JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURJADA VIZIANAGARAM
VIZIANAGARAM – 535 003, Andhra Pradesh, India
B.Tech (R23-COURSE STRUCTURE & SYLLABUS)
(Applicable from the academic year 2024-25 and onwards)
Minors

MINORS COURSES OFFERED BY AI AIDED COURSES

TRACK1: APPLICATION PROGRAMMING

OE-1   Python Programming/ Object Oriented Programming through C++

OE-2   Java Programming

OE-3   Advanced Java Programming /Advanced Python Programming

OE-4   Dot Net Programming / Java Enterprise Framework

TRACK2: DATA SCIENCE

OE-1   Database Management System

OE-2   Data Mining

OE-3   Machine Learning / Artificial Intelligence & Neural Networks

OE-4   Deep Learning/ Image Processing

TRACK3: WEB PROGRAMMING

OE-1   Web UI Framework

OE-2   Angular Framework

OE-3   React Framework / Node Framework

OE-4   Mobile App Development/ DJango Framework

TRACK4: SECURITY

OE-1   Unix Programming

OE-2   Information Security

OE-3   Cyber Security / Cyber Laws

OE-4   Block Chain Technology / Secure Coding.

TRACK5: AI TRACK

OE-1   Mathematics for Machine Learning

OE-2   AI for All

OE-3   Machine Learning Using Python

OE-4   AI for Data Science1

Course Code	Subject Name	L	T	P	C
R20CIT-PC2101	Python Programming Common to CSE, CSSE,CSIT	3	0	0	3

Course Objectives:
1. Understand structure and data types of python script.
2. Implement iterations and functions in python.
3. Implement modules and data structures using mutable &immutable objects.
4. Understand object oriented concepts on real world scenarios.
5. Understand packages for statistics and gaming.

Course Outcomes:

1. Understand installation of python and different types of variable allocations. (L2)

2. Implement control flow and functions for data processing. (L3)

3. Applying modules and Packages in programming. (L3)

4. Analyze different data structures and their functionalities. (L4)

5. Understand Object oriented concepts and handle different errors through exceptions. (L3)

Unit I:

Introduction: what is python programming , History of Python, Features of Python, Applications, python installation steps, Python Using the REPL(Shell), Running Python Scripts, Variables, Assignment forms, Program Comments and Doc strings, Keywords, Input-Output, Indentation.
Operators and Type Conversion: Data Types: Numeric, Booleans, Sequence, Strings, Operations in python, Type conversions, Expressions.

Learning Outcomes:
After completing this chapter, student will be able to
1. Understand the environment of python.(L2)
2. Create and run simple scripts in python.(L2)
3. Understand data types and their conversions.(L2)
4. Understand operators for doing operations on different expressions.(L2)

Applications:

1. Operating Systems
2. Web and Internet Development

Unit II:

Control Flow: Control Flow-if, elif, for, range (), while, break, continue, pass, nested loops.
Functions: Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Fruitful Functions (Function Returning Values), recursive function, Scope of the Variables in a Function - Global and Local Variables, Anonymous Functions, Lambdas, map, reduce and filter.
Learning Outcomes:

2. Make decisions through conditional statements.(L2)
3. Understand functions to define call and pass as arguments.(L2)
4. Write anonymous functions for resolving complex problems.(L2)

Applications:

1. Game Development
2. Artificial Intelligence and Machine Learning

Unit III:

Modules: why module programming, Creating modules, import statement, from Import statement, namespace, built-in modules- os, random, math, json, request, date, RegEx, itertools.

Packages: Introduction to PIP**,** Installing packages using PIP.

Learning Outcomes:

After completing this chapter, student will be able to

1. Create and implement modules using import.(L3)
2. Understand different built-in modules.(L2)
3. Understand data science libraries.(L2)

Applications:

1. Game Development
2. Business Applications

Unit IV:

Exploring Data Science Libraries: NumPy, Pandas, Matplotlib

Strings & Data Structures: String**,** String Formatting**,** List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File I/O Operations. **Learning Outcomes:**

After completing this chapter, student will be able to

1. Implement String operations and formatting.(L3)
2. Understand fundamentals of data structures and their methods.(L2)
3. Implementing file operations for data processing.(L3)

Applications:

1. Data Science

2. Data Structures

3. Artificial Intelligence and Machine Learning

Unit V:

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: SyntaxErrors, Exceptions, ExceptionHandlers, RaisingExceptions, User-defined Exceptions

Learning Outcomes:

After completing this chapter, student will be able to

1. Implement Object oriented concepts with real world scenarios.(L3)
2. Understand class hierarchies and abstraction.(L2)
3. Understand error handling and handle exceptions.(L2)

Applications:
1. Desktop GUI
2. Business Applications

Text Books:
1. PythonProgramming:UsingProblemSolvingApproachbyReemaTheraja,Oxford publications
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

Reference Books:
1. Fundamentals of Python by Kenneth HL ambert, Cengage
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming by Ashok N Kamathane, McGrawhill

Course Code	Subject Name	L	T	P	C
	Introduction to Java Programming	3	0	0	3

Course Objectives

1. Understand the structure and environment of Java.

2. Implement the relationship between objects.

3. Understand the Strings and Organize data using different data

4. Implement text processes and error handling.

5. Understand to create multi-threading applications and GUI applications.

Course Outcomes:

1. Understand the environment of JRE and Control Statements. (L2)

2. Implement real world objects using class Hierarchy (L3)

3. Implement generic data structures for iterating distinct objects (L3)

4. Implement error handling through exceptions and file handling through streams. (L3)

5. Design thread-safe GUI applications for data communication between objects (L4)

Unit I: Java Environment and Program Structure

History of Java, Features, Applications, Java Installation - JDK and JRE, JVM Architecture, OOPS Principles, Class and Object, Naming Convention, Data Types, Type Casting, Type Conversion, Wrapper classes, Operators, instance of operator, Command Line Arguments, Decision making, Arrays, and Looping statements.

Learning Outcomes: Student will be able to

1. Understand architecture of Java Virtual Machine. (L2)

2. Understand the structure of java program and its environment. (L2)

Unit II: Class Hierarchy & Data Hiding

Property, Method, Constructor, Inheritance (IS-A) , Aggregation and Composition (HAS-A), this and super, static and initialize blocks, Method overloading and overriding, static and final keywords, Types of Inheritance, Compile time and Runtime Polymorphism, Access Specifiers and scope, packages and access modifiers, Abstract class, Interface, Interface Inheritance, Achieving Multiple Inheritance, Class casting, Object Cloning, Inner Classes.

Learning Outcomes: Student will be able to

1. Understand the class hierarchy and their scope. (L2)

2. Implement relationship between objects. (L3)

3. Understand data hiding and nested classes. (L2)

4. Implement data type casting and cloning of objects. (L3)

Unit III: Strings and Collections

String: Methods, StringBuffer and StringBuilder, StringTokenizer

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: foreach, Enumeration, Iterator and ListIterator.

Learning Outcomes: Student will be able to

1. Understand the usage of String and its properties and methods. (L2)

2. Understand data structures and Iterators. (L2)

3. Create the data structures and implement different utility classes. (L3)

Unit IV: IO and Error Handling

IO Streams: Exploring java.io. *, Character and Byte Streams, Reading and Writing, Serialization and De-serialization, Error Handling: Error vs Exception, Exception hierarchy, Types of Exception, Exception handlers, User defined exception, Exception propagation.

Learning Outcomes: Student will be able to

1. Understand character and byte streams. (L2)

2. Understand the hierarchy of errors and exceptions. (L2)

3. Implement data streams and exception handlers. (L3)

Unit V: Threads and GUI

Multi-Threading: Process vs Thread, Thread Life Cycle, Thread class and Runnable Interface, Thread synchronization and communication.

GUI: Component, Container, Applet, Applet Life Cycle, Event delegation model, Layouts, Menu, MenuBar, MenuItem.

Learning Outcomes: Student will be able to

1. Understand the Thread Life Cycle and its scheduling. (L2)

2. Implement the synchronization of threads. (L2)

3. Create graphical components using Abstract window toolkit. (L3)

Applications:
- Desktop GUI Applications
- Mobile Applications
- Artificial intelligence
- Web applications
- Big Data technology
- Gaming applications
- Business applications
- Embedded systems
- Cloud applications
- Scientific applications

Contemporary Topics
Annotations, Reflections

TEXT BOOKS:

1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.

2. Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford.

3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.

4. Java: How to Program, 9th Edition (Deitel) 9th Edition.

5. Core Java: An Integrated Approach, Java 8 by R. Nageswara Rao.

REFERENCE BOOKS:

1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers

2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Weblinks:

1. https://www.javapoint.com/
2. https://www.sitesbay.com/java/index
3. https://www.tutorialspoint.com/java/index.htm
4. https://www.w3schools.com/java/
5. https://www.programiz.com/java-programming

Subject Code	Subject Name	L	T	P	C
	Advanced Java Programming	3	0	0	0

Course Objectives:

- Create GUI screens for standalone applications.

- Understand the features of lambdas and streams.

- Understand the different driver specific database connections.

- Implement server-side programming using Servlets.

- Implement server-side programming using Java Server pages.

Course Outcomes:

1. Create GUI based applications using Panels and Components.

2. Analyze the collections using Lambdas and Streams.

3. Implement JDBC connections using java SQL packages.

4. Create Server-Side programs for request-response handling using Servlets.

5. Apply JSP for server-side tag implementation.

Unit 1: GUI Programming: Basics of Swing, Swing Features, Components and Containers, Event Handling, Various Swing components, Writing Swing Application

Learning Outcomes: student will be able to
- Understand the fundamentals of GUI programming. (L2)
- Understand components and panels for user interface. (L2)
- Create Stand-alone GUI components using Swing Components. (L4)

Unit 2: Lambdas & Streams : Functional Interface, Lambda expressions, scope, streams-creation, collections, filtering, pipeline, lazy invocation, reduction, collect method

Learning Outcomes: Student will be able to
- Understand the functional interface and expressions. (L2).
- Apply streams and lambdas for data collectors. (L4).
- Create Filters and maps for generated collection data. (L4)

Unit 3: Java database Programming: Basics of Java database, JDBC Architecture, Different Types of Drivers of JDBC, Establishing JDBC Database Connections, JDBC Statements, ResultSet Interface, RowSet interface, JDBC Batch Processing, exploring java.sql.*, javax.sql.*

Learning Outcomes: Student will be able to
- Understand fundamentals of SQL and its operations (L2)

- Create JDBC drivers for different database vendors. (L4)
- Implement JDBC connections for CRUD operations. (L4)

Unit 4: Java Servlet Programming: Servlet: Basics of Servlet, Types of Servlet, Servlet Life Cycle, HTTP request, HTTP response, Servlet init parameters, ServletRequest, ServletConfig, ServletContext, Session Tracking, Database Handling

Learning Outcomes: Student will be able to
- Understand the life cycle of servlet. (L2)
- Implement HTTPRequest and response handling using HTTPServlet APIs. (L4)
- Implement Sessions and Cookies using servlet APIs. (L4)

Unit 5: Java Server Pages (JSP): Basics of JSP, Life cycle of JSP, Scripting elements, Implicit Objects, Directive Elements, JSP actions: include and forward, Session Tracking, Page redirection, Database Handling

Learning Outcomes: Student will be able to
- Understand Life cycle of JSP over Servlet. (L2)
- Implement scripting elements of JSP in web pages. L4)
- Apply implicit objects and actions on server side APIs. (L4)

APPLICATIONS:
- Building stand-alone applications
- Building Financial, banking applications, gateways etc
- Online and Social media applications

TEXT BOOKS:
1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book Paperback – 1 January 2009
   by Kogent Learning Solutions Inc, Dreamtech Press; 1st edition.
2. Java for Web Development (English, Paperback, Vivek, Gupta Sarika, Agarwal), BPB Publications

REFERENCE BOOKS:

1. Java: How to Program, 9th Edition (Deitel) 9th Edition by Paul Deitel (Author), Harvey M. Deitel (Author).
2. Java 8 in Action: Lambdas, Streams, and functional-style programming Paperback, 2014 by Raoul-Gabriel Urma (Author), Mario Fusco (Author), Alan Mycroft (Author)

Subject Code	Subject Name	L	T	P	C
	Advanced Python Programming				

Course Objectives:

- Understand the pattern matching techniques in python.

- Understand the python web scraping libraries.

- Write queries for connecting database using python libraries.

- Analyse different data files using pandas libraries.

- Implement data visualization libraries for data plotting.

Course Outcomes:

1. Analyze regular expressions for matching patterns in a String sequences.
2. Analyze web data using python scraping libraries.
3. Develop python scripts for database CRUD operations.
4. Apply data analysis using pandas library.
5. Implement data visualizations using matplotlib library.

Unit I: PATTERN MATCHING - Introduction to Regular Expression, Applications, re module in python, RegEx Functions, Flags, Meta Characters, Quantifiers, Character Sets, Repetitions, Rangers, Grouping, Validations.

Learning Outcomes: student will be able to

- Understand RegEx expressions and functions.(L2)
- Implement new patterns for matching large sequences. (L3)
- Implement metacharacters for finding patterns. (L4)

Unit II: WEB SCRAPING: Introduction to Web Scraping, Exploring requests, json, urllib modules, Scraping Web Services, application types (JSON/HTML/XML), Exploring Beautiful Soup: Parsing XML,HTML content.

Learning Outcomes: Student will be able to

- Understand request and urllib modules for web scraping (L2).
- Implement response application types from web services. (L4).
- Implement beautiful soup module for parsing web files (L4).

Unit III: PYTHON DATABASE CONNECTIVITY: Introduction to SQLite, Create Connection, Cursor, Creating database, tables, Insert and Update data, Fetch data operation, Drop tables and databases, SQL Execute and Close, SQLite Exceptions, SQL datetime.

Learning Outcomes: Student will be able to

- Understand the structure of SQLite database. (L2)
- Create queries for updating and fetching data.(L4)
- Implement SQL Exceptions for handling errors.(L4)

Unit IV: DATA ANALYSIS: Introduction to PANDAS, Reading and Viewing files, Data Frames & Series Data Types, Indexes, Filtering, Add/Remove/Update rows and Columns, Sorting Data, Grouping & Aggregating Data, Cleaning Data, Date and Time Series.

Learning Outcomes: Student will be able to

- Understand data frames and series data types for data analysis (L2)
- Create indexes and filters on data frames. (L4)
- Implement aggregation, grouping and sorting techniques for data frames. (L4)
- Understand date and time series data analysis. (L2)

Unit 5: DATA PLOTTING: Introduction to matplotlib, creating and customizing plots, Bar Charts,Pie Charts, Stack Plots, Plot Fills, Histograms, Scatter Plots, Plotting Time Series, Plotting Streaming Data, Sub plots.

Learning Outcomes: Student will be able to

- Understand matplotlib library for plotting different plots.(L2)
- Implement streaming data plots for live data. (L4)
- Create sub plots for complex time series data. (L4)

APPLICATIONS:

- Web search engines like Yahoo, Bing etc.
- Web Service Applications like Fixer.io, Movie Databases and NetFlix etc.
- Stock Market Analysis, Matrimonial data analysis.

TEXT BOOKS:

- Core Python Programming by Dr. R.Nageswara Rao, 2nd Edition, DreamTech Press.
- Python Data Science Handbook: Essential Tools for Working with Data, Orielly, Jake Vanderplas
- Orielly: Web Scraping with Python, 2nd Edition, by Ryan Mitchell
- Orielly: Mastering Python Regular Expressions, Packt Publishing, Victor Romero

REFERENCE BOOKS:

- Python for Data Science For Dummies, 2ed, Luca Massaron John Paul Mueller
- MySQL for Python: Database Access Made Easy, by Albert Lukaszewski

Subject Code	Subject Name	L	T	P	C
R20CSE-HN3203	Java Enterprise Framework (Track-3)	3	1	0	4

Course Objectives:
- Implement CRUD operations using Java APIs
- Understand server's ide environment using Servlets.
- Creates erverside WebPages using Java Server Pages.
- Understand Object relational mapping using Hibernate.
- Write business logics using Spring MVC and AO Pprogramming.

Course Outcomes:
1. Implement database operations from front end javaAPIs.
2. Writ servers ide programs for controlling HTTP requests.
3. Create dynamic servers e webpages using JSPtags.
4. Create Hibernate objects for mapping objects and data baserelations.
5. Createmodelbasedjavaobjectsforcontrollingserverbasedapplications.

UnitI:

Java Database Connectivity - JDBC Overview & Architecture, JDBC Driver Types, Types of ResultSet, Statement, Prepared Statement, Call able Statement, Executing DDL and DML Commands.
Learning Outcomes: Studentwill beableto

- UnderstandJDBCDriversforconnectingDatabase.(L2)
- Writecomplexqueries forretrievingdatafromdatabase.(L4)
- Createcallablestatementsforexecutingdatabaseprocedures.(L4)

Unit-II:

Servlets: Web Server, Container, Servlet Overview, Life cycle of Servlet, Handling WebForm Data in Servlets., Dynamically including Content in Servlets, Handling Exceptions inWeb Applications, Reading and Setting Cookies, Session Tracking, Servlet Filters, AccessingDatabases.
Learning Outcomes: Studentwill beableto

- UnderstandWebcontainerforstoringserversideprograms(L2).
- ImplementRequestand responsehandlersusingHttplibraries.(L4).
- CreateServletforretrievingdata fromdatabases.(L4)

UnitIII:

JavaServerPages: OverviewofJSP,JSPArchitecture&lifecycle,ComponentsofJavaServerPages, ImplicitObjects&StandardJSPTags,ScopeofJSPobjects,Dynamicallyincluding content in JSPs, Handling Form data in JSPs, Accessing Databases, Tag Libraries.**LearningOutcomes: S**tudent willbe able to
- UnderstandthestructureofJSP andits LifeCycle(L2)
- CreatedynamicwebpagesusingJSPtaglibraries.L4)
- ImplementJSP scopeforswitchingbetweenpages.(L4)

Unit-IV:

 HIBERNATE: Introduction to Hibernate, Hibernate Architecture, Understanding ObjectPersistence, Hibernate Basics, Types of Relations, Querying Persistent Objects, HibernateQueryLanguage (HQL)
Learning Outcomes:Studentwill beableto

- UnderstandHibernateObjectrelationalmapping(L2)
- CreateHibernate objectsforimplementingrelations betweentables.(L4)
- ImplementHibernate queriesforpersistingjavaobjects. (L4)

UnitV:

Spring Framework: Spring Architecture and Container, Spring Setup in Eclispe, SpringBean Factory, Bean factory VS Application Context, Dependency Injection (DI),   Types   of   DI,BeanAuto wiring,CollectionswithSpring,BeanScopes,EventHandlinginSpring,Introductionto AspectOriented Programming(AOP).
Learning Outcomes:Studentwillbeableto

- Understandarchitecture ofspringcontainer.(L2)
- Implementdependencyinjectionfor settingdata forbeans.(L4)
- Createspringbeans forhandlingevents andaspects.(L4)

Applications:
- Buildingenterpriselevelapplicationslike IRCTC.
- BuildingFinancial,bankingapplications,gatewaysetc
- OnlineandSocialmedia applications

Text Books:

1. JDBC,ServletsandJSPBlackBook,byKogentSolutionsInc.SantoshKumarK,Drea mtechPublications. 2nd Edition, 2016.
2. JavaServlet &JSPCookbookbyBruceW. PerryPublisher(s): O'ReillyMedia, 2004
3. SpringandHibernate-2ed,byK.SantoshKumar, McGraw-HillEducation

Reference Books:

1. SpringinAction,4ed(Manning),byCraigWalls(Author),Dreamtech.
2. JavaPersistencewithHibernate:RevisedofHibernateinAction,Dreamtech,byChris tianBauer.

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B.Tech (R23-COURSE STRUCTURE & SYLLABUS)

(Applicable from the academic year 2024-25 and onwards)

Minors

Subject Code	Subject Name	L	T	P	C
HN3203	NET Framework	3	1	0	4

Course Objectives:

1. To understand the working environment of Microsoft Visual Studio.

2. Understand the OOPS concepts, Threads and File handling

3. Understand and gain practical knowledge of Collections and Reflection framework

4. To make the student to create websites using ASP.NET

5. Understand the concept of session tracking mechanism in real time applications.

Course Outcomes:

1. Understand structure of C# program constructs.

2. Implement object oriented concepts with files and threads.

3. Implement generics and reflections for data collection.

4. Create user interactive web pages using ASP.NET

5. Develop secure web applications with persistence and state.

NET Syllabus

Unit I: The .NET Technology & Introduction to C#: Understanding the fundamentals of the .NET Core framework and its architecture, Overview of .NET Core vs .NET Framework,CTS,CLS,Base Class Library (BCL) and Common Language Runtime (CLR).

C# features and basics-Program structure, data types, Operators, decision-making statements, loops, Arrays and strings

Learning Outcomes:

- Understand.NET Core program structure (L2)
- Understand decision-making and iterations in C# (L2)

Unit II: OOPS Concepts- Class, Object, Inheritance, abstract classes, Interfaces ,polymorphism, operator overloading, exception handling, Collections in c#

Learning Outcomes:

- Understand object-oriented concepts with real-time applications (L2)
- Understand error and exception handling strategies (L2)

Unit III:ASP.NET& ASP.NET Core Web Development: Overview of ASP.NET framework, ASP.NET Page – lifecycle, Web Forms ,introduction to Server Controls, HTML Controls, Validation Controls, User control, Master Pages, themes and skins. Creating web applications using ASP.NET &ASP.NET Core

Learning Outcomes:

- Implement the Model-View-Controller architecture for creating web applications (L4)
- Implement ASP.NET Core life cycle through user controls and navigation (L4)
- Implement web applications using ASP.NET Core (L3)

UNIT-IV ASP.NET Session Management–Overview of session state, its importance, and the challenges of maintaining user state in web applications, Client side session management and Server-side session management

Learning outcomes:

- Understand and identify the challenges associated with maintaining user state.(L2)
- Compare client-side and server-side session management techniques in ASP.NET(L4)
- Implement both client-side and server-side techniques.(L3)

Unit V: ADO.NET(Working with Database): Overview of ADO.NET ,Connected and Disconnected Architecture, Database Connectivity using- DataConnection object, Data Command, DataAdapter, ,DataReader,Dataset.

Learning Outcomes:

- Describe the components and architecture of ADO.NET, including connected and disconnected models(L2)
- Demonstrate database connectivity in ADO.NET application.(L3)
- Analyze connected and disconnected architectures in ADO.NET and their impact on application performance.(l4)

TEXT BOOKS:
1. A Text book on C#- Pearson Education,S.TamaraiSelvi,R.Murugesan.
2. Programming C# 8.0: Build Cloud, Web, and Desktop Applications,Orielly Publications
3. C# 9 and .NET 5 – Modern Cross-Platform Development - Fifth Edition,by Mark J. Price, November 2020,Publisher(s): Packt Publishing

REFERENCE BOOKS:

3. The Complete Reference ASP.NET, Mathew Mc Donald,Mc Graw Hill
4. C# in depth, manning publications, John Skeet
5. ASP.NET Core in Action, Andrew Lock,Manning publication.

(Applicable from the academic year 2024-25 and onwards)
Minors

Course Code	Subject Name	L	T	P	C
R23CSE-PC2102	**Database Management Systems**	3	0	0	3

Course objectives:
- Learn the fundamental concepts of database systems.
- Enable students to design ER diagrams for any customized applications
- Learn simple and Complex queries using SQL.
- Learn schema refinement techniques (Normalization).
- Knowledge about transaction and recovery techniques, and advanced databases.

Course Outcomes:
1. Design the ER model using the basic concepts of DBMS, and RDBMS
2. Apply SQL concepts to Construct simple and complex queries.
3. Analyze schema refinement techniques.
4. Understand the transaction serializability and concurrency control.
5. Apply the concepts of file organization on B & B+ Trees.

Unit-I   **[10 Hours]**

Introduction- Database – Purpose, Characteristics, advantages, disadvantages and applications, Database Users, Data Models; Instance and Data Independence; Three Tier Schema Architecture, Database System Structure.

RDBMS Design: Introduction, Entities, Attributes Entity Set, Relationship Set, Specialization, and Generalization. Types of Keys.

Applications: Design ER Diagrams for Library Management System, Banking System, Other applications

Learning outcomes:

Students will be able to

1. Distinguish between Database System and File System (L2)

2. Design a database relational model using ER diagrams. (L5)

UNIT-II   **[10 Hours]**

Relational Operations & Basic SQL: Relational Algebra, Relational Operations, Relational Calculus, Tuple And Domain Relational Calculus.

PL/ SQL: Database Languages, Data Types, Integrity Constraints, Simple And Nested Queries, Implementation Of Different Types Of Joins, Stored Procedures

Learning Outcomes:

Students will be able to

1. Understand relational operations and calculus (L2)

2. Implement simple and complex queries for relational data (L3)

Applications: SQL Query generation for Different databases.

UNIT-III   **[8 Hours]**

Schema Refinement (Normalization): Types Of Anomalies, Concept Of Functional Dependency, Normalization, Advantages, Types Of Normal forms(1NF, 2NF, And 3NF), Boyce-Codd Normal Form(BCNF), Fourth Normal Form(4NF). Lossless Join And Dependency Preserving Decomposition.

Learning Outcomes:

Students will be able to

1. Identify anomalies and remove redundancies using Normal Forms (L2)

2. Analyze the lossy and lossless decomposition on databases (L3)

Unit-IV   [10 Hours]

Transaction Management: Transaction, Transaction States, ACID Properties, Schedule, Serializability And Types, Concurrent Control, Concurrency Control Protocols-Two Phase Locking- Timestamp – Multi version – Validation and Snapshot isolation– Multiple Granularity locking, Crash Recovery: Introduction To ARIES, The Log, Write-Ahead Log Protocol.

Learning Outcomes:

Students will be able to

1. Understand transaction and serializability schedules. (L2)

2. Understand concurrency control protocols on transactions. (L2)

UNIT-V   [10 Hours]

Implementation Techniques: File Organization and Indexing - RAID, File Organization, Indexing - B & B+ Tree Index files, Hashing Vs Indexing.

Advanced Databases - NoSQL, NewSQL, and Not-yet-SQL

Learning Outcomes:

Students will be able to

1. Understand basic concepts of File Organization and storage (L2).

2. Apply the concepts of file Organization and Indexing on B Trees and B+ Trees. (L3)

3. Understand the Advanced Database Systems (L2)

Contemporary Topics

➢ Big Data and NoSQL Databases:

➢ Cloud Databases:

➢ Distributed Databases

➢ Database Security

➢ Artificial Intelligence and Machine Learning in Databases

Text Books:

1. Database Management Systems, 3/e, Raghuram Krishnan, Johannes Gehrke, TMH

2. Database System Concepts,5/e, Silberschatz, Korth, TMH

Reference Books:

1. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA

2. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

3. Introduction to Database Systems, 8/e C J Date, PEA.

NPTEL Web Course:

https://onlinecourses.nptel.ac.in/noc18_cs15/preview

http://nptel.ac.in/courses/106106093/

http://nptel.ac.in/courses/106106095/

NPTEL Video Course:

https://www.youtube.com/watch?v=EUzsy3W4I0g

https://www.youtube.com/playlist?list=PL52484DF04A264E59

Relevant syllabus for GATE: Databases:

ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions, and concurrency control.

Subject Code	Subject Name	L	T	P	C
	Data warehousing & Data Mining	3	0	0	3

OBJECTIVES:
• Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining.
• They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
• They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.

OUTCOMES:
   • Understand the process of knowledge discovery from data.[L2].
   • Analyze the Data Pre-processing techniques.[L4]
   • Apply classification techniques to various data sets.[L3]
   • Apply the association rule mining to real time applications.[L3]
   • Apply the clustering algorithms to various data sets.[L3]

Syllabus:

UNIT –I: **10-HOURS**
Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity
Learning Outcomes: Student should be able to

   1. Summarize the process of Data mining.(L2)
   2. Classify various kinds of Data Mining techniques.(L2)
   3. Memorize different visualization techniques.(L1)
   4. Differentiate a data warehouse with data mining(L4)

UNIT –II: **09-HOURS**
Data Pre-processing: Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.
Learning Outcomes: Student should be able to

   1. Recognize various steps in Data Preprocessing.(L1)
   2. Identify the process of handling noisy data.(L1)

UNIT –III: **10-HOURS**
Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.
Classification: Alterative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building, (Tan)

Learning Outcomes: Student should be able to

1. Summarize the process of classification.(L2)
2. Apply the process of classification on sample data.(L3)
3. Construct a decision tree for any sample data.(L3)
   4. Calculate Bayes probability for any given data(L3)
   5. Calculate Naïve Bayes probability.(L3)

UNIT –IV:
09-HOURS
Association Analysis: Basic Concepts and Algorithms: Problem defination, Frequent Item Set generation, Mining Frequent Itemsets Using the Vertical Data Format Rule generation, compact representation of frequent item sets, FP-Growth Algorithm. **(Tan &Vipin)**
Learning Outcomes: Student should be able to

1. Apply the Apriori algorithm on any sample data.(L3)
2. Construct an FP tree for any sample data. (L3)

UNIT –V
10-HOURS
Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Requirements for Cluster Analysis, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. **(Tan &Vipin)**
Learning Outcomes: Student should be able to

1. Identify the data objects and partition them into different clusters.(L2)
2. Apply the different clustering techniques on sample data.(L3)
3. Acquire the knowledge of The strenthg and weakness of clustering algorithms.(L2)

Applications:
- **Marketing and Retail**
- **Banking and Finance**
- **Healthcare**
- **Telecommunications**
- **Government and Public Sector**
- **Entertainment and Media**

TEXT BOOKS:
1. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
2. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

REFERENCE BOOKS:
1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining : VikramPudi and P. Radha Krishna, Oxford.

3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki,Wagner Meira, Jr, Oxford

4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURJADA VIZIANAGARAM
VIZIANAGARAM – 535 003, Andhra Pradesh, India
B.Tech (R23-COURSE STRUCTURE & SYLLABUS)
(Applicable from the academic year 2024-25 and onwards)
Minors

ARTIFICIAL INTELLIGENCE NEURAL NETWORKS

(SYLLABUS)

TRACK -2
COURSE OBJECTIVES:
1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
2. Understand the role of supervised learning in neural networks.
3. Understand the role of computation and dynamical systems using neural networks.
4. Apply knowledge of reinforcement learning using neural networks.
5. Make use of unsupervised learning using neural networks.

COURSE OUTCOMES:
1. Understand the basics of artificial neural networks (ANN) and its architecture.
2. Understand the learning mechanisms of ANN using matrix and vector algebra concepts.
3. Understand the concept of single layer perceptron and its limitations.
4. Apply the back propagation algorithm using multi-layer perceptron and it limitations.
5. Apply the concept of radial basis functions to overcome the limitation of multilayer perceptron and SVM.

UNIT-I: Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

> **Learning Outcomes:** Students will be able to

> ➢ Understand the difference between Biological neurons and artificial neurons.
> ➢ Understand different network architectures.

Applications:
> ➢ Architectures are influenced by different activation functions
> ➢ System stakeholders
> ➢ Predicting the performance of the system.

UNIT-II: Mathematical Foundations and Learning mechanisms. Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.

> **Learning Outcomes:** Students will be able to

> ➢ Understand the different learning mechanisms of artificial neurons.
> ➢ Understand concept of optimization.

Applications:
> ➢ Error correction mechanism of artificial neurons.
> ➢ Predicting the errors and performance of the system.

UNIT-III: Single layer perceptrons. Structure and learning of perceptrons. Pattern classifier - introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptrons.

Learning Outcomes: Students will be able to

- ➢ Understand the structure of perceptrons.
- ➢ Understand concept of pattern classification.
- ➢ Limitations of perceptrons.

Applications:
- ➢ Computational space required for perceptron pattern.
- ➢ The topological structure used in pattern classification

UNIT-IV: Feed forward ANN: Structures of Multi-layer feed forward networks. Back propagation algorithm. Back propagation-training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.

Learning Outcomes: Students will be able to

- ➢ Apply the structure of perceptrons.
- ➢ Apply the concept of pattern classification.
- ➢ Limitations of perceptrons.

Applications:
- ➢ Spectroscopy.
- ➢ Multiple criteria decision making.
- ➢ Ability to use a feed-forward neural network as a mapping tool.

UNIT-V: Radial Basis Function Networks: Pattern separability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF.
Support Vector machines: Linear separability and optimal hyperplane. Determination of optimal hyperplane. Optimal hyperplane for nonseparable patterns. Design of an SVM. Examples of SVM.

Learning Outcomes: Students will be able to

- ➢ Use the Radial Base Functions in pattern classification and interpolation problems.
- ➢ Design the RBF network.
- ➢ Use the optimal hyperplanes using SVM

Applications:
- ➢ Image retrieval process.
- ➢ Intrusion detection.
- ➢ Ability to use a feed-forward neural network as a mapping tool.
- ➢ Predictors to diagnosis of students with learning disabilities.

Contemporary Topics: Gradient Descendent Problem
TEXT BOOKS:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

REFRENCE BOOKS:

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.

Subject Code	Subject Name	L	T	P	C
	Machine Learning	3	0	0	3

Course Objectives:

- To familiarizewith a set of well-known MachineLearning (ML) algorithms.

- The ability to implement machine learning algorithms.

- To understandhow machine learning algorithms are evaluated.

- To formulate machine learning problems corresponding to different applications.

- To understand a range of machine learning algorithms with their pros and cons.

Course Outcomes:

- Illustrate the characteristics of machine learning algorithms.

- Summarize the process of classification usingdecision tree approach.

- Apply Bayesian classifier to label data points an ML approach.

- Understand computational and instance-basedlearning.

- Understand advanced computational and types oflearning.

UNIT I: (10 Hours)

Introduction: Well- posed learning problems, designing a learning system, perspectives, and issues in machine learning. Applications of machine learning. **Concept Learning:** Concept learning and the general to specific ordering. Concept learning task, Concept learning as search, Find-s: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Learning Outcomes: Student will be able to

- Summarize the process of machine learning.

- Recognize various machine learning Applications.

- Understand various candidate elimination algorithms

UNIT II: (09 Hours)

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Learning Outcomes: Student will be able to

- Summarize the process of classification.
- Construct a decision tree for any sample data.

UNIT III: (11 Hours)

Bayesian learning: Bayes theorem, Byes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Bayes optimal classifier, An example learning to classify text, Bayesian belief networks

Learning Outcomes: Student will be able to

- Calculate Bayes probability for any given data.
- Calculate Naïve Bayes probability.
- Distinguish the process of Bayes and Naïve Bayes probability calculation.

UNIT IV: (09 Hours)

Computational learning theory – 1: Probability learning an approximately correct hypothesis, Sample complexity for infinite Hypothesis spaces, The mistake bound model of learning- Instance- Based learning- Introduction.

Learning Outcomes: Student will be able to

- Understand Probability learning and Instance- Based learning.

UNIT V: (09 Hours)

Computational learning theory – 2: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning

Learning Outcomes: Student will be able to

- Understand the concept of classification.

- Distinguish lazy Lazy and Eager Learning.

Contemporary Problems:

Explore Modern Tools- Altair Rapid Miner Tools- Scalability Issues- Regularity Complex-Black Box Problem

Text Books

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2019
3. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

References

1. Ethem Alpaydin, Introduction to machine learning, 2nd edition, PHI.

2. Kevin P. Murphy, "Machine Learning," A Probabilistic Perspective, MIT Press, 2012

Weblinks

(i)   https://nptel.ac.in/courses/106106139

(ii)   https://www.coursera.org/learn/machine-learning-duke

(iii)   https://www.edx.org/learn/machine-learning

(iv)   https://www.geeksforgeeks.org/machine-learning/

(v)   https://www.udemy.com/topic/machinelearning

(vi)   https://altair.com/altair-rapidminer

Course Code	Subject Name	L	T	P	C
	Deep Learning	3	0	0	3

Course Objectives

1. Understand the fundamentals of machine learning algorithms and their challenges.
2. Learn the architecture and training of deep feedforward networks.
3. Master regularization techniques to improve deep learning model performance.
4. Explore optimization methods for training deep neural networks.
5. Gain comprehensive knowledge of convolutional neural networks and their applications.

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

1. Apply machine learning algorithms to solve practical problems, demonstrating understanding of overfitting and underfitting (Application).
2. Analyse and design deep feedforward networks using gradient-based learning techniques (Analysis).
3. Evaluate the effectiveness of various regularization techniques to enhance model performance and robustness (Evaluation).
4. Analyse advanced optimization strategies to efficiently train deep neural networks (Synthesis).

5. Understand the convolutional neural networks, explaining their significance in the context of deep learning history and neuroscientific principles.

Unit-I – Machine Learning Basics (8 Hours)

Learning Algorithms-Capacity,OverfittingandUnderfitting-HyperparametersandValidationSets-Estimators,BiasandVariance   -SupervisedLearningAlgorithms   -UnsupervisedLearningAlgorithms   -ChallengesMotivatingDeepLearning.

Learning Outcomes: Student will be able to understand the fundamentals of machine learning.

Application:ML Algorithms can use in health care, NLP and computer vision applications.

Unit – II: DeepNetworks (8 Hours)

Deep Feed forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design – BackPropagation and Other Differentiation Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of deep learning.

Application: Deep Networks can use in NLP and finance applications for solving complex problems.

Unit – III: RegularizationforDeepLearning (8 Hours)

Parameter Norm Penalties – Norm Penaltiesas Constrained Optimization- Regularization and Under Constrained Problems – DatasetAugmentation-NoiseRobustness- SemiSupervisedLearning- MultiTaskLearning- EarlyStopping - ParameterTyingandParameterSharing – SparseRepresentations -BaggingandOtherEnsembleMethods -Dropout.

Learning Outcomes: Student will be able to evaluate the regularization importance in deep neural networks.

Application: Regularization is used for improve the performance of network in various applications like computer vision and NLP etc.

Unit – IV:OptimizationforTrainingDeepModels(8 Hours)

How Learning Differs from Pure Optimization- Challenges in Neural Network Optimization- Basic Algorithms – Parameter Initialization Strategies – Algorithms with Adaptive Learning Rates- Approximate Second Order Methods- Optimization Strategies and Meta-Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of optimization techniques in deep learning.

Application: Optimization techniques are using in many applications like NLP,computer vision and finance sector.

Unit – V: Convolutional Networks(8 Hours)

The Convolution Operation- Motivation- Pooling – Convolution and Pooling as an Infinitely Strong Prior – Variants of the Basic Convolution Function- The Neuro scientific Basis for Convolutional Networks – Convolutional Networks and the History of Deep Learning.

Learning Outcomes: Student will be able tounderstand the purpose of CNN and its importance in deep learning.

Application:CNN used in the area of computer vision applications and many more like NLP, finance and manufacturing sectors.

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville," Deep Learning"MIT Press, 2017.

References Books:

1. Shai ShalevShwartz, Shai BenDavid"Understanding Machine Learning: From Theory to Algorithms" , Cambridge Press

2.Peter Harington " Machine Learning in Action", , 2012, Cengage.

TRACK-3 (HONORS)

S.No.	YEAR& SEM	NAME O THE SUBJECT	CREDITS(4)			PRE-REQUISITES
			L	T	P	
1	II-II	Web UI Framework	3	1	0	Mathematics, C and Data Structures

Course Objectives:

- Understand the design functionalities of static web pages
- Implement cascading features to the web pages.
- Create dynamic web pages using Jscript.
- Implement XML Processing and Parsing techniques with AJAX.
- Create responsive web pages using Web framework.

Course Outcomes:

1. Create static web pages using different tags.

2. Implement look and feel style sheets for static web pages.

3. Create dynamic web pages using objects and events.

4. Implement XML processing and traversing techniques

5. Create responsive web pages using Bootstrap web framework.

Unit I: HTML - Introduction to WWW, HTML Tags, Hyperlinks, images, Lists, Layouts: frames, table, div; HTML forms, HTML5 Tags

Learning Outcomes: student will be able to

- Understand various singleton and paired tags.(L2)
- Create Hyperlinks and layout design. (L5)
- Understand advanced HTML5 tags. (L2)

Unit II: CSS: Introduction to CSS, Style sheets Types, CSS Selectors, CLASS vs ID, CSS Properties, CSS 2D & 3D Transforms, CSS Animations

Learning Outcomes: Student will be able to

- Understand different types of style sheets (L2).

- Implement CSS properties and selectors. (L4).

- Implement CSS3 transforms and animations.(L4).

Unit III: JAVA SCRIPT: Introduction to JScript, Variables & Operators, Data Types, Conditional statements, Loops, Arrays, Functions, Jscript Objects, Event Handling, JSON & RegExp.

Learning Outcomes: Student will be able to

- Understand the structure of Jscript in various browsers (L2)

- Create dynamic web pages using Jscript Events.(L4)

- Implement jscript objects for parsing and pattern recognition.(L4)

Unit IV: XML & AJAX: Introduction to XML, XML vs HTML, XML Document rules, Document Type Definition(DTD), Types of DTD, XSD Schema, XML Styles with XSL & CSS, XPath, XQuery, Introduction to AJAX, XMLHttp, AJAX Request and Response, GET & POST methods

Learning Outcomes: Student will be able to

- Understand XML document rules and features. (L2)

- Create and validate XML using DTD and XSD. (L4)

- Implement XML searching using XPath and XQuery. (L4)

- Understand request and response handling using AJAX calls. (L2)

Unit V: WEB UI FRAMEWORK: Building Responsive Website, Introduction to Bootstrap, Bootstrap Grid System, Containers, Colors, Tables, Buttons, DropDowns & Navigations, Input groups, Images & Media, Pagination

Learning Outcomes: Student will be able to

- Understand responsiveness of web pages using meta tag.(L2)

- Understand Bootstrap tool and its usage. (L2)

- Create dynamic web site with plug-ins and add-ons. (L4)

TEXT BOOKS:

1. Web Technologies Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed.

2. Web Technologies by Achyut Godbole, 3Ed

3. Programming the World Wide Web, Robert. W. Sabesta, pearson Publisher

4. https://getbootstrap.com/docs/5.0/getting-started/introduction/

REFERENCE BOOKS:

1. Web Technologies (Oxford Higher Education), Uttam. K.Roy

2. Web Technology: A Developer's Perspective, PHI, 2E, N.P.Gopalan

Subject Code	Subject Name	L	T	P	C
R23CSE-	Angular JS Framework (Minors Course)	1	0	2	2

Course Objectives:

- To understand model view framework for building applications.
- To create modules for binding the application.
- To understand dependency injection for implementing services.
- To create and establish routes redirects and navigation.
- To validate forms for the submission of data.

Course Outcomes:

1. Understand the fundamentals of Angular JS and its architecture.
2. Apply data binding objects for implementing modules.
3. Implement service and retrieve rest call data.
4. Understand routes and their configuration in angular.
5. Implement form handling with event driven apps.

Unit 1 (8 Hours)

Angular JS – Introduction to Angular JS, Java Script vs Angular, MVC Framework, Component Based Model, Setting Up Angular, Installation of Node and NPM, Angular CLI, Creating and Running Project, Dependencies, App Component, Anatomy of Component, Creating Components.

Learning Outcomes: Student will be able to
- Understand MVC framework for building applications. (L2)
- Understand the installations of Node, NPM and angular. (L2)
- Implement Components using angular dependencies. (L3)

Unit 2 (10 Hours)

Data Binding: Introduction to Data Binding, Types of Binding, Binding Data from Component, Async, Template Interpolation, Looping with ngFor, Condition with ngif, Passing inputs and variables to Components, ngModel for 2-way binding, ngOnInit, Styling with components, Creating multiple modules.

Learning Outcomes: Student will be able to
- Understand data binding for components. (L2)
- Implement looping and decision making for components. (L3)
- Implement components and modules for binding data from the applications. (L3)

Unit 3 (10 Hours)

Dependency Injection: Understanding Dependency Injection(DI), Services, Creating a Service, Service Injection Context, Rest Calls with HttpClient, Building Angular Project.

Learning Outcomes: Student will be able to
- Understand the dependency injection and its types. (L2)
- Implement rest based calls from client using HttpClient. (L3)
- Implement Angular project by building angular services. (L3)

Unit 4 (12 Hours)

Routing: Introduction to Routing, Angular Project with routing, Creating routes, Route redirects and wild cards, Configuring child routes, Navigation for routes.

Learning Outcomes: Student will be able to
- Understand routing with angular. (L2)
- Implement and redirect routes for navigation. (L3)
- Implement wild cards for building angular project. (L3)

Unit 5 (8 Hours)

Form Handling : Introduction to Form Handling, Form Validation, ng-minlength, ngmaxlength, ng-pattern, ng-required, Submitting Forms, Event Handling with Forms.

Learning Outcomes: Student will be able to
- Understand the working of forms and its validations. (L2)
- Implement event handling methods for form submissions. (L3)

CONTEMPORARY TOPICS:
- Pipes
- HTTP Requests
- Authentication
- Angular Modules
- Animations

APPLICATIONS:
- Online Web Applications
- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:

1. Angular 6 by Example: Get up and running with Angular by building modern realworld web apps, 3rd Edition, by Chandermani Arora.
2. Pro Angular 6, Apress, by Adam Freeman

REFERENCE BOOKS:
1. Angular JS by Green, Orielly
2. Professional AngularJS (WROX), by Valeri Karpov

Subject Code	Subject Name	L	T	P	C
	Node Framework (Minors Course)	1	0	2	2

Course Objectives:

- To understand about the traditional web server model and applications
- To understand to setup a development environment in node js
- To understand different kinds of modules in node js
- To understand how to create node js web server and debugging
- To understand how to handle events and database connectivity

Course Outcomes:

6. Understand Node JS and REPL terminal. (L2) and
7. Experiment with Node JS Modules and Node Package Manager. (L3)
8. Develop applications to handle events in Node JS (L3)
9. Make use of Web Server to manage database. (L3)
10. Demonstrate Express Framework (L3)

Unit 1 (10 Hours)

Introduction: Overview of server-side development and the role of Node.js, Introduction to Node.js and its features, Setting up a Node.js development environment, Understanding the event-driven architecture, Working with Node.js modules and the Node Package Manager (npm), Building a simple HTTP server

Learning Outcomes: Student will be able to:
- Understand the basics of server-side development and Node.js.
- Set up a Node.js development environment.
- Understand the event-driven, non-blocking I/O model.
- Use Node.js modules and npm for dependency management.
- Build and run a simple HTTP server using Node.js.

Unit 2 (10 Hours)

Core Node.js Modules and File System: Understanding and using core Node.js modules (fs, path, os, etc.), Working with the file system: reading, writing, and manipulating files, Handling asynchronous operations with callbacks, Promises, and async/await, Streams and buffers in Node.js, Building a simple command-line tool

Learning Outcomes: Student will be able to:
- Utilize core Node.js modules for various tasks.
- Perform file system operations using Node.js.
- Handle asynchronous operations effectively.
- Understand and work with streams and buffers.
- Build simple command-line tools using Node.js.

Unit 3 (12 Hours)

Building Web Applications with Express.js: Introduction to Express.js and its features, Setting up an Express.js application, Middleware functions and their use, Routing and handling HTTP requests, Serving static files and templates, Working with forms and handling form submissions, Building a RESTful API with Express.js

Learning Outcomes: Student will be able to:
- Understand the basics of Express.js and its role in web development.
- Set up and configure an Express.js application.
- Use middleware functions to handle requests and responses.
- Implement routing and handle different types of HTTP requests.
- Serve static files and use templates in an Express.js application.
- Build a RESTful API using Express.js.

Unit 4 (8 Hours)

Databases and Authentication: Introduction to databases and their integration with Node.js, Working with MongoDB and Mongoose for data persistence, CRUD operations with MongoDB, User authentication and authorization, Implementing sessions and JWT (JSON Web Tokens), Securing APIs and handling security best practices.

Learning Outcomes: Student will be able to:
- Integrate databases with Node.js applications.
- Use MongoDB and Mongoose for data storage and retrieval.
- Perform CRUD operations using MongoDB.
- Implement user authentication and authorization mechanisms.
- Use sessions and JWT for secure authentication.
- Follow best practices for securing Node.js applications.

Unit 5 (8 Hours)

Advanced Topics and Deployment: Error handling and debugging in Node.js applications, Writing and running tests with Mocha and Chai, Performance optimization and best practices, Introduction to microservices with Node.js, Deploying Node.js applications (Heroku, AWS, DigitalOcean), Continuous Integration and Continuous Deployment (CI/CD), Real-time communication with WebSockets.

Learning Outcomes: Student will be able to:
- Handle errors and debug Node.js applications effectively.
- Write and run tests to ensure application reliability.
- Optimize performance and follow best practices in Node.js development.

- Understand the basics of microservices architecture.
- Deploy Node.js applications to various hosting platforms.
- Implement CI/CD pipelines for Node.js applications.
- Build real-time applications using WebSockets.

CONTEMPORARY TOPICS:
- Working with Data Serialization
- Sending Emails
- Sending SMSs
- Communication using Web sockets

APPLICATIONS:
- Ecommerce Web Applications
- Financial, Banking applications and Payment gateways etc
- Social media applications

TEXT BOOKS:
- Dhruti Shah, "Node.JS Guidebook", BPB Publications, 2018.

REFERENCE BOOKS:
- Basarat Ali Syed, Beginning Node.js, A press, 2014,

WEB REFERENCES :

- https://nodejs.org/en/docs/

(Applicable from the academic year 2024-25 and onwards)
Minors

Subject Code	Subject Name	L	T	P	C
R23CSE-	React JS Framework (Minors Course)	1	0	2	2

Course Objectives:

- To learn essential React JS skills for front-end development.
- To explore client-side JavaScript application development and the React library.
- To implement React components, hooks, and state management for building interactive UIs.
- To gain experience with React.js, JSX, HTML, CSS, and JavaScript.
- To create a functional front-end web application using React.

Course Outcomes:

11. Understand the anatomy of React Java Script. (L2)

12. Understand the life cycle methods of React JS. (L2)

13. Implement React components for building applications. (L3)

14. Apply React hooks for component reusability and monitoring. (L3)

15. Implement React rendering for interactive applications. (L3)

Unit 1 (10 Hours)

Introduction: Introduction to Single Page Applications (SPAs), Overview of ReactJS and its features, Setting up a React development environment, Understanding JSX and rendering elements, **Components**: Functional and Class-based components, Props and State, Component lifecycle methods
.
Learning Outcomes: Student will be able to
- Understand the basics of ReactJS and its place in modern web development. (L2)
- Set up a ReactJS development environment. (L3)
- Implement simple React components using JSX. (L3)
- Understand and implement functional and class-based components. (L3)
- Manage component state and props effectively. (L3)

Unit 2 (8 Hours)

React Core: Props, State, Event Handling, Lists and Keys, Styling, React Life Cycle, Life Cycle Methods, State Management, Mounting Life Cycle.

Learning Outcomes: Student will be able to
- Understand event handling in React. (L2).
- Implement life cycle methods in react. (L3).
- Implement props and states in building react apps. (L3)

Unit 3 (10 Hours)

React Router and Navigation: Introduction to React Router, Setting up routing in a React application, Nested routes and route parameters, Programmatic navigation and redirecting, Handling 404 pages and route guards.

Learning Outcomes: Student will be able to
- Set up and configure React Router in a React application. (L2)
- Implement navigation using React Router. (L3)
- Create nested routes and handle route parameters. (L3)
- Implement programmatic navigation and redirects. (L3)
- Handle 404 pages and protect routes using route guards. (L3)

Unit 4 (12 Hours)

React Hooks: Introduction to Hooks, useState, useEffect, Run Effects, Fetching Data, useContext, useReducer, useCallBack, useMemo, useRef, Custom Hooks

Learning Outcomes: Student will be able to
- Understand react hooks. (L2)
- Apply hooks and custom methods for handling components. (L3)
- Implement context and callback methods in hooks. (L3)

Unit 5 (8 Hours)

React Render: Introduction to Rendering, useState, useReducer, State Immutability, Parent & Child, Memo, Context, useCallBack.

Learning Outcomes: Student will be able to
- Understand the working react rendering. (L2)
- Implement userReducer and context for rendering react apps. (L3)

CONTEMPORARY TOPICS:
- React - Http client programming
- React - Form programming
- React - Routing
- React - Redux
- React - Animation

APPLICATIONS:
- Online Web Applications

- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:
1. "Learning React: Modern Patterns for Developing React Apps" by Alex Banks and Eve Porcello.
2. "React Up & Running: Building Web Applications" by Stoyan Stefanov.

REFERENCE BOOKS:

- Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, 2nd Edition by Shama Hoque, Packt

Subject Code	Subject Name	L	T	P	C
	DJango Framework (Minors Course)	1	0	2	2

Course Objectives:

- To understand the fundamentals of DJango Framework.
- To implement Basic Templates for Client-side web pages.
- To implement DJango model objects for generating data processing.
- To implement DJango Forms for input processing and signals for profiles.
- To implement Serializers and Models using Rest APIs.

Course Outcomes:

16. Understand the environment of DJango Web Server Framework. (L2)

17. Implement URL Mappings and Views using Templates. (L3)

18. Implement DJango models for processing data from templates. (L3)

19. Implement DJango Forms and Signals. (L3)

20. Implement Restfull APIs using DJango Rest Framework. (L3)

Unit 1 (10 Hours)

Introduction to Django: Introduction to web development and MVC architecture, Overview of Django framework and its features, Setting up a Django development environment, Creating a Django project and understanding its structure, Introduction to Django applications and creating your first app, URL routing and views, Templates and template inheritance.

Learning Outcomes: Student will be able to
- Understand the basics of web development and MVC architecture.
- Set up a Django development environment.
- Create and configure a Django project and applications.
- Implement URL routing and create views.
- Use templates and template inheritance for dynamic HTML generation.

Unit 2 (8 Hours)

Models and Databases: Introduction to Django ORM (Object-Relational Mapping), Defining models and fields, Database migrations and schema management, Querying the database with Django ORM, Relationships: One-to-One, One-to-Many, and Many-to-Many, Admin interface: Customizing the Django admin site

Learning Outcomes: Student will be able to
- Understand and implement Django ORM for database management.

- Define models and perform database migrations.
- Query the database using Django ORM.
- Implement relationships between models.
- Customize and use the Django admin interface for database management.

Unit 3 (12 Hours)

Forms and User Input: Creating and processing forms in Django, Form validation and error handling, Advanced form handling with ModelForm, File uploads and management, Handling user authentication and authorization, User registration and profile management

Learning Outcomes: Student will be able to
- Create and process forms in Django.
- Implement form validation and handle errors.
- Use ModelForm for advanced form handling.
- Manage file uploads in Django applications.
- Implement user authentication and authorization.
- Handle user registration and profile management.

Unit 4 (10 Hours)

Advanced Django Features: Middleware: Custom and built-in middleware, Caching strategies in Django, Internationalization and localization, Using Django REST framework for building APIs, Django Channels for real-time applications, Signals and asynchronous tasks with Celery

Learning Outcomes: Student will be able to
- Understand and implement custom middleware.
- Implement caching strategies to optimize performance.
- Internationalize and localize a Django application.
- Build and consume APIs using Django REST framework.
- Develop real-time applications using Django Channels.

Unit 5 (8 Hours)

Django Rest Framework: Introduction to DJango Rest Framework**,** Features of Rest APIs, Installation of DJango Rest Framework, API_view, Response, JSONResponse, Models and Serializers, PATH and urlpatterns, HTTP methods GET, POST, PUT and DELETE methods

Learning Outcomes: Student will be able to
1. Understand DJango Rest framework and its packages. (L2)
2. Implement Models and Serializers for rest api. (L3)
3. Implement GET, POST, PUT and DELETE calls using rest framework package. (L3)

CONTEMPORARY TOPICS:
- Building a Pages Application.
- Building a Message Board Application.
- Building a Blog Application.
- Building a Password Change and Reset.

APPLICATIONS:
- Building enterprise level applications.
- Building Financial, banking applications, gateways etc.
- Online and Social media applications.

TEXT BOOKS:
- "Django for Beginners" by William S. Vincent
- "Building Websites with Django", by Awanish Ranjan

REFERENCE BOOKS:
- Light Weight DJango by O'Reilly Media, by Julia Elman and Mark Lavin
- Python Web Development with DJango, by O'Reilly – Paul Bissex and Jeff Forcier

Subject Code	Subject Name	L	T	P	C
	Mobile App Development (Minors Course)	1	0	2	2

Course Objectives:

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development.
- To inculcate working knowledge of Android Studio development tool.

Course Outcomes:

21. Identify various concepts of mobile programming that make it unique from programming for other platforms.

22. Critique mobile applications on their design pros and cons.

23. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.

24. Program mobile applications for the Android operating system that use basic and advanced phone features.

25. Deploy applications to the Android marketplace for distribution.

Unit 1 (10 Hours)

Android and its tools – Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building the first Android application, Understanding Anatomy of Android Application.

Learning Outcomes: student will be able to
- Explain the given basic terms related to Android System. (L2)
- Explain with sketches Android architecture for the given application. (L2)
- Identify tools and software required for developing the given Android application with justification. (L4)

Unit 2 (8 Hours)

Android Application Design Essentials: Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

Learning Outcomes: Student will be able to
- Explain with relevant analogy the given Directory Structure. (L2).
- Describe the steps to use the given Android rich UI component. (L3).
- Develop the given basic Android application. (L3)

Unit 3 (10 Hours)

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Learning Outcomes: Student will be able to
- Develop rich User Interfaces for the given Android application. (L3)
- Explain the significance of the given display Alert. (L2)
- Develop the given application using time and Date Picker. (L3)

Unit 4 (12 Hours)

Testing Android applications: Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

Learning Outcomes: Student will be able to
- Write the steps to publish the given android App (L2)
- Explain the features of the given android security service. (L3)
- Write the steps to customize the given permissions for users. (L2)

Unit 5 (8 Hours)

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Learning Outcomes: Student will be able to
- Understand Android Data and Storage (L2)
- Write the query to perform the given database management operation (L3)
- Explain the given location-based service. (L2)

CONTEMPORARY TOPICS:
- Sharing Data in Android
- SMS Messaging
- Consuming Web Services Using HTTP

APPLICATIONS:
- Develop Mobile App on Online Shopping.
- Develop Mobile App on Traffic Surveying
- Develop Mobile App for Making a Calculator.

- Develop Mobile App for a Game

TEXT BOOKS:

3. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education.

REFERENCE BOOKS:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd.
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.
3. Android Application Development All in one for Dummies by Barry Burd, Edition.

Subject Code	Subject Name	L	T	P	C
	UNIX and Shell Programming (**Open Elective Courses -3**)	3	0	0	3

Course Objectives:

- To provide an overview of the history, development, and significance of UNIX/Linux in computing.

- To provide skills in diagnosing common problems, log analysis, and troubleshooting techniques in a UNIX/Linux environment.

- To provide an overview of system administration tasks such as user management, backup and restore, system monitoring, and software installation.

- To explain file systems, mounting, disk usage, file permissions (chmod), and file attributes (chown).

Course Outcomes:

- Understand the architecture and features of UNIX. (L2)

- Apply the commands for implementation of the File System. (L3)

- Understand the Streams, Pipes and Filters. (L2)

- Apply the pattern reorganization commands and scripting concepts. (L3)

- Implementation of system calls for file system. (L3)

Unit 1 (10 Hours)

Introduction to Unix:

Introduction to Unix-Brief History-What is Unix-Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving Multiple Commands.

Learning Outcomes: Student will be able to
- Understand the origins and development of Unix. (L2)

- Learn the key milestones in the evolution of Unix (L3)

- Learn how to use command substitution to streamline tasks. (L3)

Unit 2 (8 Hours)

Unix Utilities:

Introduction to Unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, Arp, ftp, telnet, rlogin. Text processing utilities and backup utilities , detailed commands to be

covered are tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Learning Outcomes: Student will be able to
1. Learn the organization and layout of the Unix directory hierarchy. (L2)
2. File Attributes and Permissions: Understand the various file attributes and how permissions work. (L2)

Unit 3 (10 Hours)

Introduction to Shells:
Using the Shell-Command Line Structure-Met characters- Creating New Commands-Command Arguments and Parameters-Program Output as Arguments-Shell Variables- -More on I/O Redirection-Looping in Shell Programs.

Filters:
Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

Learning Outcomes: Student will be able to
1. Understand the role and management of variables in the Unix shell. (L2)
2. Gain advanced knowledge of input/output redirection in Unix. (L3)
3. Learn how to implement loops in shell scripts. (L3)

Unit 4 (12 Hours)

Grep: Operation, grep Family, Searching for File Content.

Sed: Scripts, Operation, Addresses, commands, Applications, grep and sed.

Shell Programming:
Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Learning Outcomes: Student will be able to
1. Understand the basics of awk for pattern scanning and text processing (L2)
2. Learn best practices for creating and using effective filters and well-structured files in Unix. (L3)

Unit 5 (8 Hours)

File Management:

File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

Learning Outcomes: Student will be able to
1. Learn how to change file ownership using the chown command.(L2)
2. Understand how to change the group ownership of a file using the chgrp command.(L2)

TEXT BOOKS:
4. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.Thomson
5. Your Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCE BOOKS:
- Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.
- Unix programming environment, Kernighan and Pike, PHI. / Pearson Education.
- The Complete Reference Unix, Rosen, Host, Klee, Farber, Rosinski, Second Edition, TMH.

Subject Code	Subject Name	L	T	P	C
	Cryptography and network security	3	0	0	3

Course Objectives:

This course aims at training students to master the:

1. The concepts of classical encryption techniques and concepts of finite   fields and number theory

2. Working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms

3. Design issues and working principles of various authentication protocols and PKI standards

4. Various secure communication standards including Kerberos, IP sec, SSL/TLS, S/MIMEand PGP

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Understand the security goals and acquire fundamental knowledge on the concepts offinite fields and number theory [L2]
2. Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication [L3]
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes. [L3]
4. Apply different digital signature algorithms to achieve authentication and create secureapplications [L3]
5. Apply network security basics, analyze different attacks on networks and evaluate theperformance of security protocols like SSL, IPSec, and PGP [L3]

UNIT-1

Introduction to Security: Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, a Model for Network Security

Mathematics of Cryptography: Algebraic Structures (Groups, Rings, Fields and Galois Fields), Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, PrimeNumbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem,Discrete Logarithms.

Learning outcomes: Student should be able to
1. Understand various types of Information Security concepts [L2]
2. Analyze the role of information security.[L4]

Applications:

1. Encryption/Decryption in email

2. E-Commerce

3. Password Protection

UNIT-2

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

Block Ciphers: Traditional Block Cipher Structure, The Data Encryption Standard, The Strength of DES, Block Cipher Design Principles, Advanced Encryption Standard, AES Structure, AES Transformation Functions, AES Key Expansion, Multiple Encryption and Triple DES, Block Cipher Modes of Operation

Learning outcomes: Student should be able to
   1.   Understand the need of Different encryption and decryption techniques.[L2]
Applications:

   1. Access Control
   2. E-Commerce

UNIT-3

Public-Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Cryptography **Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Requirements andSecurity, Secure Hash Algorithm (SHA)

Message Authentication Codes: Requirements for Message Authentication Codes, HMAC, CMAC

Learning outcomes: Student should be able to
   1. Understand the role of public key cryptography [L2]
   2. Analyze the impact of Symmetric& Asymmetric key Cryptography in real time applications [L4]

   3. Understand the role of hash function [L2]
Applications:

   1. Authentication

   2. **Password Protection**

   3. Electronic Money

UNIT-4

Digital Signatures: Digital Signatures, Elgamal Digital Signature Scheme, Schnorr DigitalSignature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure

User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos, Remote User-Authentication Using Asymmetric Encryption:

Learning Outcomes: Student should be able to

1. Understand the role of Digital Signatures [L2]
2. Identity various key management and distribution techniques [L2]

Applications:

1. Digital Signatures

2. Authentication

3. Cyber Security

UNIT-5

Transport-Level Security: Web Security Considerations, Transport Layer Security, Secure Shell(SSH)

Electronic Mail Security: S/MIME, Pretty Good Privacy

IP Security: IP Security Overview, Encapsulating Security Payload, Combining SecurityAssociations, Internet Key Exchange

Learning outcomes: Student should be able to
1. Apply the concepts of Transport –level security, Electronic mail security and IP Security. [L3]

Applications:

1. E-Commerce

2. Firewalls

3. Malware Protection

4. Protection of network.

Text Book:

1. Cryptography and Network Security, William Stallings, 8th Edition, Pearson Education

References:

1. Cryptography, Network Security and Cyber Laws, Bernard L. Menezes, Ravinder Kumar, Cengage Learning.

2. Cryptography and Network Security, Behrouz A Forouzan, DebdeepMukhopadhyaya, 3rdEdition, Mc-GrawHill.

3. Network Security Illustrated, Jason Albanese, Wes Sonnenreich, McGrawHill.

E-Resources

1. https://nptel.ac.in/courses/106/105/106105031/lecture by Dr.Debdeep Mukhopadhyay IITKharagpur [VideoLecture]

2.https://nptel.ac.in/courses/106/105/106105162/lecture by Dr. Sourav Mukhopadhyay IITKharagpur [VideoLecture]

3.https://www.mitel.com/articles/web-communication-cryptography-and-network-securityweb articles by Mitel PowerConnections

Course Code	Subject Name	L	T	P	C
	CYBER SECURITY (CSXXXX) (Honors &Minors- Track IV)	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and principles of cybersecurity.
2. Understand Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.
3. To Provide the importance of Cyber Security and the integral role of Cyber Security professionals.
4. Recognize the importance of cybersecurity in protecting digital assets and information.
5. Analyze real-world cyber-attack scenarios and case studies.

Course Outcomes:

1. Understand Cyber Security architecture principles
2. Analyze the System and application security threats and vulnerabilities
3. Estimate operational cyber security strategies and policies.
4. Apply security model to handle mobile, wireless devices and related security issues.
5. Analyze the functionality of Security Technologies and Controls in Cybersecurity

UNIT - I: (8 Hours)

Introduction to Cyber Security: Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security, scope of Cyber security, Importance of Cyber security in the modern world, Evolution of cyber threats, Importance of Cyber security in the digital age.

Foundations of Cyber Security: Cyber Security principles, threat models, and cyber laws. Confidentiality, integrity, and availability (CIA) Triad– Cyber security Framework, Security principles and concepts, Risk management.to better understand the dynamics of Cyber Security.

Learning Outcomes: student will be able to

•Outline the Importance of Cyber security. (L2)
•Understand the Security architecture principles and concepts. (L2)
•Understand the Design of Cyber security Framework. (L2)

UNIT-II: (10 Hours)

Common Threats and Attack Vectors: Introduction, Proxy Servers and Anonymizers, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Social Engineering attacks: Introduction, Phishing, spear phishing, pretexting, Identity Theft (ID Theft).

Learning Outcomes: student will be able to

- Understand about the Cyber security Threats and Attacks. (L2)
- Summarize the various types of application security vulnerabilities(L2)

- Analyze the System and application security threats and vulnerabilities(L4)

UNIT-III: (12 Hours)

Introduction to Cyber Crime, law and Investigation: Introduction to Cybercrime, Definition and scope of cybercrime, Categories of cybercrimes, Impact of cybercrime, Cybercrime and Information Security, classifications ofcybercrimes, Cybercrime: The Legal Perspectives, cybercrime and theIndian IT Act 2000, a Global perspective on Cybercrimes.

Cyber laws: Introduction to Cyber Laws, Need for Cyber laws The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards.

Learning Outcomes:student will be able to

- Extend The Categories of cybercrimes and Impact of cybercrime(L2)
- Understand about the Need for Cyber laws and Cybercrime Scenario in India(L2)
- Estimate operational cyber security strategies and policies(L5)
- Develop an understanding of cybercrimes and various legal perspectives involved(L3)

UNIT-IV: (10 Hours)

Cybercrime-Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Authentication Service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Learning Outcomes: student will be able to

- Understand Various devices and related security issues (L2)
- Develop a security model to handle Policies and Measures in Computing era(L3)
- Develop a security model to handle mobile, wireless devices and related security issues of an organization (L3)

UNIT-V: (8 Hours)

Security Technologies and Controls in Cybersecurity: Access control mechanisms, Encryption, Firewalls, intrusion detection systems (IDS), intrusion prevention systems (IPS), Network Security,Security Information and Event Management (SIEM),functionality of cyber security tools.

Legal and Ethical Aspects of Cyber Security: Laws and regulations governing cyber security, Ethical considerations in cyber security practices, Privacy issues.

Learning Outcomes: student will be able to

- Analyze the functionality of Security Technologies and Controls in Cybersecurity(L4)
- Outline the Ethical considerations in cyber security practices(L2)
- Understand the functionality of cyber security tools(L2)

Application:

- Web Firewall
- Antivirus and Antimalware
- Bots
- Threat management systems
- Network Security Surveillance

Contemporary Topics

Critical infrastructure security, Endpoint security, Application security, Cloud security, Diverse Attack Vectors, Supply Chain Attacks.

Text Books:

1. Computer Security: Principles and Practice, Third Edition, William Stallings, Lawrie Brown,Pearson Education, 2014.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, SunitBelapure, 1st Edition Publication Wiley, 2011.
3. William Stallings, Effective Cybersecurity: A Guide to Using Best Practices and Standards, 1st edition, 2019.
4. Mark Rhodes, Ousley, Information Security, 1st Edition, MGH, 2013.

Reference Books:

1. Principles of Information Security, MichaelE. Whitman and Herbert J. Mattord, CengageLearning.
2. 2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers, 2018.

Weblinks:
1. **https://www.cybrary.it/course/entry-level-cybersecurity-training**
2. **https://www.professormesser.com/security-plus/sy0-601/sy0-601-video/sy0-601-comptia-security-plus-course/**
3. **https://www.cto.int/strategic-goals/cybersecurity/web-links/**

Subject Code	Subject Name	L	T	P	C
	Block Chain Technologies	3	0	0	3

Course Objectives:

1. Understand how Block chain systems (mainly Bit coin and Ethereal) work,

2. To securely interact with Block chain systems,

3. Design, build, and deploy smart contracts and distributed applications,

4. Integrate ideas from Block chain technology into their own projects.

5. To identify the importance of crypto currency.

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

1. Understand basic skills and knowledge of Block Chain and Cryptography. [L2]
2. Analyze Block chain system by sending and reading transactions. [L4]
3. Design, build and deploy a distributed application. [L3]
4. Understand the Basic knowledge of Crypto currency. [L2]
5. Understand the Basic knowledge of Crypto currency Regulation. [L2]

Unit I

Block chain Basics, Distributed Ledgers, Categories of Block chains: Public, Private block chains, Permissioned Ledger, Tokenized block chains, Token less block chains, Side chains. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Learning Outcomes: At the end of the unit, student will be able to

1. Acquire basic skills and knowledge of Cryptography.[L2]
2. Understanding of current trends of Block chain, and ability to imagine its use cases and future.[L2]

Applications:

1. Cross-Border Payments
2. Crypto currency
3. Online Identity Verification

Unit II

Block chain: Introduction, Advantage over conventional distributed database, Block chain Network, Decentralized network, Distributed ledger, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public Block chain.

Learning Outcomes: At the end of the unit, student will be able to

1. To understand the applications of Block chain. [L2]

Applications:

1. Healthcare
2. Birth and Death Certificates
3. Asset Management

Unit III

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn,Difficulty Level, Sybil Attack, Energy utilization and alternate.
Learning Outcomes: At the end of the unit, student will be able to:

1. Identify the challenges in Distributed Consensus. [L2]

Applications:
1. Asset Management
2. Crypto currency
3. Online Identity Verification

Unit IV

Crypto currency: History, Distributed Ledger, Double spending Bit coin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Side chain, Name coin.
Learning Outcomes: At the end of the unit, student will be able to:

1. Applying the Basic knowledge of Crypto currency. [L3]
2. Analyze how Bit coin Crypto currency works uses in global market.[L4]

Applications:

1. Crypto currency
2. Online Identity Verification

Unit V

Crypto currency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Cryptocurrency Exchange, Black Market and Global Economy.
Learning Outcomes: At the end of the unit, student will be able to:

1. Applying the Basic knowledge of Crypto currency Regulation. [L3]

Applications:

1. Copyright and Royalties
2. Cross-Border Payments
3. Crypto currency

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction,

Princeton University Press (July 19, 2016).

Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellowpaper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereumsmart contracts

Subject Code	Subject Name	L	T	P	C
	Secure Coding	3	1	0	4

Course Objectives:

1. To understand the security development process.
2. Knowledge of outline of the techniques for developing a secure application.
3. To handling dynamic memory management effectively.
4. Knowledge on stored procedures and XSS attacks.
5. Acquire knowledge on software architecture and design.

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

1. Analyze secure systems and various security principles.
2. Understand the development of process of software leads to secure coding practices
3. Apply Secure programs and various risk in the dynamic memory management.
4. Understand XSS related attacks and remedies
5. Understand various software architecture models.

UNIT–I:

Introduction-Need for secure systems, Proactive security development process, Security principles to live by and threat modeling.

Learning Outcomes: student will be able to
- Understand the need of secure system (L2).
- Analyze security development process(L4).
- Analyze various threats in secure systems (L4).

UNIT–II:

Secure Coding in C-Character strings- String manipulation errors, String Vulnerabilities and exploits Mitigation strategies for strings, Pointers, Mitigation strategies in pointer based vulnerabilities Buffer Overflow based vulnerabilities.

Learning Outcomes: student will be able to
- Describe the string manipulation errors (L2).
- Analyze the string buffer overflow Vulnerabilities (L4).
- Analyze mitigation strategies for strings (L4).

UNIT–III:

Secure Coding in C++ and Java-Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double –free vulnerabilities, Integer security, Mitigation strategies.

Learning Outcomes: student will be able to
- Analyze errors in dynamic memory management (L4).
- Analyze double free vulnerabilities (L4).
- Apply integer security to various applications (3).

UNIT–IV:

Database and Web Specific Input Issues-Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS related attacks and remedies.

   Learning Outcomes: student will be able to
- Understand the stored procedures (L2).
- Implement SQL statements related to security (L5).
- Analyze XSS attacks and remedies (L4).

UNIT–V:

Software Security Engineering-Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software security practices and knowledge for architecture and design.

Learning Outcomes: student will be able to
- Describe Misuse and abuse cases in requirements engineering (L2).
- Understand software security practices (L2).
- Understand software architecture and design (L2).

Text Book:

1. Michael Howard, David LeBlanc, "Writing Secure Code", Microsoft Press, 2nd Edition, 2003.

Reference Books:

1. Robert C. Seacord, "Secure Coding in C and C++", Pearson Education, 2nd edition, 2013.
2. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, "Software Security Engineering: A guide for Project Managers", Addison-Wesley Professional, 2008.

Year Semester	MATHEMATICS FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

The purpose of this course is to provide a mathematically rigorous introduction to these developments with emphasis on methods and their analysis.

Course Outcomes:

At the end of the course, the students will be able to:
- Understand the strengths and weaknesses of many popular machine learning approaches.
- Justify the underlying mathematical relationships within and across Machine Learning algorithms.
- Evaluate the several areas of mathematics beyond calculus
- Solve problems in a range of mathematical applications
- Apply various methods to compute the probabilities of events, Analyze and interpret statistical data using appropriate probability distributions.

UNIT-1: (10 Hours)
Linear Algebra: Systems of Linear Equations, Matrices, Solving systems of linear equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings.
Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections.

UNIT-2: (10 Hours)
Matrix Decompositions: Determinant and Trace, Eigen values and Eigen vectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.
Vector Calculus: Differentiation of Univariate Functions, Partial differentiation and Gradients, Gradients of vector valued functions, Gradients of Matrices, Useful identities for computing gradients, Backpropagation and Automatic Differentiation

UNIT-3: (10 Hours)
Probability and Distributions: Construction of a Probability space, Discrete and Continuous probabilities, sum rule, product rule and Bayes Theorem, Summary statistics and Independence, Gaussian Distribution.
Continuous Optimization: Optimization using Gradient Descent, Constrained optimization and Lagrange Multipliers, Convex Optimization.

UNIT-4: (10 Hours)
Linear Regression: Problem Formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection.
Dimensionality Reduction with Principal Component Analysis: Problem setting, Maximum Variance Perspective, Projection Perspective, Eigenvector computation and Low Rank Approximations, PCA in High Dimensions, Latent Variable Perspective.

UNIT-5 (08 Hours)

Density Estimation with Gaussian Mixture Models: Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm, Latent-Variable Perspective.

Classification with Support Vector Machines: Separating Hyperplanes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels, Numerical Solution.

Text Books:

1. https://mml-book.github.io/book/mml-book.pdf - c 2021 M. P. Deisenroth, A. A. Faisal, C. S. Ong. Published by Cambridge University Press (2020).

References:

1. https://www.youtube.com/watch?v=1VSZtNYMntM

Year Semester	Artificial Intelligence for All	L	T	P	C
		3	0	0	3

Course Objective

Define and explain the fundamental concepts and subfields of AI. Identify real-world applications of AI across various industries. Analyze the ethical, social, and economic implications of AI.

Course Outcomes

Student will be able to

1. Illustrate the scope of Artificial Intelligence (AI) in gaming and expert systems.
2. Demonstrate various applications of AI related to perception and biometrics.
3. Summarize and learn different case studies in classification and recognition systems.
4. Describe and apply natural language processing techniques for designing AI Bots,
5. Illustrate the role of AI in robotics.
6. Demonstrate the state of AI in solving human labor problems for social equity.

Unit -I: (12 Hours)

AI for Everyone, Gaming and Expert Systems

AI for Everyone- What is AI? AI Explosion, AI at work, AI at Society, Applications of AI**. Gaming –** Games as search problems- Mini Max Search, Alpha Beta Cutt-Offs, State of the Art Games- Chess & Checkers Problem. **Expert Systems-** Representing and using domain knowledge, Expert System Shells, Explanation and Knowledge Acquisition. **Case Study:** MYCIN expert system using AI to identify bacteria causing Infections.

Unit -II: (10 Hours)

Perceptions and Biometrics

Perceptions-Image formation, Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D world, Object recognition from structural information. Using Vision for manipulation and navigation. **Biometrics-** Understanding the Biometric fingerprints, facials, voice, iris, palm, and finger vein patterns Identifies Challenges in Biometric Systems. **Case Study I**: Text Classification System **Case Study II:** Face Recognition System.

Unit -III: (10 Hours)

Natural Language Processing and Natural Language Communication

Natural Language Processing- Language Models, Text Classification, Information Retrieval and Information Extraction. **Natural Language Communication-** Phrase Structure Grammars, Syntactic Analysis, Augmented Grammars and Semantic Analysis, Machine Translation and Speech Recognition. Case Study: Automatic Speech Recognition System. **Case Study I**: Understand the development and deployment of AI Chat Bots.

Unit -IV: (08 Hours)

Robotics and Impact of AI on Human Labor and Social Equity
Robotics- Robot Hardware- Robot Perception- Planning to Move- Planning Uncertain Movements- Planning Moves- Robotic Software Architectures and Domains.

Unit -V: (08 Hours)

Impact of AI on Human Labor and Social Equity -Benefits on this Technological Revolution- Need and Necessity of Labor based Economy and Society- Distribute future assets more equitably-Support for Unemployed.

Text Book (s)

1. Russel and Norvig, Artificial Intelligence A Modern Approach, 4th Edition, Pearson Education 2021.
2. Stevan Finaly, Artificial Intelligence for Everyone, Relativistic Publications, Great Britan,2020.
3. E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017.
4. Jerry Kaplan, Artificial Intelligence- What everyone needs to know, Oxford University Press,2016.

Reference (s)

1. Artificial intelligence: a very short introduction; Margaret A. Boden; Oxford University Press; 2018.
2. Artificial Intelligence and Social Work; Milind Tambe, Eric Rice; Cambridge University Press; 2018.
3. Artificial Unintelligence; Meredith Broussard; The MIT Press; 2018.
4. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

	MATHEMATICS FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives:

- To illustrate the concepts of Python Language To introduce.

- To explore the basics of Machine Learning & their types.

- To understand data preprocessing for Machine Learning.

- To apply machine learning algorithm on given data.

- To evaluate and visualize the model performance.

- To make predictions using machine learning algorithms.

- To solve real world problems through machine learning implementation leading to predictions.

Course Outcomes:

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

1. Illustrate the concepts of Python Language and basics of Machine Learning & their types.
2. Apply various data visualization tools.
3. Understand data preprocessing for Machine Learning.
4. Make predictions using machine learning algorithms.
5. Solve real world problems through machine learning implementation leading to predictions.

UNIT-1: (10 Hours)
Introduction of Python: Python Installation with various IDE's, Python data Types, Control Structures, Functions, Introduction of OOP's

UNIT-2: (10 Hours)

Data analysis and Exploration: Data Analysis & Visualization using, NumPy, Pandas, MatPlotlib, SciPy etc

UNIT-3: (10 Hours)

Machine learning & Its Applications: Introduction to machine learning, Supervised machine learning, Unsupervised machine learning, Study of various machine learning algorithms including, Classification, Regression, KNN, K Means, Logistic Regression, Support Vector Machines (SVM), Decision Tree, Naïve Bayes, Ensemble Methods, Random Forest etc

UNIT-4: (10 Hours)

Regression: Introduction to Regression, Simple Linear Regression, Multiple Linear Regression, Non-Linear Regression, Polynomial Regression, Logistic Regression vs Linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models.

UNIT-5 (08 Hours)

Classification & Clustering: Introduction to Classification, K-Nearest Neighbors (KNN), **Decision Trees**: Building Decision Trees, Support Vector Machines (SVM), Evaluation Metrics in Classification, **Clustering**: Introduction to Hierarchical Clustering,

Text Books:

- "Introduction to Machine Learning with Python" by Andreas C Muller, Sarah Guido.
- "Python Programming - A modular Approach with Graphics, database, Mobile and Web Applications" by Sheetal Taneja and Naveen Kumar, Pearson.

References:

- "Beginning Programming with Python Dummies" by John Paul Meuller.
- "Machine Learning an Algorithmic Perspective" by Stephen Marshland.

	AI for Data Science	L	T	P	C
		3	0	0	3

Course Objectives:

To understand AI systems often utilize machine learning algorithms via data science for predictive modeling and pattern recognition.

Course Outcomes:

1. Illustrate the concepts of traditional AI with its agents and environment.
2. Explore the concepts of problem solving techniques.
3. Understand the role of Big Data and how to gather data.
4. Summarize the concepts of Data Science Process.
5. Understand the various applications of data science.

UNIT I:
(10Hours)

AI Introduction: The Foundation of Artificial Intelligence, The History of Artificial Intelligence, **Intelligent Agents:** Agents and Environments, **Good Behaviour:** The Concept of Rationality, The Nature of Environments, Structure of Agents.

UNIT II:
(10Hours)

Problem Solving by Searching: Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

UNIT III:
(09Hours)

Preparing and Gathering Data and Knowledge: Philosophies of Data Science - Data sciencein a Big Data World - Benefits and Uses of Data Science and Big Data. **Facets of Data:**

Structured data, Unstructured data, Natural Language, Machine generated data, Graph-based or network data, Audio, Image and Video Streaming data.

UNIT IV:
(09Hours)

The Data Science Process: Overview of the Data Science Process - Defining Research Goals and Creating Project Charter, Retrieving Data, Cleansing, Integrating and Transforming Data, Exploratory Data Analysis, Build the Models. Presenting Findings and Building Applications on top of them.

UNIT V:
(10Hours)

Applications of Data Science: Technologies for Visualization, Bokeh (Python), Recent trends in various Data Collection and Analysis Techniques, Various Visualization Techniques, Application Development Methods used in Data Science.

Text Books

- Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", PearsonEducation.
- "Introducing Data Science", Davy Cielen, Arno D. B. Meysman and Mohamed Ali,Manning Publications.

References

- Elaine Rich, Kevin Knight: "Artificial Intelligence", Tata McGraw Hill.
- Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier.
- Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O'Reilly.
- Think Like a Data Scientist, Brian Godsey, Manning Publications.