flutter	8 Hours

Flutter SDK, Installing and Configuring Flutter SDK, Creating a New Flutter Project, Setup an Android Virtual Device, Run a Flutter App, Installing Flutter on Mac, Test Your Flutter App on iOS Phone with Windows O.S, Android Studio Sugar and Spice, Run your Apps on a Hardware Device (Physical Phone), Run your Flutter App on Android Phone, Run your Flutter App on Android Phone, Emulator Debug Mode, Introduction to Flutter Widgets, Creating a Flutter App Using Widgets, What is a Material App widget?		
Unit 3	**Flutter Widgets**	**8 Hours**
Scaffold Widget, Image Widget, Container Widget, Column and Row Widgets, Icon Widget, Layouts in Flutter, Card Widget, App Icons for iOS and Android Apps, Hot Reload and Hot Restart, Stateful and Stateless Widgets, Use a Custom Font		
Unit 4	**Navigation and Routing**	**8 Hours**
Button Widget, FloatingActionButton, RaisedButton, FlatButton, and IconButton, DropdownButton, OutlineButton, ButtonBar, PopupMenuButton, App Structure and Navigation, Navigate to a New Screen and Back, Navigate with Named Routes, Send and Return Data Among Screens, Animate a Widget Across Screens, WebView Widget in Flutter		
Unit 5	**Material Design and Motion-Rich Widgets**	**8 Hours**
Material Design Guidelines Part 1, Introduction, BottomNavigatorBar Widget, DefaultTabController, TabBar, and TabBarView Widgets, ListTile Widget, ListView Widget, Drawer Widget, DataTable Widget, SelectableText Widget, Stack Widget, Material Design Guidelines - Part 2, Input and Selections, Text Field Widget., Checkbox Group and RadioButtonGroup Widgets, Date Picker., Time Picker., Slider Widget., Switch Widget, Dialogs, Alerts, and Panels, Alert Dialog Widget, Cupertino Alert Dialog Widget., Bottom Sheet., Modal Bottom Sheet, Persistent Bottom Sheet., Expansion Panel Widget., Snack Bar Widget.		
Unit 6		**8 Hours**
Introduction, What is the JSON?, How does Firebase Database work?, Firebase authentication (Signup and Login to Flutter App), Configure Your App to use Firebase Services, Adding Firebase to Android App, Adding Firebase to iOS App, Configuring Firebase Authentication, Login to an App Using Firebase User Accounts, Logout Configuration, Firebase Database, Which database is right for your project?, Real Time Database, Cloud Fire store		
Text Books:		
Flutter Cookbook: Over 100 proven techniques and solutions for app development with Flutter 2.2 and Dart Packt Publishing Limited by Simone Alessandria		
Reference Books:		
Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart 2 Packt Publishing Limited by by Alessandro Biessek		

Course Code:	UCSC0607		L	T	P	Credit
Course Name:	Mini Project-III		0	0	2	1

Course Prerequsites:

Data structures, Algorithms, Procedural Programming, Object-Oriented Programming, Software Engineering Basics

Course Description:

In this mini project, the students will apply multi-course Project Based Learning concepts to solve different real- world problems.In this course, students will apply the concepts they have learned in the Second Year as well as this semester .Students will develop & Implement a solution to an identified problem, maintain repository on web.

Course Outcomes: After completing the course, students will be able to

CO1	Identify real world problems which can be solved using CS concepts and technologies (Operating System, Compiler Construction and Information Security).
CO2	Describe the proposed solution to the real world problem using a technical report.
CO3	Implement the proposed solution using Computer Science & Engineering techniques.
CO4	Build detailed project report and maintain repository on web.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Problem identification and Design
3	In Semester Evaluation 2 (ISE2)	50%	Coding, Testing and Creating Repository

Course Contents:

Guidelines for Mini-Project-III

Guidelines for Mini Project -III

1 The primary objective of the mini project-III is to achieve multi course project based learning.
2 Course Instructor shall form the project team of 3 to 4 students in the batch of students
Each team shall use the knowledge they learned in the TY B.Tech courses to identify the real world problem which can be solved using technology Based on the principles, algorithms, and data structures involved in the design and construction of compilers which includes Language processors, lexical analysis, context-free grammars, Types of parsers and parsing techniques. introduction to intermediate code generation and code optimization.

The solution shall be using the tools & techniques from multiple courses - e.g a solution shall be using data structures, networking algorithm, Web Technology to develop mini project based on
practical survey of both the principles and practice of cryptography and network security.
As students have undertaken Fundamentals of Web - its recommended to develop user interface using HTML 6 The evaluation shall be done in two phases

Phase 1 ISE-1 In ISE 1 the students shall be graded based on the skills demonstrated to identify the problem statement, define the problem statement & Designing its solution. The partial working model is expected to be completed.
Phase 2 ISE-2 In ISE 2 the students shall be graded based on the complete project implementation and its working.
Followed by the detailed project report which shall cover the technical aspects of the project.
Its recommended to share a common project report format to all batches.

All course instructors shall coordinate and work towards common evaluation process.

Course instructors shall demonstrate and discuss sample case studies with students to help them understand the mini project deliverables.

Course Code:	UCSA601		L	T	P	Credit
Course Name:	Fundamentals of Economics (Audit Course-IV)		2			

Course Prerequsit

Course Descriptio

Basic knowledge of Micro and Macro Economics is essential for the Engineers studying the Computer Science and Business Systems Programme. In this course the analysis of basics of Microeconomics, studying theory of demand, elasticity of demand, theory of supply, consumers' surplus, analysis of consumer behaviour through Indifference analysis are introduced to understand the consumer & behaviour. Production function, cost analysis and study of competitive markets is taught to provide insights into the significance of competitive markets in business decisions. Analysis of national income, Keynesian theory of consumption function, theory of multiplier, supply of and demand for money, bank credit, theory of business cycles, monetary and fiscal policies are discussed to help engineering students to understand the behaviour of business enterprise based on these macroeconomic concepts.

Course Outcomes:

CO1	Describe consumer behaviour with the help of theory of demand and indifference analysis.
CO2	Analyze production function, theory of costs and various competitive markets.
CO3	Apply Keynes' theory of consumption function and theory of multiplier.
CO4	Understand the money market.
CO5	Understand Business cycles and significance of monetary and fiscal policies

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CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	In Semester Evaluation 2 (ISE2)	50%	Assignment, Test, Quiz, Seminar, Presentation, etc.
3			
4			

Course Contents:

Part- I	12 Hours

Microeconomics: Principles of Demand and Supply - Supply Curves of Firms - Elasticity of Supply; Demand Curves of Households - Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve); Welfare Analysis - Consumers' and Producers' Surplus - Price Ceilings and Price Floors; Consumer Behaviour - Axioms of Choice - Budget Constraints and Indifference Curves; Consumer's Equilibrium - Effects of a Price Change, Income and Substitution Effects -Derivation of a Demand Curve; Applications - Tax and Subsidies - Intertemporal Consumption - Suppliers' Income Effect; Theory of Production - Production Function and Iso-quants - Cost Minimization; Cost Curves - Total, Average and Marginal Costs - Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competitio

Part - II	**12 Hours**

Macroeconomics: National Income and its Components - GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector - Taxes and Subsidies; External Sector - Exports and Imports; Money - Definitions; Demand for Money -Transactionary and Speculative Demand; Supply of Money - Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets - IS, LM Model; Business Cycles and Stabilization - Monetary and Fiscal Policy - Central Bank and the Government; The Classical Paradigm - Price and Wage Rigidities - Voluntary and Involuntary Unemployment

Text Books:

1. Microeconomics, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. Macroeconomics, Dornbusch, Fischer and Startz.
3. Economics, Paul Anthony Samuelson, William D. Nordhaus.

Reference Books:

1. Intermediate Microeconomics: A Modern Approach, Hal R, Varian.
2. Principles of Macroeconomics, N. Gregory Mankiw.

Course Code:	UCSPE601		L	T	P	Credit
Course Name:	Ethical Hacking		3			3

Course Prerequsite Computer Network, Data Communication,OS and DBE

Course Description

Ethical hacking course is designed to help learners to develop a deeper understanding of threats to information system. We hope learners will develop a lifelong passion and appreciation for ethical hacking, which we are certain will help in future endeavours. Students will benefit from this learning experience. Almost all aspects of security are covered in this course.

Course Outcomes:

CO1	Define the basic concepts of components of Information and systems security and ethical hacking .
CO2	Explain different steps involved in ethical hacking with examples and scenarios.
CO3	Outline Sesion Hijacking , Firewall,IDS ,Honeypot, Web Server and web applications security issues.
CO4	Summarize Hacking Wireless Network and Mobile Platform like Android,iOS,Balckberry.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE1	10%	
2	MSE	30%	
3	ISE2	10%	
4	ESE	50%	

Course Contents:

Unit 1 Introduction to Ethical Hacking **5 Hours**

Essential Terminology, Elements of Information Security, The Security, Functionality, and Usability Triangle, Top Information Security Attack Vectors, Information Security Threat Categories, Types of Attacks on a System, Information Warfare, Hacking Concept and Scope, Vulnerability Assessment, Penetration Testing

Unit 2 Footprinting and Reconnaissance **6 Hours**

FootprintingConcept,Footprinting Methodology, Overview of Network Scanning, Scanning Methodology, Enumeration,Vulnerability Assessment Concept, System Hacking, Mulware Threats

Unit 3 Sniffing and Social Engineering **8 Hours**

Sniffing Concepts, MAC attacks,DHCP attacks,ARP Poisoning, Spoofing Attack,DNS Poisoning,Sniffing Tools,Social Engineering Concepts and Techniques,Impersonation on Social Networking Site, Identity Theft,Denial of Services

Unit 4	**Session Hijacking and Firewall and Web Server**	**7 Hours**
IDS and Firewall Concepts and System,Evading IDS,Firewall, Web Server Concepts and attacks, Attack Methodology,Countermeasures,Patch Management		
Unit 5	**Web Application Hacking and SQL Injection**	**7 Hours**
Web App concepts and attack methodology, Countermeasures ,SQL Injection methodology , SQL Injection Techniques		
Unit 6	**Hacking Wireless Network and Mobile Platform**	**7 Hours**
Wireless Concept,Wireless Encryption, Wireless Threats,Hacking Methodology, Bluetooth Hacking, Wireless Security Tool, Mobile Platform Attack Vector, Hacking Android, iOS ,Blackberry, Understanding IoT Hacking,Cloud Computing		
Text Books:		
Textbooks: 1. CEH V10: EC-Council Certified Ethical Hacker Complete Training Guide by IPSpecialist		
References: CEH v10 Certified Ethical Hacker Study Guide,Ric Messier, CEH, GCIH, GSEC, CISSP,SYBEX Publication		

Course Code:	UCSPE602	L	T	P	Credit
Course Name:	Ethical Hacking Lab			2	1

Course Prerequsites:

Computer Network, Operating System, Information Security

Course Description:

Ethical Hacking lab course cover tools and techniques that are used by hackers and penetration testers. Students will get exposure to different real time scenarios and able to aquire skills required for ethical

Course Outcomes

After completion of the course, students shall be able to -	
CO1	Demonstrate the Footprinting and Reconnaissance techniques
CO2	Make use of different types of scanning tools
CO3	Evaluate vulnerabilty assessment and penetration testing tools
CO4	Demonstarate the hacking of web server,web application and wireless network

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignments completed, quiz, oral etc
2	In Semester Evaluation 1 (ISE2)	50%	Assignments completed, quiz, oral etc

Course Contents:

Experiment No. 1	**2 Hours**
Footprinting and Reconnaissance	
Experiment No. 2	**2 Hours**
Scanning Networks	
Experiment No. 3	**2 Hours**
Vulnerability Scanning	
Experiment No. 4	**2 Hours**
System Hacking	
Experiment No. 5	**2 Hours**
Malware Threats	
Experiment No. 6	**2 Hours**
Sniffing	
Experiment No. 7	**2 Hours**
Social Engineering	
Experiment No. 8	**2 Hours**
Denial-of-Services	
Experiment No. 9	**2 Hours**

Session Hijacking	
Experiment No. 10	**2 Hours**
Evading IDS,Firewall and Honeypots	
Experiment No. 11	**2 Hours**
Hacking Web Servers	
Experiment No. 12	**2 Hours**
Hacking Web Applications	
Experiment No. 13	**2 Hours**
SQL Injection	
Experiment No. 14	**2 Hours**
Hacking Wireless Networks	
Experiment No. 15	**2 Hours**
Hacking Mobile Platforms	

Course Code:	UCSPE603		L	T	P	Credit
Course Name:	Application Devcelopment in Augmented Reality-Virtual Reality		3			3

Course Prerequ

Computer Graphics, Basics of Animation

Course Descrip

This course is introduced at third year level to get the students familiar with Immersive Technolgies related to AR-VR. Learn the techniques required for VR-AR application development.

Course Outcom After the completion of the course the student will be able to -

CO1	Differentiate between Virtual Reality and Augmented Reality
CO2	Demonstrate Unity Game Engine
CO3	Creating Content for Virtual and Augmented Reality
CO4	Explain Use Cases in AR-VR applications

CO-PO Mapping

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (M	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (E	50%	100% course contents

ISE 1 and **ISE 2** are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.
Note: Exam Question pattern will be in 50% MCQ & 50% Theory

Course Content

Unit	Defining Virtual and Augmented Reality	4 Hours

Introducing Virtual Reality and Augmented Reality,Other Types of Virtual and Augmented Reality-Mixed Reality,Augmented Virtuality,Extended Reality, Quick History tour ofn AR-VR,Evaluating the Technology Hype Cycle

Unit	Exploring the Current State of Virtual Reality & Augmented Reality	10 Hours

Looking at the Available Form Factors in VR,Focusing on Features-Room-scale versus stationary experience,Inside-out tracking,Haptic feedback,Audio,Considering Controllers-Toggle button, integrated hardware touchpad,Gaze controls,Keyboard and mouse, Standard gamepads,Motion controllers,Hand tracking,Eye tracking,Recognizing the Current Issues with VR-Simulator sickness, The screen-door effect,Movement in VR,Health effects,Looking at the Available Form Factors in VR-Mobile devices, AR headset,AR-glasses, Current Issues with Augmented Reality-Form factors and first impressions,Cost and availability,Perceived usefulness,Tracking,Field of view,Visuals

Unit	**Creating Content in Virtual and Augmented Reality**	**8 Hours**

Choosing Virtual Reality,Choosing Augmented Reality,Planning Your Virtual Reality Project-Defining Your Virtual Reality Project,Exploring Design Principles in Virtual Reality,Planning Your Augmented Reality Project-Defining Your Augmented Reality Project,Exploring Design Principles in Augmented Reality

Unit	**Games and Games Engine**	**6 Hours**

Introduction to game engine,Game Engines Today, Introduction to Unity Engine-Install Unity, Configure Unity-on disk, in the cloud,Script Editor-VS Code,Navigating the unity interface, understanding the different window views,Confiure and custmize layout, The transform toolset, handle position control, unity project structure, VR and AR app development in Unity

Unit	**Creating Content for Virtual and Augmented Reality**	**8 Hours**

Assessing Design Software-User experience design software,VR/AR-based design tools,Capturing Real Life-Video-capture options,Mass-consumer models,Still-image capture options,Audio options-Voiceover,Sound effects,Background audio,Spatial audio

Unit	**Virtual and Augmented Reality in the Wild**	**4 Hours**

Exploring Virtual Reality Use Cases-Art, Education,Entertainment, Healthcare, Gaming,Exploring Augmented Reality Use Cases-Art,Education,Industry and commerce, Entertainment, Utilities

Text Books:

1. Virtual & Augmented Reality For Dummies,Published by: John Wiley & Sons, Inc.
2. Developing 2D games with unity-Independent game prograaming with C#-Jared Halpern

Reference Bool

1.The VR Book-Human Centered Design for Virtual Reality-Jason Jerald
2. Virtual and Augmented Reality, An educational handbook by Zeynep Tacgin, Cambridge scholares publishing
3. Virtual Reality-steven m lavalle, cambridge university press, copyright steven m lavalle 2019

Course Code:	UCSPE604		L	T	P	Credit
Course Name:	on Devcelopment in Augmented Reality-Virtual Re:				2	1

Course Prerequsites

Computer Graphics, Basics of Animation & C#

Course Description:

This course is introduced at third year level to get the students familiar with Immersive Technolgies related to AR-VR. Creating 3d models using advanced software tools. Developing AR and VR applications using Unity tool.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Design 3d models & Develop VR application in Unity
CO2	Develop AR application in Unity
CO3	Design Virtual Tour, Make use of VR Devices for demonstrating VR environment

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignments completed, quiz, oral etc
2	In Semester Evaluation 1 (ISE2)	50%	Assignments completed, quiz, oral etc

ISE based on Practicals,Oral, Presentation ,Quiz etc
ESE having External Oral Exam

Experiment List:

EXP 1 **Create 3d Models using Blender** **2**

Aim & Objective: Learn Blender platform. Create 3d graphical models

EXP 2 **Installation of Unity** **2**

Aim & Objective: Installing Unity hub. Creating Unity hub account to download required unity version. Download all the dependency files and including it in XR Setting

EXP 3 **Create Basic Scenes in Unity using 3d models and Unity asset store** **2**

Aim & Objective: Learn the basic unit interface. Importing assets in scene window. Set objects properties in Inspector window. Generate Graphical scenario and test it

EXP 4 **Creating VR application using google cardboard** **2**

Aim & Objective: Download the GVR SDK package for supprting google card board. Create VR Scenario in unity. Applying GVR Rectical pointer,GVR Event System, GVR phyiscspointer raycaster properties. Create the basic C# scripts and applying it on 3d objects

EXP 5 **Grab and Relese objects using google cardboard** **2**

Aim & Objective: Create interactive application in VR using google cardboard.		
EXP 6	**Create Simple game using mobile joysticks in unity**	**2**
Aim & Objective: Apply the mobile joysticks properties to unity game and create andriod aok file, run it on mobile		
EXP 7	**Creating AR application using Vuforia platform**	**2**
Aim & Objective: Create Vuforia account and generate the database and upload it on unity. Visualize the 3d object on target image		
EXP 8	**Creating Interactive AR Book**	**2**
Aim & Objective: Learn how to use multiple target images in AR. Apply lean touch properties for making the book interactive		
EXP 9	**Making of Virtual Tour/ Virtual Walkthrough**	**2**
Aim & Objective: Capturing 360 degree images of surroundings and make a virtual walk through		
EXP 10	**Test and Configure VR application using HTC Vive**	**2**
Aim & Objective: Download the steam VR asset. Configure it to HTC Vive and test the generated VR Scene throgh HTC Vive		
Text Books:		
1. Virtual & Augmented Reality For Dummies,Published by: John Wiley & Sons, Inc. 2. Developing 2D games with unity-Independent game prograaming with C#-Jared Halpern		
Reference Books:		
1.The VR Book-Human Centered Design for Virtual Reality-Jason Jerald 2. Virtual and Augmented Reality, An educational handbook by Zeynep Tacgin, Cambridge scholares publishing 3. Virtual Reality-steven m lavalle, cambridge university press, copyright steven m lavalle 2019 Websites: 1. https://developer.vuforia.com 2. https://unity.com/download 3. https://kuula.co/		

Course Code:	UCSPE605		L	T	P	Credit
Course Name:	Artificial Neural Networks		3			3

Course Prerequsites:

Basics of Machine Learning

Course Description:

This is one of the important courses in the Computer Science & Engineering Programme, In this course students will become familiar with different types of artificial neural networks.

Course Outcomes: After the completion of the course the student will be able to -

CO1	describe the basic architecture of ANNs,
CO2	describe and analyse CNNs
CO3	desribe and analyse diffent types of RNNs
CO4	apply ANN concepts to design applications in different domains

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc,
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc,
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	Introduction	4 Hours

Building Blocks of Neural Network, Optimizers, Activation Functions, Loss Functions, Feature Engineering, Overfitting and
Underfitting, Hyperparameters

Unit 2	**Convolutional Neural Networks**	**6 Hours**
Building a convolutional neural network, Input Layers, Convolution Layers, Pooling Layers, Dense Layers, Backpropagation Through the Convolutional Layer, Filters and Feature Maps, Backpropagation Through the Pooling Layers, Dropout Layers and Regularization, Batch Normalization, Various Activation Functions, Various Optimizers, LeNet, AlexNet, VGG16, ResNet,		
Unit 3	**Recurrant Neural Networks**	**8 Hours**
RNN, Bidirectional RNNs (BRNN) , Long Short Term Memory (LSTM), Bi-directional LSTM, Sequence-to-Sequence Models (Seq2Seq), Gated recurrent unit GRU		
Unit 4	**Reinforced Learning**	**8 Hours**
Reinforcement Learning, Q-Learning, Deep Q-Network (DQN), Policy Gradient Methods, Actor-Critic Algorithm, Autoencoding, Convolutional Auto Encoding, Variational Auto Encoding, Autoencoders for Feature Extraction, Auto Encoders for Classification, Denoising Autoencoders, Sparse Autoencoders		
Unit 5	**Generative Adverserial Networks**	**6 Hours**
Introduction to GANS, How do GANs work,Types of GANS- Vanilla, Conditional GAN, Deep Convolutional GAN		
Unit 6	**Speech Recognition using RNN**	**6 Hours**
Connectionist Temporal Classification,RNN Transducer, Decoding, Regularization		
Text Books:		
1. Neural Nttworks and Deep Learning - Charu Aggarwal		
Reference Books:		
1. Elements of Artificial Neural Networks - Mehrotra, Mohan and Ranka		
2. Deep Learning - Goodfellow, Bengio and Cornville		

Course Code:	UCSPE606		L	T	P	Credit
Course Name:	Artificial Neural Networks Lab				2	1

Course Prerequsi

Basics of Machine Learning

Course Descriptio

This lab course is designed to give students practical experience in implementing various ANN algorithms using real-world datasets. Students will gain hands-on experience with popular algorithms such as CNN, RNN, GAN and their variations.

Course Outcomes After the completion of the course the student will be able to -

CO1	Analyze the different types of ANN algorithms.
CO2	Apply the different types of ANN algorithms to real-world data sets.
CO3	Evaluate the performance of different ANN algorithms using appropriate metrics and techniques.
CO4	Make use of modern tools to design and implement ANN algorithms to solve specific problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Marks	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignments completed, quiz, oral etc
2	In Semester Evaluation 1 (ISE2)	50%	Assignments completed, quiz, oral etc

Course Contents:

Assignment 1

To implement a simple ANN

Assignmnet 2

To implement a simple CNN

Assignment 3

To develop an application using LeNet 5/AlexNet/VGG16/ResNet

Assignment 4

To study and make variations in an application based on RNN

Assignment 5
To study/modify/develop an application based on the LSTM algorithm
Assignment 6
To study/modify/develop an application based on the GRU model
Assignment 7
To develop an application based on the Q-learning algorithm
Assignment 8
To develop an application based on the Q-learning algorithm
Assignment 9
To develop an application using autoencoders for feature extractions
Assignment 10
To develop an application using autoencoders for classification
Assignment 11
To dcevelop an application to generate new images using the Vanilla GAN
Assignment 12
To study/modify/develop an application based on the deep convolutional GANs for image modification.
Note:
The course teacher should conduct lab assignments based on (but not limited to)the above assignments.
The course teacher should preferably implement the assignments in Python. In case the course teacher finds implementation of an assignment using any other language, he/she is free to do so.
References:
1. Neural Network Programming with TenserFlow by Manpreet Ghotra and Rajdeep Dua
2. Hands on Neural Networks with Keras by Niloy Purkait
3. https://machinelearningmastery.com

Course Code:	UCSPE607		L	T	P	Credit
Course Name:	Linux Internals		3			3

Course Prerequsites:

Operating System

Course Description:

This course aims at making the learners familiar with the basic linux utilities and shell scripting. It also helps them to understand the basics of different linux kernel modules, system calls, and device drivers.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Make use of various linux utilities.
CO2	Build shell scripts for various tasks.
CO3	Summarize the basics of Linux Kernel modules.
CO4	Interpret the basics of system calls and device driver.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (MSE)	30%	50% of course contents
3	In Semester Evaluation 2 (ISE2)	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (ESE)	50%	100% course contents

Course Contents:

Unit 1	Introduction to Linux operating system	5 Hours

History of Linux, features of Linux, architecture of unix/linux, Linux Utilities- File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities; Sed: Scripts, operation, addresses, commands; awk: Execution, fields and records scripts, operation, patterns, actions, applications

Unit 2	Working with the Bourne again shell (bash)	4 Hours

Introduction, shell responsibilities, pipes and input Redirection, output redirection, running a shell script, the shell as a programming language, shell metacharacters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

Unit 3	Introduction to Linux Kernel Modules	6 Hours

What is Kernel, Types of Kernels, Overview of the Linux kernel structure and components, Understanding the kernel initialization process, Exploring the kernel's memory management and process scheduling, Introduction to system calls and kernel API interfaces.

Unit 4	System Call Implementation	6 Hours

System Calls, Communicating with the Kernel, APIs, POSIX, and the C Library, System Call Numbers, System Call Performance, System Call Handler, Denoting the Correct System Call, Parameter Passing, Implementing System Calls, Verifying the Parameters, System Call Context, Accessing the System Call from User-Space

Unit 5	Writing Linux Kernel Module	7 Hours

Identify the functionality or feature you want to implement in your module, Define the data structures, variables, and functions needed for your module, Write the code for your module, including the initialization and cleanup functions, Use the appropriate kernel APIs and data structures to interact with the kernel, Write a Makefile that specifies the compilation options, dependencies, and output file for your module, Use the kernel build system (typically using the make command) to compile the module, Load the module into the kernel using the insmod command, Test your module's functionality to ensure it behaves as expected.

Unit 6	**Writing Device Drivers**	**7 Hours**

Device Drivers and Kernel Subsystems, Introduction to device drivers and their role in Linux, Examining the kernel's I/O subsystem and driver model, Writing and integrating device drivers into the Linux kernel, Exploring different subsystems, such as networking, storage, and input/output.

Text Books:

1. Linux Kernel Development - Robert Love - 3rd Edition (Pearson Education)
2. Linux Kernel Programming - Kaiwan N Billimoria - Released March 2021 (Packt Publishing)
3. The Linux Kernel Module Programming Guide - Peter Jay Salzman, Michael Burian, Ori Pomerantz, Bob Mottram, Jim Huang - Open Source License

Reference Books:

1. Operating Systems –Concepts and design –Milan Milenkovic (TMGH)
2. Operating Systems: Internals and Design Principles (8th Edition)- by William Stallings (Pearson Education)
3. The Design of Unix Operating System - Maurice J. Bach (PHI)
4. Unix concepts and administration – 3rd Edition – Sumitabha Das (TMGH).

Course Code:	UCSPE608		L	T	P	Credit
Course Name:	Linux Internals Lab			1		1

Course Prerequsites:

Operating System

Course Description:

This course aims at making the learners familiar with the basic linux utilities and shell scripting. It also helps them to understand the basics of different linux kernel modules, system calls, and device drivers and write basic programs to implement simple - kernel module, system call and device driver.

Course Outcomes: After the completion of the course the student will be able to -

CO1	Make use of various linux utilities.
CO2	Build shell scripts for various tasks.
CO3	Build simple Linux Kernel modules, system calls and device drivers.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Marks	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignments completed, quiz, oral etc
2	In Semester Evaluation 1 (ISE2)	50%	Assignments completed, quiz, oral etc

Course Contents: **List of Assignments**

Assigment 1: Study linux text processing utilities.

Assigment 2: A program on Shell Script

Assigment 3: A program on Shell Script

Assigment 4: Installation and configuration of LINUX Kernel Development Environment using GNU toolchain.

Assigment 5: Download Kernel source code and compile the kernel.

Assigment 6: Implementing a simple system call

Assigment 7: Writing a simple kernel module

Assigment 8: Writing a simple device driver

Text Books:

1. Linux Kernel Development - Robert Love - 3rd Edition (Pearson Education)
2. Linux Kernel Programming - Kaiwan N Billimoria - Released March 2021 (Packt Publishing)
3. The Linux Kernel Module Programming Guide - Peter Jay Salzman, Michael Burian, Ori Pomerantz, Bob Mottram, Jim Huang - Open Source License

Reference Books:

1. Operating Systems –Concepts and design –Milan Milenkovic (TMGH)
2. Operating Systems: Internals and Design Principles (8th Edition)- by William Stallings (Pearson Education)
3. The Design of Unix Operating System - Maurice J. Bach (PHI)
4. Unix concepts and administration – 3rd Edition – Sumitabha Das (TMGH).

Course Code:	UCSPE609		L	T	P	Credit
Course Name:	Internet of Things		2			2

Course Prerequ

Knowledge of Computer Networking, Knowledge of Micro Processors, Micro Controllers, Knowledge of Programming languages such as C, Python, Assembly level.

Course Descript

This course introduces the necessary fundamental principles of Internet of Things. It aims to develop various applications related to smart cities, agriculture etc.

Course Outcome After the completion of the course the student will be able to -

CO1	Explain key concepts and terminologies related to Internet of Things (IoT).
CO2	Compare different IoT devices based on its architecture.
CO3	Build IoT solution for real life problems.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (IS	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
2	Mid Semester Examination (	30%	50% of course contents
3	In Semester Evaluation 2 (IS	10%	Assignment, Test, Quiz, Seminar, Presentation, etc.
4	End Semester Examination (	50%	100% course contents

Course Contents

Unit	Introduction to IoT	5 Hours

Introduction to Internet of Things-Defination and Characteristics of IoT, Physical design of IoT-IoT Protocols, Logical design of IoT- IoT Communication Model, IoT Communication APIs, IoT Enabling Technologies, IoT Levels & deployment Templates.

Unit	Fundamental IoT Mechanisms & Key Technologies :	6 Hours

Structural aspects of the IoT:Environment characteristics, Traffic characteristics, scalability, Interoperability, Security and Privacy, Open architecture, **Key IoT Technologies:**Device Intelligence, Communication capabilities,
Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology. **Evolving IoT Standards:** IETF IPv6 Routing Protocol for RPL Roll, Constrained Application Protocol(CoAP), REST, 6LoWPAN, ZigBee IP(ZIP)

Unit	Introduction to IoT Devices	7 Hours
What is an IoT Devices, **Rasberry Pi:**Architechture, Pin Configuration, Pin Interface, Installation of Raspian OS, **Arduino:** Architechture, Pin Configuration, Pin Interface **Sensors**. DTH, Touch Sensor, Humidity Sensor, Soil Mositure Sensor.		
Unit	**Building IoT with Arduino & Raspberry Pi**	**6 Hours**
Building IOT with Arduino- Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks - Pi - Raspberry Pi Interfaces		
Unit	**IoT Physical Servers and Cloud Offerings**	**6 Hours**
Introduction to Cloud storage models and communication API's, WAMP –AutoBahn for IoT, Amazon web services for IoT		
Unit	**Case studies Illustrating IoT Design:**	**5 Hours**
Introduction, Home automation, cities, Environment, Agriculture, Productivity applications.		
Text Books:		
1. Internet of Things: A Hands-On Approach By ArshdeepBahga, Vijay Madisetti (Unit 1,3,4,5,6) . 2. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, Wiley Publications.		
Reference Books:		
1. The Internet of Things: Connecting Objects to the Web, HakimaChaouchi, Wiley Publications		

Course Code:	UCSPE610		L	T	P	Credit
Course Name:	Internet Of Things (Lab)				2	1

Course Prerequsi

Knowledge of Computer Networking, Knowledge of Micro Processors, Micro Controllers, Knowledge of Programming languages such as C, Python, Assembly level.

Course Descriptio

This course introduces the necessary fundamental principles of Internet of Things. It aims to develop various applications related to smart cities, agriculture etc.

Course Outcomes After the completion of the course the student will be able to -

CO1	Identify and solve the problems using Python.
CO2	Experiment with Raspberry Pi kit.
CO3	Experiment with Intel Arduino kit.

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	In Semester Evaluation 1 (ISE1)	50%	Assignments completed, quiz, oral etc
2	In Semester Evaluation 1 (ISE2)	50%	Assignments completed, quiz, oral etc

Course Contents:

Exper	**Networking in Python** **2 Hours**

Implement simple client server message passing program

Exper	**Basic setup for Raspberry Pi** **2 Hours**

To understand Raspberry Pi Pin configuration, Raspberry Pi os setup

Exper	**Blinking LED using Raspberry Pi** **2 Hours**

Write a program to implement blinking LED using Raspberry Pi

Exper	**Blinking LED using Arduino** **2 Hours**

Write a program to implement blinking LED using Arduino

Exper	**Implementation of IoT with Raspberry Pi** **2 Hours**

Implement DHT sensor interface with Raspberry Pi

Exper	**Implementation of IoT with Arduino** **2 Hours**

Implement DHT sensor interface Intel Galileo kit

Exper	Implementation of IoT with Raspberry Pi	2 Hours
To implement Buzzer sensor interface with Raspberry Pi		

Exper	Implementation of IoT with Raspberry Pi	2 Hours
To implement Touch sensor interface with Raspberry Pi		

Exper	DETECT THE VIBRATION OF AN OBJECT USING ARDUINO	2 Hours
To implement Vibration sensor interface with Arduino		

Exper	CONNECT WITH THE AVAILABLE WI-FI USING ARDUINO	2 Hours
To write a program to connect with the available Wi-Fi using Arduino		

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8th edition, Wiley India, 2009.
2. The Design of Unix Operating System - Maurice J. Bach (PHI)

Reference Books:

1. Operating Systems –Concepts and design –Milan Milenkovic (TMGH)
2. Operating Systems: Internals and Design Principles (8th Edition)- by William Stallings (Pearson Education)
3. Modern Operating Systems by Andrew S. Tanenbaum (Pearson Education International)
4. Unix concepts and administration – 3rd Edition – Sumitabha Das (TMGH).

Course Code:	UCSO0601	L	T	P	Credit
Course Name:	Cyber Security (Open Elective)	3			3

Course Prerequsite Computer Network, Data Communication

Course Description

Cyber security course is designed to help learners to develop understanding of threats to information system and basic concepts of cyber security. Also they will get exposure to cyber security policies and standards inluding cyber terrorism and cyber forensics.

Course Outcomes:

CO1	Explain the basic components of security and Internet
CO2	Outline diferent types of cyber attacks ,malware and encryption
CO3	Describe the process of scanning and tsting the network
CO4	Explain security policies,standards ,cyber terrorism and cyber forensics concepts

CO-PO Mapping:

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

Assessment Scheme:

SN	Assessment	Weightage	Remark
1	ISE1	10%	
2	MSE	30%	
3	ISE2	10%	
4	ESE	50%	

Course Contents:

Unit 1	Introduction to Computer Security	6 Hours

Introduction (3)
Introduction**,**Identifying Types of Threats, Assessing the Likelihood of an Attack on Your Network,Basic Security Terminology,Concepts and Approaches,How Do Legal Issues Impact Network Security
Networks and the Internet(3)
Network Basics,How the Internet Works,Basic Network Utilities, Other Network Devices,Advanced Network Communications Topics,Cloud Computing

Unit 2	Cyber Attacks and Malware	6 Hours

Cyber Stalking, Fraud, and Abuse (2)
How Internet Fraud Works,Identity Theft, Cyber Stalking,Protecting Yourself Against Cybercrime
Denial of Service Attacks and Malware (4)
DoS Attacks,Illustrating an Attack,Common Tools Used for DoS Attacks,DoS Weaknesses, Specific DoS Attacks,Real-World Examples of DoS Attacks and Defence,Virus and types of Malware

Unit 3	Hacker Techniques and Encryption	7 Hours

Techniques Used by Hackers (1)
Basic Terminology,The Reconnaissance Phase, Actual Attacks,Malware Creation,Penetration Testing, Dark Web
Industrial Espionage in Cyberspace (3)
What Is Industrial Espionage?,Information as an Asset,Real-World Examples of Industrial Espionage, Protecting Against Industrial Espionage,Trade Secrets,The Industrial Espionage Act, Spear Phishing
Encryption (4)
Cryptography Basics,Modern Cryptography Methods,Public Key (Asymmetric) Encryption,PGP, Legitimate Versus Fraudulent Encryption Methods, Digital Signatures,Hashing ,Quantum Cryptography

Unit 4	**Computer Security Technology and Policies**	**6 Hours**

Computer Security Technologies (3)
Virus Scanners,Firewalls,Antispyware, IDSs,Digital Certificates,SSL/TLS,VPN,Wi-Fi Security

Security Policies (3)
What Is a Policy,Important Standards,User Policies,Security breaches and access control,Disaster recovery ,Zero Trust and Important Laws

Unit 5	**Network Scaning and Cyber Terrorism**	**6 Hours**

Network Scanning (2)
Basics of Assessing a System,Securing Computer Systems,Scanning Your Network,Testing and Scanning Standards

Cyber Terrorism and Information Warfare(4)
Actual Cases of Cyber Terrorism,Weapons of Cyber Warfare, Economic Attacks,Military Operations Attacks, Supervisory Control and Data Acquisitions, Information Warfare,Actual Cases of Cyber Terrorism,Defense Against Cyber Terrorism,Terrorist Recruiting and Communication,TOR and Dark Web

Unit 6	**Cyber Detective and Forensics**	**6 Hours**

Cyber Detective (2)
General Searches,Company Searches,Court Records and Criminal Checks,Usenet,Google,Maltego
Forensics (3)
General Guidelines,Finding Evidence on a PC and System log,Getting Back Deleted Files,Operating System Utilities,The Windows Registry, Mobile Forensics: Cell Phone Concepts,Expert Witnesses, Additional Types of Forensics
Cyber Security Engineering(1)
Defining Cybersecurity Engineering,Standards,SecML,Modeling

Text Books:

Textbooks:
1. Computer Security Fundamentals, 5th edition Published by Pearson IT Certification (December 23, 2022) © 2023, William Chuck Easttom

References:
1. Cryptography & Network Security B.A. Forouzan McGrawHill
2. Cryptography and network security – Atul Kahate (TMGH)
3. Cyber Security: Understanding Cyber Crimes,Computer Forensic and Legal Perspectives- Nina Godbole,Sunit Belapure ,Wiley India Publication