DIT UNIVERSITY
Dehradun

Detailed Course Structure& Syllabus
of
Master of Computer Applications

Approved by the Academic council in its 22nd Meeting held on 06.03.2023

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

Salient Features of the Program Structure

The Program Structure has the following features:

1. 86 Credits has to be earned by a student to be eligible for a Post Graduate degree in Computer Application MCA 2 years.

2. Course categories or baskets have been identified, and each program has the flexibility to choose number of credits in each basket, following general guidelines of respective regulatory bodies. Minor variations are allowed.

3. Courses under each basket will be updated from time to time. A faculty advisor will advise students for registration of courses in the beginning of semester, depending upon the availability of seats.

Program Structure of MCA 2 Years

Basket/Area	Min Credits To be taken	Credit per course	Courses
Language and Literature (LL) Core: Professional Communication Elective: Choose any 1 more LL course	3	3	1
Discipline Core (DC) COA, SE, IJP, DBMS, AJP, DSA, OS, CN, AI	36	4	9
Discipline Elective (DE) Elective: Choose any 3 courses	9	3	3
Ability Enhancement Courses (AEC) Aptitude Building and Soft Skills	8	4	2
Skill Enhancement Courses (SEC) Training-1, Training-2	8	4	2
Free Electives (FE) Elective: Choose any courses across University course offerings	6	3	2
Minor Project	4	4	1
Capstone Project (TP) Mode A: Project with a department faculty Mode B: Project as part of Industry Internship Mode C: Project in an academic institute/lab of National Importance. All Modes must be semester long	12	12	1
Total Credits	86		

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A Sample Plan of Study

A Sample MCA Cohort Structure for 2 Years is mentioned below:

1st Year **Sem 1**

S NO	Course Code	Course	Name of Course	L	T	P	Credit
1	CAF601	DC	Computer Organization and Architecture	3	1	0	4
2	CAF611	DC	Database Management Systems	3	0	2	4
3	CAF603	DC	Introduction to Java Programming	3	0	2	4
4	LAF181	LL	Professional communication	2	0	2	3
5	MAF451	FE	Statistical Technique and Applications	3	0	0	3
6	UCF 101	AEC	Aptitude Building & Soft Skills-I	3	1	0	4
			Total Credits				**22**

1st Year **Sem2**

S NO	Course Code	Course	Name of Course	L	T	P	Credit
1.	CAF612	DC	Advanced Java Programming	3	0	2	4
2.	CAF613	DC	Data Structures and Algorithm	3	0	2	4
3.	CAF614	DC	Operating System	3	0	2	4
4.		DE	Department Elective1	3	0	0	3
5.		DE	Department Elective2	3	0	0	3
6.	CSF306	SEC	Technical Training 1	2	0	4	4
7.	UCF102	AEC	Aptitude Building & Soft Skills-II	3	1	0	4
			Total Credits				**26**

Summer	Course Code	Course	Name of Course	L	T	P	Credits
1	CSF307	SEC	Technical Training 2	2	0	4	4

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2nd Year **Sem III**

S NO	Course Code	Course	Name of Course	L	T	P	Credits
1	CAF602	DC	Software Engineering	4	0	0	4
2	CAF701	DC	Computer Networks	3	0	2	4
3	CAF702	DC	Artificial Intelligence	3	0	2	4
4		DE	Department Elective 3	3	0	0	3
5		FE	Free Elective	3	0	0	3
6	CAF703	PRJ	Minor Project	0	0	8	4
			Total Credits				**22**

2nd Year

Sem IV

Course Category	Course Code	Course Title	L	T	P	Credit
PRJ	UCF439	Capstone Project	0	0	24	12
Total						**12**

MCA 2 Years = 86 Credits

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	Discipline Core					
	Name of Courses	**Pre – requisite Courses**	L	T	P	C
CAF601	Computer Organization and Architecture	None	3	1	0	4
CAF603	Introduction to Java Programming	None	3	0	2	4
CAF614	Operating Systems	None	3	0	2	4
CAF611	Database Management Systems	None	3	0	2	4
CAF612	Advanced Java Programming	None	3	0	2	4
CAF602	Software Engineering	None	4	0	0	4
CAF701	Computer Networks	None	3	0	2	4
CAF702	Artificial Intelligence	None	3	0	2	4
CAF613	Data Structure and Algorithm	None	3	0	2	4

Discipline Electives					
Artificial Intelligence, Machine Learning and Robotics					
	Name of Courses	L	T	P	C
CSF341	R Programming	2	0	2	3
CSF342	Fuzzy Logic and Neural Network	2	0	2	3
CSF343	Evolutionary Computing	2	0	2	3
CSF344	Machine Learning	2	0	2	3
CSF441	Deep Learning	2	0	2	3
CSF442	Robotics	2	0	2	3
Data Science and Analytics					
CSF341	R Programming	2	0	2	3
CSF344	Machine Learning	2	0	2	3
CSF345	Introduction to Data Science	2	0	2	3
CSF346	Data Mining and Data Warehousing	2	0	2	3
CSF441	Deep Learning	2	0	2	3
CSF443	Big Data Analytics	2	0	2	3
Internet of Things and Edge Computing					
CSF347	Wireless and Mobile Systems	3	0	0	3
CSF348	Mobile Application Programming using Android	2	0	2	3
CSF349	Cloud Computing	2	0	2	3
CSF351	Advanced Computer Networks	3	0	0	3
CSF444	Internet of Things	2	0	2	3
CSF445	Mobile & Wireless Network Security	2	0	2	3
Cyber security and Privacy					
CSF352	Number Theory and Cryptology	2	0	2	3

CSF353	Foundation of Cyber Security	2	1	0	3
CSF354	Data Encryption & Network Security	2	0	2	3
CSF355	Cyber Crime & Investigation	3	0	0	3
CSF445	Mobile & Wireless Network Security	3	0	0	3
CSF446	Ethical Hacking & Digital Forensics	2	0	2	3
Computer Vision and Biometrics					
CSF341	Machine Learning	2	0	2	3
CSF356	Digital Image Processing	2	0	2	3
CSF357	Satellite Image Processing	2	0	2	3
CSF358	Computer Vision	2	0	2	3
CSF447	Information Retrieval	3	0	0	3
CSF448	Biometrics Security	3	0	0	3
Cloud Computing and Blockchain					
CSF349	Cloud Computing	2	0	2	3
CSF354	Data Encryption and Network Security	2	0	2	3
CSF361	Introduction to Blockchain Technologies	2	1	0	3
CSF362	Design & Development of Blockchain Technologies	2	0	2	3
CSF363	Blockchain Ecosystems & Governance	2	1	0	3
CSF364	Container Technologies	2	0	2	3
Full Stack and DevOps					
CSF349	Cloud Computing	2	0	2	3
CSF364	Container Technologies	2	0	2	3
CSF371	Front-End Engineering	2	0	2	3
CSF372	Advance Topics in Front-End Engineering	2	0	2	3
CSF373	Server Side Engineering	2	0	2	3
CSF374	DevOps	2	0	2	3

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Course Code	FFCBCS Baskets (other than DC/DE)				
	Language and Literature	**Credits**			
	Name of Courses	L	T	P	C
LAF181	Professional Communication	2	0	2	3
LAF182	Indian English Literature	3	0	0	3
LAF183	English Language Teaching	3	0	0	3

	Skill Enhancement				
	Name of Courses	L	T	P	C
CSF306	Technical Training 1	2	0	4	4
CSF307	Technical Training 2	2	0	4	4
	Ability Enhancement				
	Name of Courses	L	T	P	C
UCF101	Aptitude Building & Soft Skills-I	3	1	0	4
UCF102	Aptitude Building & Soft Skills-II	3	1	0	4
	Free Electives				
	Name of Courses	L	T	P	C
ECF482	Cellular Communication Network (ECE)	3	0	0	3
ECF483	Digital Image processing (ECE)	3	0	0	3
CSF381	Software Project Management	3	0	0	3
MAF451	Statistical Technique and Applications	3	0	0	3

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MCA Course Description Document

School offering the course	SOC
Course Code	**CAF601**
Course Title	**Computer Organization and Architecture**
Credits (L:T:P:C)	3:1:0:4
Contact Hours (L:T:P)	3:1:0
Prerequisites (if any)	None
Course Basket	Discipline Core

Course Summary

The course is proposed to teach the students the concepts of computer organization for several engineering computing systems. Students will develop the ability and confidence to use the fundamentals of computer organization as a tool in the engineering of digital systems.

Course Objectives

This course will facilitate the students to learn the fundamentals of computer organization and its relevance to classical and modern problems of computer design.

Course Outcomes

On successful completion of the course students will be able to :

CO1: Familiarize with the hardware components and concepts related to the control design and memory organization
CO2: Familiarize with addressing modes, different types of instruction formats
CO3: Learn about various I/O devices and the I/O interface.
CO4: Understand the theoretical concept of parallel processing and different types of multiprocessor's interconnection structures.

Curriculum Contents

Unit-1 Fundamental of Computer Design (8L)
Basic Structure of Computers: Computer Types; Functional Units; Bus structure; Performance-Processor Clock, Basic Performance Equation, Clock rate; Historical Perspective; Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters; Memory Location and Addresses; Memory Operations; Instructions and Instruction Sequencing

Unit-2 Instruction set, Assembly language and input/output Organization. **(9L)**
Machine Instructions and Programs: Addressing Mode; Assembly Language; Basic input and Output Operations; Stacks and Queues; Subroutines; Encoding of Machine Instructions; Accessing I/O Devices; Interrupts- Interrupt Hardware; Enabling and Disabling Interrupts; Handling Multiple Devices; Controlling Device Requests; Exceptions; Direct Memory Access; Standard I/O Interfaces-PCI Bus, SCSI Bus, USB.

Unit-3 Pipelining and Parallel Processing (8L)
Introduction to Pipelining; pipeline hazards; Implementation of pipeline; Instruction level parallelism concepts and challenges: Basic compiler techniques for exposing ILP; Reducing branch costs with prediction; Overcoming data hazards with dynamic scheduling; hardware-based speculation; Exploiting ILP using multiple issue and static scheduling; Introduction to multicore architecture

Unit-4 The Memory System. (6L)

Basic Concepts: Semiconductor RAM Memories, Read only memories, speed, size, and cost, cache memories- mapping functions, replacement algorithms; cache performance; cache optimization; Virtual memory; Protection: Virtual memory and virtual machines.

Unit-5 Arithmetic for Computers. (9L)

Addition and subtraction of signed numbers, design of fast adders, multiplication of positive numbers, signed operand multiplication, fast multiplication, integer division, floating-point numbers and operations.

Text Books:

1. John P. Hayes. Computer Architecture and Organization, 4rd Edition, McGraw Hill, 2010
2. M. Morris Mano. Computer System Architecture 3rd Ed, Pearson
3. Carl Hamacher, Zvonko Vranesic, Safwat zaky. Computer Organization, 5th Edition

Reference Books:

1. John L. Hennessey and David A. Patterson: Computer Architecture, A Quantitative Approach, 4th Edition, Elsevier, 2007
2. Kai Hwang: Advanced Computer Architecture Parallelism, Scalability, Programmability, 2nd Edition, Tata Mc Graw Hill, 2010

Teaching and Learning Strategy

All materials (pdf/ppts, assignments etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

School offering the course	SOC
Course Code	**CAF602**
Course Title	**Software Engineering**
Credits (L:T:P:C)	4:0:0:4
Contact Hours (L:T:P)	4:0:0
Prerequisites (if any)	None
Course Basket	Discipline Core

Course Summary

Software Engineering (SE) comprises the core principles consistent in software construction and maintenance: fundamental software processes and life-cycles, mathematical foundations of software engineering, requirements analysis, software engineering methodologies and standard notations, principles of software architecture and re-use, software quality frameworks and validation, software development, and maintenance environments and tools. An introduction to object-oriented software development process and design.

Course Objectives

Knowledge of basic SW engineering methods and practices, and their appropriate application. Describe software engineering layered technology and Process frame work. A general understanding of software process models such as the waterfall and evolutionary models. Understanding of software requirements and the SRS documents. Understanding of the role of project management including planning, scheduling, risk management, etc.. Describe data models, object models, context models and behavioural models. Understanding of different software architectural styles. Understanding of implementation issues such as modularity and coding standards. Understanding of approaches to verification and validation including static analysis, and reviews. Understanding of software testing approaches such as unit testing and integration testing. Describe software measurement and software risks. Understanding of software evolution and related issues such as version management. Understanding on quality control and how to ensure good quality software.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Apply the various design models of software engineering, and Implementation of Software Life Cycle Model.
CO2: Develop proper SRS for software quality assurance.
CO3: Demonstrate the complexities of software projects at the beginning of design phases.
CO4: Estimate the cost and budget of projects, and Removing the errors and bugs so that re-design of models can be done.

Curriculum Content

Unit 1: **Introduction** **(7L)**

To Software Engineering, Software Characteristics, Software Crisis, Software Engineering Processes, Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.

Unit 2:Software Requirement Analysis and Specifications (7L)

Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Data Flow Diagrams, Data Dictionaries, Entity-Relationship diagrams, Software Requirement and Specifications, Functional and non-Functional requirements, Software Prototyping, Feasibility Study, Information Modeling, Decision Tables, SRS Document, IEEE Standards for SRS, Software Quality Assurance (SQA),SEI-CMM Model.

Unit 3: Design (8L)

Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead‟s Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Unit 4:Software Reliability (8L)

Failure and Faults, Reliability Models: Basic Model, Logarithmic Poisson Model, Calendar time Component, Reliability Allocation. **Coding:** Top-Down and Bottom –Up programming, structured programming, Compliance with Design and Coding Standards.

Software Project Management: Project planning and Project scheduling. Software Metrics: Size Metrics like LOC, Token Count, Function Count. Cost estimation using models like COCOMO. Risk management activities. Software Reliability and Quality Assurance: Reliability issues, Reliability metrics, reliability models, Software quality, ISO 9000 certification for software industry, SEI capability maturity model. Computer-aided software engineering (CASE), software reuse, component-based software development, extreme programming.

Unit 5:Testing (6L)

Objectives, Testing Tools & Standards. Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Path Testing, Structural Testing (White Box Testing), Functional Testing (Black Box Testing),
Maintenance: Corrective and Perfective Maintenance, Maintenance Process, Maintenance Models, Maintenance Cost, Software Re-Engineering, Reverse Engineering. Constructive Cost Models (COCOMO).
Software Quality Management: Software Quality Factors, Quality Assurance, Quality Standards, Software Maintenance.

Textbooks

1. R. S. Pressman, ―Software Engineering – A practitioner‟s approach‖, McGraw Hill Education; 7 edition(2009)
2. K.K. Aggarwal & Yogesh Singh, ―Software Engineering‖, New Age International, 2nd Ed. 2006.
3. Pankaj Jalote, Software Engineering, Wiley India,2010

Reference Books

1. Rajib Mall, Fundamentals of Software Engineering, PHI Publication, 4th Edition, 2014.
2. Ian Sommerville, Software Engineering, Addison Wesley, 10th Edition,2015
3. James Peter, W Pedrycz, ―Software Engineering‖, John Wiley & Sons,2000

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

School offering the course	SOC
Course Code	**CAF603**
Course Title	**Introduction to Java Programming**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Discipline Core

Course Summary

This course covers Java and fundamental programming techniques with primitive data types, variables, constants, assignments, expressions, and operators, selection statements, mathematical functions, characters, and strings, loops, methods, and arrays. Students will learn how to write recursive methods for solving inherently recursive problems. The next part will introduce object-oriented programming. Java is an object-oriented programming language that uses abstraction, encapsulation, inheritance, and polymorphism to provide great flexibility, modularity, and reusability in developing software. Students will learn programming with objects and classes, class inheritance, polymorphism, exception handling, abstract classes, interfaces, Text I/O and binary I/O.

Course Objectives

The objectives of this course are to learn object oriented programming paradigm using Java as programming language. Students will be exposed to fundamental concepts in java programming language, followed by object oriented paradigm and its building blocks.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand and implement fundamental programming techniques and data types, variables, constants, assignments, expressions, and operators of Java programming language.
CO2: Understand and implement selection statements, mathematical functions, characters, strings, loops.
CO3: Understand and implement methods, arrays and recursion using Java.
CO4: Understand and implement object-oriented paradigm using objects and classes, abstraction, encapsulation, inheritance, polymorphism, interfaces, and exception handling.

Curriculum Content

UNIT 1: Introduction, Fundamental Programming Techniques (6L)
Introduction, the Java Language Specification, API, JDK, and IDE, Creating, Compiling, and Executing a Java Program, Beans. Identifiers, Variables, Assignment Statements and Assignment Expressions, Named Constants, Naming Conventions, Numeric Data Types and Operations, Numeric Literals, Evaluating Expressions and Operator Precedence, Increment and Decrement Operators, Numeric Type Conversions.

UNIT 2:Selection Statements, Loops, Mathematical Functions, Characters and Strings (6L)
Boolean Data Type, if Statements, Two-Way if-else Statements, Nested if and Multi-Way if-else Statements, Logical Operators, switch Statements, Conditional Expressions, Operator Precedence and Associativity. *Common*, Character Data Type and Operations, *Type. The*, the do-while Loop, the for Loop, Nested Loops, Keywords break and continue.

UNIT 3: Methods, Arrays and Recursions (6L)
Defining a Method, Calling a Method, Passing Arguments by Values, Modularizing Code, Overloading Methods, The Scope of Variables, *Refinement. Array*, Copying Arrays, Passing Arrays to Methods, Returning an Array from a Method, Searching Arrays, Sorting Arrays, The Arrays Class.Two-Dimensional Array Basics, Passing Two-Dimensional Arrays to Methods, Multidimensional Arrays. Recursion, writing recursive codes in Java.

UNIT4: Object Oriented Paradigm (12L)
Defining Classes for Objects, Constructing Objects Using Constructors, Accessing Objects via Reference Variables, Using Classes from the Java Library, Static Variables, Constants, and Methods, Visibility Modifiers, Data Field Encapsulation, Passing Objects to Methods, Array of Objects, Immutable Objects and Classes, The this Reference.Class Abstraction and Encapsulation, Thinking in Objects, Processing Primitive Data Type Values as Objects, Automatic Conversion between Primitive Typesand Wrapper Class Types, The Big Integer and Big Decimal Classes, The String Class, The String Builder and String Buffer Classes.

Superclass and Subclasses, Using the super Keyword, Overriding Methods, Overriding vs. Overloading, The Object Class and Its to String() Method, Polymorphism, Dynamic Binding, Casting Objects and the instance of Operator, The Object's equals Method, The Array List Class.

UNIT5:Exception handling, Abstract Classes and Interfaces, Binary I/O. Generics (6L)
Exception-Handling Overview, Exception Types, the finally Clause, When to Use Exceptions, Classes. Abstract, Interfaces, The Comparable Interface, The Clone able Interface, Classes. Introduction, How Is Text I/O Handled in Java?, Text I/O vs. Binary I/O, Binary I/O ClassesMotivations and Benefits, Defining Generic Classes and Interfaces, Generic Methods.

Textbook(s)

1. Intro to Java Programming (Comprehensive Version), by Y. Daniel Liang. Publisher: Pearson Education; Tenth edition (2018), ISBN-10: 935306578X, ISBN-13: 978-9353065782

Reference Books

1. Java - The Complete Reference, by Herbert Schildt, Publisher: McGraw Hill Education; Tenth edition (2017), ISBN-10: 9789387432291, ISBN-13: 978-9387432291

Teaching and Learning Strategy

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S.NO.	EXPERIMENT NAME
1	Program in Java to design simple calculator for (+, -, *, and /) using switch case
2	Program in Java to design accounts class and two functions withdraw() and deposit().
3	Program in Java to search a particular element in a one dimensional array.
4	Program in Java to the concept of polymorphism by designing functions to sum different type of numbers
5	Program to show the concept of method overriding in Java.
6	Program in Java that import the user define package and access the Member variable of classes that Contained by Package.
8	Program in Java to handle the Exception using try and multiple catch block.
9	Program in Java demonstrating usage of abstract classes and interfaces.
10	Write a program to demonstrate usage of constructor chaining in inheritance.

School offering the course	SOC
Course Code	**CAF611**
Course Title	**Database Management System**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Discipline Core

Course Summary

The students will learn the basic theory of database. They will be able to design and develop database using conceptual schema, logical schema and physical schema and are expect to learn how to write database management system software. They will also learn some of the specialized databases.

Course Objectives

This course aims to educate students on the role of a well-structured relational database management system (RDBMS) to the efficient functioning of an organization. This course covers theory and practice in designing a relational database management system with example of a current database product of MYSQL. Students also learn about the important concepts of database integrity, security and availability with techniques like normalization, concurrency control and recoverability control.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Demonstrate the basic elements of a relational database management system.
CO2: Identify the data models for relevant problems.
CO3: Design entity-relationship and convert entity-relationship diagrams into RDBMS and formulate SQL queries.
CO4: Apply and create relational database design process with Normalization and De-normalization of data so that data redundancy, data inconsistency, and data loss problems may be resolved.

Curriculum Content

Unit 1: Introduction to Database System (6L)

Introduction: Data base System Applications, data base System VS file System, Data Abstraction, Instances and Schemas, data Models: the ER Model, Relational Model & Other Models, Database Languages, data base Users and Administrator, data base System Structure, Storage Manager, the Query Processor, Two/Three tier architecture.

Unit 2: E-R Modeling Data Base Design (10L)

E-R model: Basic concepts, Design Issues, Mapping Constraints, Attributes and Entity sets, Relationships and Relationship sets, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Unit 3 Relational Model & SQL (8L)

Relational Model: Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra

SQL: Form of Basic SQL Query, Nested Queries, Aggregative Operators, NULL values, Logical operators, Outer Joins, Complex Integrity Constraints in SQL.

Unit-4 Database Design Concepts (8L)

Database Design: Schema refinement, Different anomalies in designing a Database, Decompositions, Problem related to decomposition, Functional Dependency, Normalization using functional dependencies, 1NF, 2NF, 3NF & BCNF,Lossless join decomposition, Dependency preserving Decomposition, Schema refinement in Data base Design, Multi valued Dependencies Closer properties of Multivalued dependency, Join dependency, 4NF, 5NF.

Unit- 5: Transaction & Concurrency (8L)

Transaction Management: Transaction-concepts, states, ACID property, schedule, serializability of schedules, concurrency control techniques - locking, timestamp, deadlock handling, recovery-log based recovery, shadow paging.

TEXT BOOKS

1. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, TATA McGraw-Hill 3rd Edition,2014
2. Silberschatz, Korth, Database System Concepts, McGraw hill, 6th edition,2013
3. Elmasri Navate, Fundamentals of Database Systems, Pearson Education,7th edition 2016

REFERENCES

1. Peter Rob & Carlos Coronel, Data base Systems design, Implementation, and Management, 7thEdition, 2006.
2. C.J.Date, Introduction to Database Systems, Pearson Education, 8th edition, 2012.
3. Bayross I., SQL, PL/SQL the Programming Language of Oracle, BPB Publications (2009) 4th ed.
4. HofferJ. Venkataraman, R. and Topi, H., Modern Database Management, Pearson (2016) 12th ed.

Teaching and Learning Strategy

The teaching of students will be conduct through power point lectures, tutorials, and short classroom exercises aimed at solving real life problems. The lecture material will be availed to the students in Moodle to enable them have appropriate reading.

List of Experiments

S.NO.	EXPERIMENT NAME
1	Implementation of Data Definition language in Query Language.
2	Implementation of Data Manipulation in Query Language.
3	Insertion &Updation of records in Database table
4	Implementation of GROUP functions (avg, count, max, min, Sum).
5	Execution of the various type of SET OPERATORS (Union, Intersect, Minus).
6	Apply the various types of Integrity Constraints on table.
7	Creation of various types of JOINS.
8	Implementation of Views and Indices in database.
9	Implementation of foreign key on database.
10	Modify the database structure and drop the record with structure.

School offering the course	SOC
Course Code	**CAF612**
Course Title	**Advance Java Programming**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Discipline Core

Course Summary

This course covers advanced Java programming concepts that includes Java user interface programming and design, collections framework, multithreading, networking, java database programming. Students will also be introduced to technologies like Java beans, Servlets and JSP.

Course Objectives

The objectives of this course are to learn advanced java programming techniques and technologies required to build applications at enterprise level with good user interface.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand and implement swing components and event handling mechanisms.
CO2: Understand and implement various collections classes and interfaces.
CO3: Understand and implement multithreading concepts using Java.
CO4: Understand and implement network programming in Java.

Curriculum Content

UNIT I: User Interface (6L)
Java FX vs Swing and AWT, The Basic Structure of a Java FX Program, Panes, UI Controls, and Shapes, The Color Class, The Font Class, The Image and Image View Classes, Layout Panes, Shapes. Events, Registering Handlers and Handling Events, Inner Classes, Anonymous Inner Class Handlers, Simplifying Event Handling Using Lambda Expressions, Mouse Events, Key Events, Objects. Labeled, Button, Check Box, Radio Button, Text Field, Text Area, Combo Box, List View, Scrollbar, Slider.

UNIT 2: JAVA COLLECTIONS FRAMEWORK (6L)
Collections, Iterators, Lists, the Comparator Interface, Static Methods for Lists and Collections, Queues and Priority Queues, Binary Search Trees, Array Lists, Linked Lists, Stacks and Queues, Maps.

UNIT 3: Multithreading (6L)
Thread Concepts, Creating Tasks and Threads, The Thread Class, Thread Pools, Thread Synchronization, Synchronization Using Locks, Cooperation among Threads, Case Study: Producer/Consumer, Blocking Queues, Semaphores, Avoiding Deadlocks, Thread States, Synchronized Collections.

UNIT4: Networking and Java database programming (6L)

Client/Server Computing, Relational Database Systems, SQL, JDBC, Prepared Statement, Callable Statement.

UNIT5: Enterprise programming (12L)

Java Beans: The software component assembly model- The java beans development kit- developing beans JAR files-Introspection-Bound Properties-Persistence-customizers - java beans API. EJB: EJB architecture- EJB requirements –EJB session beans- EJB entity beans-EJB Clients. Java Servlet: Servlet overview, Brief origin and advantages over CGI, Writing small Servlet Programs, Deployment Descriptor, Servlet Life Cycle, Sharing Information, Initializing a Servlet, Writing Service Methods, Filtering Requests and Responses, Invoking Other Web Resources, Accessing the Web Context, Maintaining Client State, Finalizing a Servlet, Session: Definition, Different ways to track sessions.JSP: Introduction to JSP, JSP processing, JSP Application Design, Tomcat Server, Implicit JSP objects, Conditional Processing, Declaring variables and methods, Error Handling and Debugging, Sharing data between JSP pages- Sharing Session and Application Data. Accessing a database from a JSP page, Application-specific Database Action, Developing Java Beans in a JSP page, introduction to Struts framework.

Textbook(s)

1. Intro to Java Programming (Comprehensive Version), by Y. Daniel Liang. Publisher: Pearson Education; Tenth edition (2018), ISBN-10: 935306578X, ISBN-13: 978-9353065782

Reference Books

2. Java - The Complete Reference, by Herbert Schildt, Publisher: McGraw Hill Education; Tenth edition (2017), ISBN-10: 9789387432291, ISBN-13: 978-9387432291

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments

S.NO	EXPERIMENT NAME
1	Program in Java to implement OOP concepts like inheritance and polymorphism.
2	Program in Java to implement Swing components and link events to these components.
3	Program in Java to design simple calculator for arithmetic operations using GUI.
4	Program in Java to draw shapes using Graphics class.
5	Program in Java using implementations of Hashsets and Treesets.
6	Program in Java using implementations of Arraylist and LinkedList.
7	Program in Java using implementations of Maps.
8	Program in Java demonstrating usage of Collections.sort.
9	Program in Java to implement a Server and Client Socket using Input and Output Streams.
10	Program in Java to implement a server serving multiple clients.

School offering the course	SOC
Course Code	**CAF613**
Course Title	**Data Structures & Algorithm**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Discipline Core

COURSE SUMMARY

The course is a foundation level course and requires the knowledge of the C programming language. The course outlines the detailed architecture and implementation of basic data structures such as Stacks, Queues, Linked Lists, Trees, and Graphs. It also covers the time and space complexity analysis of different searching and sorting techniques. Some of the searching methods include Linear Search, Binary Search, and sorting mechanism includes Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, and Heap Sort. The course also incorporates the study of various techniques (Divide & Conquer, Greedy, Dynamic Programming, Backtracking, and Branch & Bound) to design an algorithm.

COURSE OBJECTIVES

The main objective of this course is to select the appropriate data structure model specific to some application and solve problems using data structures like Stacks, Queues, Linked Lists, Trees, Graphs, and analyzing their computational complexities.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Develop an ability to read, write, and analyze the time and space complexity of any algorithms.
CO2: Describe the properties, behavior, and implementation of basic data structures like Stacks, Queues, Linked List, Trees, and Graphs.
CO3: Compare different searching and sorting techniques in terms of their memory usage and time consumption.
CO4: Understand the greedy approach and dynamic programming .

UNIT 1: Unit 1: Introduction to Algorithms & Data Structure (8L)

Introduction: Algorithms, Performance Analysis: Space and Time Complexity, Asymptotic Notations- Big Oh, Omega, theta notations, finding complexity of the algorithm
Searching: Linear and Binary Search Techniques and their complexity analysis. Sorting Algorithms and their Analysis: Selection Sort, Bubble sort, Insertion sort, Quick sort, Merge sort, Heap Sort.

Unit 2: Stacks, Queues and Link List (7L)

Stacks: Introduction to Stacks, Array representation of Stack, Operations on Stack: Push, Pop, etc. Applications of Stacks: Infix and Postfix Conversion, Evaluations of Infix and Postfix expressions. Queue:Introduction to Queue, Array representation and implementation of queues, Operations of Queue, Applications of Queue, Types of Queue: Circular Queue, Priority Queue, Double ended Queue. Operations on each type of Queue and their Applications.

Linked Lists: Representation and Implementation of Single, Double, and Circular Linked Lists, Operations on Linked List: Insert, Delete, Traverse etc. Applications of Linked List, Linked List representation of Stack and Queue.

Unit 3 Trees and Graphs (8L)

Trees: Basic Tree terminologies, Types of Trees: Binary Tree, Binary Search Tree (BST), AVL Tree, B-Tree, and Heap. Representation and Implementations of different types of trees, Tree Traversal algorithms, Operation on trees: Insert, Delete, etc., Applications of Tress.

Graphs: Introduction to Graph and their Terminologies, Types of Graph, Representations of Graph, Graph traversal algorithms, Topological Sorting, Minimum Spanning Tree, Shortest Path Algorithms: Single Source Shortest Path like Bellman-Ford, Dijkstra and All Pair Shortest Path like Floyd-Warshall.

Unit 4 Greedy Algorithm (8L)

Greedy Method: General method, Activity Selection, job scheduling with deadlines, fractional knapsack problem, Minimum cost spanning tree: Kruskal's and Prim's, single source shortest path, Huffman tree

Unit 5: Dynamic Programming (8L)

Dynamic Programming: General Method, 0-1 Knapsack, Matrix chain multiplication, longest subsequence, all pair shortest paths, Backtracking- Travelling Salesman Problem, Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of subsets.

TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni & Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Galgotia publications pvt. Ltd.
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI Pvt. Ltd., 2012.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis (Second Edition), Published by Addison-Wesley
4. A. M. Tenenbaum, Langsam, Moshe J. Augentem, Data Structures using C PHI Pub.1st Edition.1998
5. Schaum'soutline series "Data structures" TMH. 1st Edition Indian Reprint 2014.

REFERENCE BOOKS:

1. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Introduction to Design and Analysis of Algorithms A strategic approach, McGraw-Hill Education (Asia) ,2005
2. Aho, Ullman and Hopcroft , Design and Analysis of algorithms, Pearson Education India; 1st edition 2002
3. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication,2nd Edition. 2008.
4. Robert Kruse, Data Structures and Program Design in C PHI.2nd Edition.2006.
5. Willam J. Collins, Data Structure and the Standard Template library –2003, T.M.H.1st Edition.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments

S.NO.	EXPERIMENT NAME
1	Program in C to Implement sorting algorithms
2	Program in C to Implement searching algorithms
3	Program in C for the creation of Stack for its various operation implementation.
4	Program in C for the creation of Queue for its various operation implementation.
5	Program in C for the creation of Link list for its various operation implementation.
6	Program in C for the creation of Circular Link list for its various operation implementation.
7	Program in C for the creation of Doubly Link list for its various operation implementation.
8	Program in C for the creation of Binary Search Tree for its various operation implementation.
9	Program in C for the Implementation of basic Graph Algorithms.
10	Program in C to Implement 0-1 Knapsack problem using Dynamic Programming

School offering the course	SOC
Course Code	**CAF614**
Course Title	**Operating System**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Departmental Core

Course Summary

This course will introduce the core concepts of operating systems, such as processes and threads, scheduling, synchronization, memory management, file systems, input and output device management and security.

Course Objectives

This course is classified into two sections: a theory section that educates to students about the theories and principles that underlie modern operating systems, and a practical section that relates theoretical principles to operating system implementation. Theory section includes: Process and processor management, concurrency and synchronization, memory management schemes, file system and secondary storage management, etc.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Describe the basic concepts of operating systems, including development and achievements, functionalities and objectives, structure and components.
CO2: Understand the general architecture & functioning of operating system such as processes, threads, files, Concurrency, IPC abstractions, shared memory regions, etc.
CO3: Analyze various algorithms e.g., Process scheduling and memory management algorithms.
CO4:Categorize the operating system's resource management techniques, deadlock management techniques, memory management techniques.

Curriculum Content

Unit 1: Introduction to Operating System.

(8L)

Introduction: Components of a computer System, Operating system: User view & System view, Evolution of operating system, Single Processor & Multiprocessor systems, Real Time System, Distributed Systems, Multimedia Systems, Handheld Systems.
Operating System Structure: Operating System Services, User Operating System Interfaces: Command- Line and GUI, System Calls.

Unit 2: Management & Scheduling

(6L)

Process Management: Process Concept, Process States, Process Transition Diagram, Process Control Block (PCB).CPU Scheduling: Scheduling Concepts, Performance Criteria, Scheduling Queues, And Schedulers, Scheduling Algorithms: Preemptive & Non Preemptive: FCFS, SJF, Priority, Round-Robin

Unit 3: Concurrent Processes & Deadlocks

(8L)

Concurrent Processes: Principle of Concurrency, Producer / Consumer Problem, Co-operating Processes, Race Condition, Critical Section Problem, Peterson's solution, Semaphores, Classical Problem in Concurrency- Dining Philosopher Problem; Inter Process Communication models and Schemes.
Deadlock: System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery from deadlock.

Unit 4: Memory Management

(7L)

Memory Management: Bare machine, Resident monitor, Multiprogramming with fixed partition, Multiprogramming with variable partition, Multiple base register, Paging, Segmentation, Virtual memory concept, Demand paging, Performance, Paged replaced algorithm, Allocation of frames, Cache memory.

Unit 5: File Systems & I/O Management

(7L)

File System: Different types of files and their access methods, various allocation methods. I/O Management and Disk Scheduling: I/O Devices, Organization of I/O functions, Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN, and LOOK).

TEXT BOOKS

1. Silberschatz, Galvin and Gagne, ―Operating Systems Concepts‖, Wiley, 9th Edition 2018.

REFERENCES

1. Harvey M. Dietel, "An Introduction to Operating System", Pearson Education, 1st Edition 2009.
2. D M Dhamdhere, "Operating Systems: A Concept based Approach", PHI. 3rd Edition.2017.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments

S.NO.	EXPERIMENT NAME
1	Implement the following algorithm FCFS, SJF, Round Robin, Priority in Linux.
2	Implement the concept of fork () system call using C programming in Linux environment only.
3	Implement the concept of threading in OS. Prefer threading in JAVA only.
4	Write a Java program to simulate producer-consumer problems using semaphores.
5	Write a Java program to simulate the concept of Dining Philosopher ‘s problem.
6	Write a program using Linux to simulate Banker ‘s algorithm.
7	Write a C program using Linux to simulate the following contiguous memory allocation techniques: a. Worst fit b. Best fit c. First fit.
8	Write a Java program to simulate the disk scheduling algorithms: a. FCFS b. SCAN c. C-scan
9	Write a C program using Linux to implement page replacement algorithms: a. FIFO b. LRU c. LFU
10	Write a C program to compare the Optimal page replacement algorithm with FIFO and LRU page replacement algorithms.

School offering the course	SOC
Course Code	**CAF701**
Course Title	**Computer Networks**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Departmental Core

Course Summary

The course is a foundation level course and provides an in-depth description of computer networks. It begins by introducing the fundamentals of data communication and proceeds through the protocol layering architecture. It covers the physical layer by introducing the conversion of the analog and digital signals, transmission impairments, and transmission media. It also includes the data link layer and its services through protocols, network layer, IP address, delivery & forwarding packets, and network-layer protocols. Finally, it describes the transport layer & application layer that includes flow control, error control, congestion control, and application layer protocols like HTTP, FTP, SMTP, etc.

Course Objectives

The main objective of this course is to introduce you the fundamental concept of computer networks, how to build a network, what are the software & hardware requirements, how to analyze a network for performance and quality of service, and how two computers connected to a network communicate with each other.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Develop an ability to describe what a computer network is and how data communication takes place between two computers connected to a network.
CO2: Understand the protocol layering architecture and the different functions of each layer.
CO3: Explain the IPV4 addressing technique, including classful & classless address along with subnetting.
CO4: Develop an ability to analyze a network for their performance, quality of service, and throughput.

Curriculum Content

Unit 1: Introduction to Computer Networks

Data Communication and Network Fundamentals:Components of a Data Communication System, Data Flow, Computer Network and Internet, Network Topology, Network Models, Network Protocols, The Internet, History of Computer Network and the Internet.

Network Model and Layering Architecture:Network core: Packet Switch and Circuit Switch Network, A Network of Networks, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layer and their Service Model: Layered Architecture, OSI and TCP/IP model.

Unit-2: Physical and Data Link Layer

Physical Layer: Introduction to Physical Layer, Data and Signals, Analog and Digital Signal, Transmission Impairments, Digital-to-digital conversion, Analog-to-Digital Conversion, Transmission Modes: Parallel and serial, Digital-to-Analog Conversion, Analog-to-Analog Conversion, Multiplexing: FDM, WDM, TDM, Transmission Media: Guided and Unguided Media,
Data Link Layer: Introduction to Data Link Layer,Services provided by the Data Link Layer, Error-Detection and Correction Techniques, CRC, Checksum, Media Access Control: Random access protocol, Controlled Access Protocol, Ethernet and Ethernet Protocol

Unit 3: Network Layer

Introduction to Network Layer, Packet switching at network layer, Network Layer Services, Logical Addressing, IPV4 addresses: classful and classless, Subnetting, Delivery and Forwarding of Packets: Direct Delivery, Indirect Delivery, Next-hop method, Network Specific Method, Host Specific Method, Forwarding with classful and classless addressing, Routing, Structure of a Router and switching techniques, Network Layer Protocols like ARP, RARP, ICMP etc. Unicast Routing Protocol: RIP, OSPF, BGP, Multicast Routing Protocol.

Unit 4: Transport Layer

Introduction and Transport Layer Services: Process-to-Process Communication, Encapsulation and Decapsulation, Multiplexing and Demultiplexing, Flow Control, Error Control, Congestion Control, Connection-less and Connection-oriented services, Transport Layer Protocol: Simple protocol, Stop-and-wait protocol, Go-back-N protocol, Selective-repeat protocol, TCP and UDP.

Unit 5: Application Layer

Introduction to Application Layer, Application Architecture: Client-Sever, Peer-to-Peer, Process Communication, Client-Server communication Interface: Socket, IP, Using the services of Transport Layer, Application Layer Protocols: HTTP, FTP, SMTP, POP, IMAP, DNS.

Textbook(s)

1. Behrouz Forouzan, Data Communications, and Networking; Tata McGraw-Hill; 5th Edition, 2012.
2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach (4th Edition), Pearson/Addison-Wesley, Inc. (2008),

Reference Books

- Andrews S. Tanenbaum, David J Wetherall; Computer Networks; Pearson Education; 5th Edition, 2012
- Peterson, Larry L., and Bruce S. Davie. Computer networks: a systems approach. Elsevier, 2007.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

List of Experiments

S.NO.	EXPERIMENT NAME
1	Simulate a network having two communication node using Cisco packet Tracer.
2	Simulate a network having 4 communication nodes with one switch.
3	Simulate a network having Two subnet using 2 switch, one Router and 6 nodes using Cisco packet tracer
4	Simulate a network having Two subnets and two Routers using DTE/ DCE Cable with user defined clock rate.
5	Simulate a network using Star/Bus Topology Using Cisco packet Tracer.
6	Simulate a network using Ring Topology Using Cisco packet Tracer.
7	Simulate a network using Mesh Topology Using Cisco packet Trace.
8	Create a DHCP server using Cisco packet tracer
9	Implement Intra domain and Inter domain routing Protocol using Cisco Packet Tracer.
10	Implement Bit Stuffing using Turbo C++ Editor.

Department offering the course	Computer Applications
Course Code	**CAF702**
Course Title	**Artificial Intelligence**
Credits (L:T:P:C)	3:0:1:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Departmental Core

COURSE SUMMARY

The course will start with a brief introduction to artificial Intelligence. This course includes basic AI search techniques like A*, BFS, DFS. Introduction to Prolog is also important part of the content. Knowledge Representation, Reasoning Planning and Learning being requirement for development of expert system is also part of this course.

COURSE OBJECTIVES

The course is proposed to teach concepts of Artificial Intelligence. The subject will provide the foundations for AI problem solving techniques and knowledge representation formalisms.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: Identify and formulate appropriate AI methods for solving a problem.
CO2: Apply AI algorithms.
CO3: Compare different AI algorithms in terms of design issues, computational complexity, and assumptions.
CO4: Utilize the concepts of AI for real world problem solving.

CURRICULUM CONTENT

Unit 1 **(8L)**

Introduction- Definitions, Intelligent Agents, Problem solving and Search- Uninformed Search, Informed Search, MiniMax Search, Constraint Satisfaction Problem, A*, Best Search, DFS, BFS.

Unit 2 **(7L)**

Prolog-Introduction to Prolog, Syntax and Meanings of Prolog Programs, Operators and Arithmetic, Prolog for Artificial Intelligence.

Unit 3 **(7L)**

Knowledge Representation- Introduction, Approaches and Issues in Knowledge Representation, Propositional Logic and Inference, First-Order Logic and Inference, Unification and Resolution, Expert Systems.

Unit 4 **(8L)**

Reasoning- Introduction, Types of Reasoning, Probabilistic Reasoning, Probabilistic Graphical Models, Certainty factors and Rule Based Systems, Introduction to Fuzzy Reasoning.

Unit 5 **(7L)**

Planning and Learning- Introduction to Planning, Types-Conditional, Continuous, Multi-Agent. Introduction to Learning, Categories of Learning, Inductive Learning, Supervised and Unsupervised & Reinforcement Learning, Basic Introduction to Neural Net Learning.

TEXT BOOKS:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education India; 3rd edition (2015).
2. Elaine Rich, Kevin Knight and Shivashankar B. Nair, “Artificial Intelligence”, McGraw-Hill Education; 3rd edition (2017).
3. Nils J. Nilsson, “Artifciial Intelligence-A New Synthesis", Morgan Kaufmann Publishers, Inc.; 1st edition (1998).

REFERENCE BOOKS:

1. Ivan Bratko, “Prolog Programming for Artificial Intelligence”, Pearson Education Asia, Latest 4th Edition (august 2011).
2. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI Learning, (1990).

TEACHING AND LEARNING STRATEGY

The teaching of students will be conducted through power point lectures, tutorials, short classroom exercises aimed at solving real life problems. The lecture material (pdf/ppts, assignments, labs, etc.) will be availed to the students in Moodle (lms.dituniversitu.edu.in) to enable them have appropriate reading.

List of Experiments

S. No.	EXPERIMENT NAME
1	Introduction to PROLOG programming, PROLOG platform. “Hello World” program.
2	Defining Clauses and Predicates, Variables, Anonymous Variables.
3	Arithmetic Operators, Arithmetic Functions and Logical Operators (NOT, conjunction disjunction).
4	Binding Variables and Backtracking & Concept of Unification.
5	Implementation of Recursion in PROLOG.
6	Implementation of LIST and built-in predicates of LIST in PROLOG.
7	Implementation of State-Space Searching Problem using PROLOG (Water-Jug or 8 Queens problem).
8	Universal and Existential Quantifier Variables in PROLOG.
9	Knowledge Base and Rule Base Creation for a specific domain in PROLOG.
10	Implementation of Resolution process in PROLOG.

1. School offering the course	SOC
2. Course Code	**CAF703**
3. Course Title	**Minor Project**
4. Credits (L:T:P:C)	0:0:8:4
5. Contact Hours (L:T:P)	0:0:8
6. Prerequisites (if any)	Programming Language
7. Course Basket	DC

Course Objectives

The objective of the course is to develop skills in doing literature survey, model development and report preparation

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO 1: Identify, analyze and formulate complex research problems in societal and environmental contexts.
CO 2: Design and develop solutions to the identified problem applying knowledge of engineering fundamentals, specialization and using research-based knowledge.
CO 3: Work and manage projects as a team member or leader practicing professional and ethical responsibilities in multidisciplinary settings.
CO 4: Communicate effectively the benefits of designed solutions to the problems in social benefits (Overcome the current / existing problem, Applicable for grant / funding)

Evaluation Scheme

Evaluation Instrument	Weightage
Day to Day evaluation by the guide • Synopsis (15) • Weekly Progess Evaluation by Guide (25)	40
Mid Term Presentation	20
End Term Presentation • Presentation (10) • Project Execution (20) • Project Report (10)	40
Total Marks	100

FORMAT OF THE PROJECT REPORT

Binding of Report	**Binding**	**Spiral Binding**
	Back Cover	**Blue**
	Front Cover	**Transparent**
	Margin Top	**4 Cm**
	Margin Bottom	**4 Cm**
	Margin Left	**4 Cm**
	Margin Right	**4 Cm**
	Printing on the Top	**Title of the Report in capital letters (24 font size) Times New Roman**
	Printing on Bottom	**Format is attached as Annexure1**
	Printing in the middle of cover Center	
Inside of Project Report	Contents	
	Abstract	• To convey briefly the content of the Project • To draw attention to all new information and to the main conclusions
	Chapters	The text should have suitable chapter number, titles and sub-titles with pages numbered at the bottom center. The sequence of Chapter organization may be as below • Introduction • Related Work/Literature Survey • Chapters (as per the work carried out) • Summary and Conclusions • Scope for Future Work • References • Appendix (optional, as required)
	Numbering and referring in text	Equations are to be numbered in round brackets with Chapter information, Ex: Chapter2, first equation - (2.1)…
		Title of the Figures must be written below the Figure and have to be referred in the text beforehand. Fig. numbering is chapter-wise as explained for equations. 10 Title of the Tables must be written above the Table and have to be referred in the text beforehand. Table numbering is chapter-wise as explained for equations.
	References	The references are to be listed in the order of its appearance in the text. References are to be numbered within square brackets Ex: [1], [2]. **For Book:** [1] W. C. Y. Lee, Mobile Communications Engineering: Theory and Applications,2nd edition, McGraw-Hill, 1997. **For Journal:** [2] L. A. Roy and D. P. Agrawal, "Wearable Networks: Present and Future," IEEE Computer, Vol. 36, No. 11, pp. 31–39, November 2003. **For Conference/Seminar etc:** [3] Q. Le, T. Ngo-Quynh and T. Magedanz, "RPL-based multipath Routing Protocols for Internet of Things on Wireless Sensor Networks," 2014 International Conference on Advanced technologies for Communications (ATC 2014), Hanoi, 2014,pp. 424-429. **Web Links:** [4]https://www.electronics-notes.com/articles/history/cellphonehistory/umts-3g-mobile-phone-history.ph

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

MCA Specialization Tracks

Artificial Intelligence, Machine Learning and Robotics

S. No.	Course Code	Course Title	Credits: L T P C
1.	CSF341	R Programming	2 0 2 3
2.	CSF342	Fuzzy Logic and Neural Network	2 0 2 3
3.	CSF343	Evolutionary Computing	2 0 2 3
4	CSF344	Machine Learning	2 0 2 3
5.	CSF441	Deep Learning	2 0 2 3
6.	CSF442	Robotics	2 0 2 3

1.	School offering the course	School of Computing
2.	Course Code	**CSF341**
3.	Course Title	**R Programming**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	DE

COURSE SUMMARY

In this course student will learn how to program in R and how to use R for effective data analysis. The course includes the installation and configuration of R programming a statistical programming environment, discuss generic programming language concepts and R data objects as they are implemented in a high-level statistical language. The course covers practical issues in statistical computing which includes programming in R, reading data into R, accessing R packages, writing R functions for Data Science and Machine Learning algorithms.

COURSE OBJECTIVES

The objective of this course is to develop a broad perspective about the R programming and its applications to solve basic mathematical problems, statistical manipulations and scientific tasks such as data science and machine learning. R programming has its own built in functions to perform any specialized task. The course is intended to learn the basics of R software in this course.

COURSE OUTCOMES

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

CO1: Apply the basic functionalities of R programming to solve basic mathematical problems.

CO2: Apply the R programming for preprocessing the real-life datasets.

CO3: Understand and analyze the descriptive statistics for a given dataset.

CO4: Implement some classical machine learning models using R programming.

CURRICULUM CONTENT

UNIT 1 **(5L)**

What is R?, What is S? Basic Features of R, Limitations of R, R Framework setup, R packages, Use R like calculator, Reading and Writing data into R: combine or concatenate command, scan command, alternative commands for reading data, R constant and variables, operators and expression.

UNIT 2 **(5L)**

R data types and objects: Number and Text, Vector, Matrix, Factor, Array, List Data Frame, Manipulating Objects. Control structures, looping, scoping rules, Operations on Dates and Times, functions, debugging tools. R built-in packages and functions.

UNIT 3 **(5L)**

Dataset: Import/export bigger datafile (csv, text, excel, table, url, etc.), Identify and handle missing values, data formatting, Data Standardization, Data Normalization and Scaling, Data visualization, Binning, Multimedia datasets: text dataset, image dataset, audio dataset, video dataset.

UNIT 4 **(5L)**

Central tendency, Dispersion variance, standard deviation, shape skewness, kurtosis, percentiles, five-point summary, boxplots, histograms, bar plot, pie chart, scatter plot, two-way tables, covariance, correlation, Chi-Square test for two-way tables.

UNIT 5 **(6L)**

Introduction to machine learning, types of machine Learning, supervised learning using R- regression, decision tree, KNN, SVM, Unsupervised learning using R- Clustering: K-means, hierarchical, frequent itemset, dimensionality reduction.

TEXTBOOK(S)

1. R programming for data science. R. D. Peng, Leanpub, 2016.
2. Practical Data Science with R. Author(s): Nina Zumel, John Mount, Manning Shelter Island, 2014.

REFERENCES :

1. The R book, Crawley and Michael, John Wiley & Sons, 2012.
2. Beginning R: The statistical programming language. Mark Gardener, John Wiley & Sons, 2012.

1.	School offering the course	School of Computing
2.	Course Code	**CSF342**
3.	Course Title	**Fuzzy Logic and Neural Network**
4.	Credits (L: T:P:C)	2: 0: 1 :3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	DE

COURSE SUMMARY

The course is proposed to teach students the concepts of Fuzzy Logic and Neural Networks. Students will develop understanding of the different neural network algorithms and fuzzy functions.

COURSE OBJECTIVES

The course will facilitate the students to learn the fundamentals of Fuzzy Logic and Neural Networks.

COURSE OUTCOMES

Course Outcomes (COs): After the completion of the course, students will be able to:

CO1. Understanding the concepts of Fuzzy Logic.
CO2. Applying different fuzzy operations and functions.
CO3. Understanding the concepts of Neural Network.
CO4. Understanding and implement different Activation Functions.

CURRICULUM CONTENT

UNIT 1 **(6L)**

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing. Fuzzy Computing, Neural Computing, Applications of Soft computing techniques.

UNIT 2 **(7L)**

Fundamentals of Fuzzy Logic: Basic Concepts: Fuzzy Set Theory, Basic Concepts of Crisp sets and fuzzy set, complements, union, intersection, combination of operations, general aggregation operation,
fuzzy relations, fuzzy proposition, fuzzy implication, compatibility relation. Fuzzy membership function, Defuzzification Techniques.

UNIT 3 **(7L)**

Introduction to Neural Networks:Introduction to Biological Neural Network, Artificial Neural Network. Activation Functions, Basic Learning Rules, Hebb's rule, Biases and Threshold, Perceptron, Convergence Theorem, Delta Rule, Hyperparameter, Cost Function, Applications of Artificial Neural Networks.

UNIT 4 **(6L)**

Neural Network Techniques: Gradient Descent, Stochastic Gradient Descent, Back Propagation, Multi-Layer Perceptron, Feed Forward Networks, Convolution Neural Network, Recurrent Neural Networks, Bayesian Network, Hopfield Network, Radial Basis Network.

UNIT 5 **(7L)**

Advanced Neural Networks: Architecture of Cognitron and Neocognitron, Auto Encoders, Gated Recurrent Unit, Long Short-Term Memory, Kohonen Self Organizing Network, Modular Neural Network.

TEXTBOOK(S)

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition

REFERENCES :

1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.

1.	School offering the course	School of Computing
2.	Course Code	**CSF343**
3.	Course Title	**Evolutionary Computing**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	DE

COURSE SUMMARY

The evolution of computers has been phenomenal in the last decades with computers becoming part of each and every aspect of human lives. This course seeks to use the concepts of human evolution to become a part of the further evolution of computers. Using biological evolution as a motivation many computer problems can be solved much faster. This course seeks to guide students to how to implement and think these algorithms.

COURSE OBJECTIVES

The main goal of this course is to help students learn an evolutionary method for computer solvable problems. The course seeks to find out the solution for complex computing problems using Darwinian laws as its basic motivation in order to find better solutions to certain problems. Students shall be able to get familiar with advanced concepts of mutation and the implementation of these biological concepts through methods such as neural networks and statistical methods.

COURSE OUTCOMES

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

CO1: Understand the fundamental of evolution based learning algorithms, advanced searching and optimization techniques.

CO2: Analyze and Understand the concepts of genetic algorithms.

CO3: Ability to apply swarm intelligence and Ant Colony Optimization.

CO4: Ability to create algorithms evolutionary computing based algorithms for solving problem.

CURRICULUM CONTENT

UNIT 1 **(5L)**

Introduction, Optimization Problems, Problem Domains, Global Optimization and Techniques of Global Optimization: Branch and Bound, Clustering Methods, Hybrid Methods, Simulated Annealing, Statistical Global Optimization Algorithms, Taboo Search, Multi Objective Optimization, Darwinian Evolution, Genetics, What is an Evolutionary Algorithm, Components of Evolutionary Algorithms, Competitive Learning, Working of an Evolutionary Algorithm, Evolutionary Computing and Global Optimization.

UNIT 2 **(5L)**

Genetic Algorithm: Introduction, Representation of Individuals, Mutation, Recombination, Population Models, Parent Selection, Survivor Selection, Age-Based Replacement, Fitness Based Replacement, Evolutionary Strategies, Example Applications.

Genetic Programming: Introduction, Representation, Mutation, Recombination, Parent Selection, Survivor Selection, Initialisation, Bloat in Genetic Programming, Problems Involving ``Physical'' Environments, Example Applications.

UNIT 3 **(5L)**

Swarm Intelligence: Introduction, key principles (e.g., self-organization, stigmergy), natural and artificial examples, computational and real-time SI, Ant System (AS), the first combinatorial optimization algorithm based on ant trail/following principles, Travel Salesman Problem (TSP). Ant Colony Optimization (ACO), Ant-based algorithms (ABC, Ant-Net) applied to routing in telecommunication networks.

UNIT 4 **(5L)**

Multimodal problems, need for diversity, implicit measures, explicit diversity maintenance, multi objective evolutionary algorithms.

UNIT 5 **(6L)**

Evolutionary Robotics, Evolutionary Neural Networks, Dynamic Landscapes, Parallel EC, Multiobjective EC.

TEXTBOOK(S)

1. A.E.Eiben & J.E.Smith. Introduction to Evolutionary Computing. Springer-Verlag Berlin Heidelberg, 2nd edition, 2016.

REFERENCES :

1. S. Sumathi &T.Hamsapriya&P.Surekha, Evolutionary Intelligence-An Introduction to theory and applications with Matlab Springer-Verlag Berlin Heidelberg, 3rdedision, 2008.
2. Kenneth A. De Jong, Evolutionary Computation, A unified Approach The MIT Press Cambridge, Massachusetts London, England, 1stedision, 2006.

Data Science and Analytics

S. No.	Course Code	Course Title	Credits: L T P C
1.	CSF341	R Programming	2 0 2 3
2.	CSF344	Machine Learning	2 0 2 3
3.	CSF345	Introduction to Data Science	2 0 2 3
4	CSF346	Data Mining and Data Warehousing	2 0 2 3
5.	CSF441	Deep Learning	2 0 2 3
6.	CSF443	Big Data Analytics	2 0 2 3

1.	School offering the course	School of Computing
2.	Course Code	**CSF344**
3.	Course Title	**Machine Learning**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	DE

COURSE SUMMARY

This course is designed to provide an introduction to techniques, and algorithms in machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such as support vector machines, decision tree, and Bayesian networks. The course will give the student the basic ideas and intuition behind modern machine learning methods as well as a bit more formal understanding of how, why, and when they work.

COURSE OBJECTIVES

This course is designed to provide knowledge about basic concepts of Machine Learning, identify machine learning techniques suitable for a given problem, solve the problems using various machine learning techniques, apply Dimensionality reduction techniques and design application using machine learning techniques.

COURSE OUTCOMES

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

CO1: Analyse & Differentiate various learning approaches and to interpret the concepts of supervised and unsupervised learning.

CO2: Understand the different dimensionality reduction techniques.

CO3: Evaluate & illustrate the working of classifier models like SVM, Neural Networks and identify classifier model for typical machine learning applications.

CO4: Create & Apply clustering algorithms and identify its applicability in real life problems.

CURRICULUM CONTENT

UNIT 1 **(5L)**

Introduction: Probability Theory, Overview of machine learning: Unsupervised, Supervised, Reinforcement, Programs vs learning algorithms, goals & applications, software tools, machine learning problems, components of a learning, types of learning. Aspects of developing a learning system: training data, concept representation, function approximation.

UNIT 2 **(5L)**

Regression: Linear Regression, Ridge Regression, Sensitivity Analysis, Multivariate Regression.

Clustering: Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering, dealing with continuous, categorical values in K-Means, Constructing a hierarchical cluster, K-Medoids, k-Mode and density-based clustering, Measures of quality of clustering, Hidden Markov Model.

UNIT 3 **(5L)**

Classification: Bayesian Learning (Bayes theorem, Bayes Optimal Classifier, Naïve Bayes classifier), K-Nearest Neighbors, Support Vector Machines, Decision Trees, Boosted Trees, Random Forest, CART, Gradient boosting..

UNIT 4 **(5L)**

Dimensionality Reduction: Feature selection, principal component analysis, linear discriminant analysis, factor analysis, independent component analysis, multidimensional scaling, manifold learning, band selection.

Introduction to Analytical Learning, Combining Inductive and Analytical learning, Reinforcement learning, adaptive hierarchical clustering, Gaussian mixture model.

UNIT 5 **(6L)**

Artificial Neural Networks: The perceptron algorithm, multilayer perceptron, back propagation, Introduction to Deep Neural networks, Recurrent Neural Networks and Convolutional Neural Networks.

TEXTBOOK(S)

1. Tom Mitchell, Machine Learning, McGraw Hill, 1st edition, 2017.
2. EthemAlpaydin, Introduction to Machine Learning, PHI, 3rd edition, 2015.

REFERENCES :

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2nd edition, 2013.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2nd edition, 2014.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF442**
3.	Course Title	**Robotics**
4.	Credits (L: T:P:C)	2: 0: 1 :3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	DE

COURSE SUMMARY

The course is proposed to teach the students the concepts of Robotics. Students will develop understanding of the different principles of sensors and methods of robot.

COURSE OBJECTIVES

The course will facilitate the students to learn the fundamentals, Techniques used in Robotics .

COURSE OUTCOMES

Course Outcomes (COs): After the completion of the course, students will be able to:

CO1. Understaing of how to keep robots in modern industries.
CO2.. Applying robots in different areas (space, medical, manufacturing etc.).
CO3. Understaing different components of robots system and their working principle.
CO4. Creating robot using robot lego robotics kit.

CURRICULUM CONTENT

UNIT 1 **(5L)**

Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing. Fuzzy Computing, Neural Computing, Applications of Soft computing techniques.

UNIT 2 **(5L)**

Actuators: Characteristics of Actuating Systems, Actuating Devices and Control. Sensors: Sensor Characteristics, Description of Different Sensors, Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT 3 **(5L)**

Concepts of AI, AI Problems, techniques, Characteristics & Applications, AI versus Natural Intelligence, Problem representation in AI, Problem-solution Techniques. Elements of Knowledge Representation: Logic, Production Systems, Semantic Networks, Expert Systems. Defining the Problem as State Space Search, Production Systems, Production Systems, Issues in the Design of Search Programs, DFS & BFS Techniques

UNIT 4 **(7L)**

Introduction to lego robotics kits, Introduction to robot manipulation. Forward and inverse kinematics of robots and some case studies. Manipulator dynamics. Basics of robot control. Task planning with emphasis on computational geometry methods for robot path finding, robot arm reachability, grasp planning. Overview of robot vision and Parallel robots

UNIT 5 **(6L)**

Multi-robot representations and Task Planning: Task-Level Programming, Uncertainty, Configuration Space, Gross-Motion Planning, Grasp Planning, Fine Motion Planning, Task Planning Problem.: control architectures, simulation environments, and test beds. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system.

TEXTBOOK(S)

1. Fundamentals of Robotics Analysis and Control, Robert J Schilling, PHI, 5thedision, 2012
2. Introduction to Robotics Analysis, Systems, Applications by Saeed B. Niku, Prentice Hall, 2nd Edition, 2014.

REFERENCES :

3. An Introduction to Multi Agent Systems , Michael Wooldridge Wiley, 2014
J J Craig, "Introduction to Robotics: Mechanics

1.	School offering the course	School of Computing
2.	Course Code	**CSF345**
3.	Course Title	**Introduction to Data Science**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	NIL
7.	Course Basket	Discipline Elective

COURSE SUMMARY

This course aims to provide a basic understanding of Data Science concepts. This course introduces students to the data science principles required to tackle real-world, data-rich problems in business.

COURSE OBJECTIVES

Data Science is the study of the generalizable extraction of knowledge from data. This course serves as an introduction to the data science principles required to tackle real-world, data-rich problems in business and academia, including: Data acquisition, cleaning, and aggregation, Exploratory data analysis and Visualization, Feature engineering, Model creation and validation, Basic statistical and mathematical foundations for data science

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: An understanding of problems solvable with data science and an ability to attack them from a statistical perspective.

CO2: An understanding of when to use supervised and unsupervised statistical learning methods on labeled and unlabeled data-rich problems

CO3: The ability to create data analytical pipelines and applications in Python. .

CO4: Apply the various tools needed to continue developing as a data scientist.

CURRICULUM CONTENT

Unit 1: Computer Science/Statistics/Linear Algebra Short Review (5L)

What is data science? Brief review of prerequisite knowledge for studying data science. Basics of computer science; data structures/types, program control flow, and syntax in Python. Basics of statistics; probability and probability distributions. Basics of linear algebra; matrices, vectors using Python programming language.

Unit 2: Exploratory Data Analysis (Eda) And Visualization Design (5L)

E-R model: Basic concepts, Design Issues, Mapping Constraints, Attributes and Entity sets, Relationships and Relationship sets, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended ER features.

Unit 3 Data Modeling: Supervised/Unsupervised Learning (5L)

Two basic kinds of statistical models used for prediction. Supervised Learning algorithm: Linear Regression and Logistic Regression. Unsupervised Learning algorithm: K-Means clustering. Advanced supervised learning algorithms like linear support vector machines, decision trees, and random forest models for regression and classification. Advanced unsupervised learning algorithm like DBSCAN.

Unit-4 Data Modeling: Feature Selection, Engineering, And Data Pipelines (5L)

Curse of dimensionality and Dimensionality reduction. Feature selection and feature extraction. Principal Component Analysis/Independent Component Analysis and regularization. Construct complete data pipelines, going from data ingestion, preprocessing to model construction and evaluation.

Unit- 5: Data Modeling: Model Evaluation And Project Presentations (6L)

Exploration of more sophisticated model evaluation approaches like cross-validation and bootstrapping with the goal of making the model as generalizable as possible. Presentation of students' project and sharing learning experience.

TEXT BOOKS :

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O'Reilly. 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei Silberschatz, Korth, Data Mining: Concepts and Techniques, Third Edition. ISBN 0123814790. 2011

REFERENCES :

1. Mohammed J. Zaki and Wagner MieraJr, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press. 2014.

1.	School offering the course	School of Computing
2.	Course Code	**CSF346**
3.	Course Title	**Data Mining and Data Warehousing**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	Discipline Elective

COURSE SUMMARY

This course aims to provide a basic understanding of Data ware housing and mining concepts, implementation of Data Mining algorithms. This course introduces students to enterprise data and the process and technologies to integrate data from a variety of sources.

COURSE OBJECTIVES

This course will covers the basic concepts of Data Warehouse and Data Mining techniques, Examine the types of the data to be mined and apply pre-processing methods on raw data. It also discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Explain and evaluate the various data mining algorithms
CO2: Discover and measure interesting patterns from different kinds of databases.
CO3: Apply the techniques of clustering, classification, association finding,
CO4: Apply techniques for feature selection and visualization to real world data.

CURRICULUM CONTENT

Unit 1: Overview (5L)

Motivation (for Data Mining), Data Mining-Definition & Functionalities. Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting. ROLAP, MOLAP, HOLAP.

Unit 2: Data Pre-Processing (5L)

Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Inconsistent Data, Data Integration and Transformation. Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Unit 3 Concept Description (5L)

Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases

Unit-4 Classification **(5L)**

What is Classification, Issues regarding Classification, Decision tree, Bayesian Classification, Classification by Back propagation.

Unit- 5: Cluster Analysis **(6L)**

Data types in cluster analysis, Partitioning methods. Hierarchical Clustering- CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based MethodsSTING, CLIQUE, Outlier Analysis

TEXT BOOKS :

1. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Elsevier, Third Edition, 2012.

REFERENCES :

2. Margaret H.Dunham, Data-Mining: Introductory & Advanced Topics, Pearson Education, India, 3rd edition, 2012.

1.	School offering the course	School of Computing
2.	Course Code	**CSF441**
3.	Course Title	**Deep Learning**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	NIL
7.	Course Basket	Discipline Elective

COURSE SUMMARY

This course aims to provide a basic understanding of deep learning concepts, implementation of supervised and unsupervised algorithms. This course introduces students to enterprise data and the process and technologies to integrate data from a variety of sources.

COURSE OBJECTIVES

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolutional neural networks. The course also requires students to implement programming assignments related to these topics.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the concept of artificial neural networks, convolutional neural networks, and recurrent neural networks

CO2: Discuss how to speed up neural networks along with regularization techniques to reduce overfitting.

CO3: Understand the concept of generative models.

CO4: Implement deep learning algorithms, and learn how to train deep networks.

CURRICULUM CONTENT

Unit 1: Basics (5L)

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for perceptron Learning Algorithm.

Unit 2: Feed Forward Networks (5L)

Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.

Unit 3: Feed Forward Networks (5L)

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training. Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

Unit 4: Recurrent Neural Networks (5L)

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs , Convolutional Neural Networks: LeNet, AlexNet.

Unit 5: Generative Models (6L)

Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines, Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multitask Deep Learning, Multi-view Deep Learning, Applications: Vision, NLP, Speech and Deep Learning Tools.

TEXT BOOKS :

3. Ian Goodfellow and YoshuaBengio and Aaron Courville, Deep Learning, , MIT Press, 2016.

REFERENCES :

1. Raul Rojas, Neural Networks: A Systematic Introduction, Springer-Verlag, Berlin, New-York, 1996
2. Christopher Bishop, Pattern Recognition and Machine Learning, 2010

1.	School offering the course	School of Computing
2.	Course Code	**CSF443**
3.	Course Title	**Big Data Analytics**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	NIL
7.	Course Basket	Discipline Elective

COURSE SUMMARY

Course Summary To learn the need for Big Data Analytics, and to acquire modern tools to implement in real life applications.

COURSE OBJECTIVES

Understanding the fundamentals of various big data analysis techniques, Hadoop structure, environment and framework.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand the need and process of data analysis.
CO2: Learn the different component of Hadoop Ecosystem.
CO3: Design Map Reduce and the use of Apriori.
CO4: Apply and Analyse different software for processing Big Data

CURRICULUM CONTENT

UNIT 1: INTRODUCTION TO BIG DATA AND HADOOP (5L)

Types of Digital Data, Introduction to Big Data, Big Data Analytics, Analytic Processes and Tools, Analysis vs Reporting, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Modern Data Analytic Tools - History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy.

UNIT 2: HADOOP DISTRIBUTED FILE SYSTEM (HDFS) (5L)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT 3: MAP REDUCE (5L)

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features. Mining Frequent Item sets :- Market Based Model, Apriori Algorithm, FP-Growth.

UNIT 4: HADOOP ECO SYSTEM (5L)

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL: Introduction.

UNIT- 5:DATA ANALYTICS WITH R (6L)

Overview of R programming language, Regression Modelling, Multivariate Analysis. Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR. Machine learning tools: Spark &SparkML, H2O, Azure ML.

TEXT BOOKS :

4. Michael Berthold, David J., Intelligent Data Analysis, 2/e, Springer, 2015.
5. Anand Raja Raman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCES :

3. Glenn J. Myatt Making Sense of Data, , John Wiley & Sons, 2014
4. Pete Warden , Big Data Glossary, O'Reilly, 2011.

Internet of Things and Edge Computing

S. No.	Course Title	Course Title	Credits: L T P C
1.	CSF347	Wireless and Mobile Systems	3 0 0 3
2.	CSF348	Mobile Application Programming using Android	2 0 2 3
3.	CSF349	Cloud Computing	2 0 2 3
4.	CSF351	Advanced Computer Networks	3 0 0 3
5.	CSF444	Internet of Things	2 0 2 3
6.	CSF445	Mobile & Wireless Network Security	2 0 2 3

1.	School offering the course	School of Computing
2.	**Course Code**	**CSF347**
3.	**Course Title**	**Wireless and Mobile Systems**
4.	Credits (L:T:P:C)	3:0:0:3
5.	Contact Hours (L:T:P)	3:0:0
6.	Prerequisites (if any)	
7.	Course Basket	Discipline Elective

Course Summary

This course deals with the basics of cellular concept and mobile communication systems, multiple radio access procedures and channel allocation techniques, the architecture and functioning of satellite systems including global positioning systems, different wireless LAN technologies and personal area networks.

Course Objectives

This course aims to provide students a comprehensive overview of different types of wireless and mobile systems with a detailed focus on architecture of modern-day cellular systems. Students will learn concepts about mobile communication systems architecture, wireless standards, satellite systems as well as personal area networks.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand various radio propagation mechanisms

CO2: Understand cellular concepts, multiple division techniques and channel allocation techniques.

CO3: Understand Mobile Communication System Architecture

CO4: Understand Wireless MANS, LANS and PANS.

Curriculum Content

Unit 1: (3L)

History of wireless systems. Introduction to various types of wireless and mobile systems.

Unit 2: (6L)

Types of Radio Waves, Propagation Mechanisms, Free Space Propagation, Land Propagation, Path loss and Fading, Doppler Effect, Delay Spread and Intersymbol Interference.

Unit 3: (12L)

Cellular Concept, Cell Area, Signal Strength and Cell parameters, Capacity of a cell, Frequency reuse, How to form a cluster, Cochannel Interference, Cell Splitting and Cell Sectoring, Multiple division Techniques, Concepts and Models of Multiple Divisions (FDMA, TDMA, etc.), Channel Allocation, Static Allocation versus Dynamic Allocation, Fixed Channel Allocation, Dynamic Channel Allocation, Hybrid Channel Allocation, Allocation in specialized System Structure.

Unit 4: (6L)

Mobile Communication Systems, Cellular System Infrastructure, Registration, Handoff and Roaming Support, Multicasting, Security and Privacy.

Unit 5: **(12L)**

Wireless MANs, LANs and PANs, Wireless Metropolitan Area Networks (4G systems), Wireless Local Area Networks (IEEE 802.11x), Wireless Personal Area Network (Bluetooth Networks), Case Studies of all these types of networks.

Textbook(s)

1. Introduction to Wireless and Mobile Systems, by D.P. Agrawal and Q. Zeng.

Reference Books

1.Wireless Communications: Principles and Practice, 2e, by T.S. Rappaport.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	**Course Code**	**CSF348**
3.	**Course Title**	**Mobile Application programming using Android**
4.	Credits (L:T:P:C)	2:0:1:3
5.	Contact Hours (L:T:P)	2:0:2
6.	Prerequisites (if any)	NA
7.	Course Basket	Discipline Elective

Course Summary

This course deals with the internals of Android Operating System, GUI, various services, graphics design, database connectivity, network connectivity and integration of various APIs.

Course Objectives

The objective of this course is to teach mobile application programming to students using Android. Students will learn about the technologies and the tools used to develop Android mobile applications. Students will be introduced to the internals of the Android OS and mobile application development using the Android SDK.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand internals of the Android OS
CO2: Implement mobile application development using the Android SDK.
CO3: Implement GUI, Services, Database Connectivity and Web Service Integration
CO4: Understand network connectivity and integration of various APIs.

Curriculum Content

Unit 1: **(3L)**

Overview of mobile applications, installing the development environment, Android Overview, architecture overview and Android development environment, Anatomy of an Android App, App lifecycle.

Unit 2: **(12L)**

GUI development: XML for UI design, development tools, Activities, multiple activities, Activity lifecycle, Intents, MVC, GUI development, Lists, fragments, dialogs, Action Bar, 2D graphics and drawables.

Unit 3: **(6L)**

Services and Broadcast Services, Database connectivity with SQLite, Web service integration using JSON, XML, SOAP and RESTful services.

Unit 4: Network connectivity, Integration with multiple APIs. **(3L)**

Textbook(s)

Head First Android Development: A Brain-Friendly Guide, by Dawn Griffiths and David Griffiths.

Reference Books

Android Programming: The Big Nerd Ranch Guide (Big Nerd Ranch Guides), 2017.

Approved by the Academic council in its 22nd Meeting held on 06.03.2023

1.	School offering the course	School of Computing
2.	Course Code	**CSF351**
3.	Course Title	**Advanced Computer Networks**
4.	Credits (L:T:P:C)	3:0:0:3
5.	Contact Hours (L:T:P)	3:0:0
6.	Prerequisites (if any)	NA
7.	Course Basket	Discipline Elective

Course Summary

The course is designed for the smooth and fast data transportation over the wired and wireless medium. The course introduces the queuing model and Markovian theory to handle process state at the various stages of the switches and routers. The course introduces the basic Wireless security to understand the various network's attack and prevention. A number of advance network protocols are included in this course to understand the various network challenges for wired as well as the wireless medium.

Course Objectives

This course is designed to provide knowledge about some of the advanced concepts of Computer Network like network design, switching and routing design, wireless LAN standards, stochastic processes and queueing concepts, and network security.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

CO1: Understand and explain the concepts of network designs.

CO2: Understand various switching and routing techniques.

CO3: Understand wireless LAN standards.

CO4: Understand stochastic processes, queueing systems and network security and management.

Curriculum Content

Unit 1: Network Design (6L)

Design Principles, Determining Requirements, Analysing the Existing Network, Preparing the Preliminary Design, Completing the Final Design Development, Deploying the Network, Monitoring and Redesigning, Maintaining, Design Documentation, Cisco PDIOO Model, Modular Network Design, Hierarchical Network Design.

Unit 2: Switching and routing (9L)

Switching Design: Switching Types, Layer 2 and 3 Switching, Multilayer Switching, Cisco Express Forwarding, Switching Security, Multi-Protocol Label, Switching (MPLS), MPLS Architecture and related protocols..IPv4 Routing Design: IPv4 Address Design, Private and Public Addresses, NAT, Subnet Masks, Hierarchical IP Address Design, Deploying IPv6 in Campus Networks. Router Design:

Configuring a Router, Routing Protocols.

Unit 3: Wireless LANs (6L)

Wireless Technology Overview, Wireless Standards, Wireless Components, Wireless Security, Wireless Design Considerations, IEEE 802.11 standards, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs), QoS Models: IntServ, DiffServ, QoS Tools, Policing and Shaping, Congestion Avoidance, Congestion.

Unit 4: Stochastic Processes & Queuing Systems. (9L)

Stochastic Processes: The Poisson Process, Birth Death Process, Markov Chains. Single Station Queuing System: Kendall's Notation, Performance Measures, The M/M/1 Queue, The M/M/$\propto$ Queue, The M/M/m Queue.

Unit 5: Network Security and Management Design (6L)

Hacking: Vulnerabilities, Threats: Reconnaissance Attacks, Access Attacks, Information Disclosure Attacks, Denial of Service Attacks, Threat Defence Secure Communication, Network Security Best Practices, SAFE Campus Design. ISO Network Management Standard: Protocols and Tools, SNMP, MIB, RMON, Cisco NetFlow, Syslog, Network Management Strategy: SLCs and SLAs, IP Service Level Agreements, Content Networking Design.

Textbook(s)

1. Diane Tiare and Catherine Paquet, ― Campus Network Design Fundamentals‖, Pearson Education, 2006.
2. Arnold O. Allen, ― Probability Statistics, and Queuing Theory with Computer Science Application, Academic Press, Inc. 6277 Sea Harbor Drive Orlando, FL United States, 2nd Edition
3. Gunter Bolch, Stefan Greiner, Hermann de Meer, Kishor S. Trivedi, ― Queueing Networks and Markov Chains John Wiley & Sons, Inc., Publication, 2nd Edition.

Reference Books

1. Craig Zacker, ―The Complete Reference: Upgrading and Troubleshooting Networks‖, Tata McGrawHill, 2000 Edition.

1.	School offering the course	School of Computing
2.	Course Code	**CSF444**
3.	Course Title	**Internet of Things**
4.	Credits (L:T:P:C)	2:0:1:3
5.	Contact Hours (L:T:P)	2:0:2
6.	Prerequisites (if any)	NA
7.	Course Basket	Discipline Elective

Course Summary

In this course students will be introduced to fundamental and architectural concepts of IoT systems, various kinds of communication using system-on-chip devices and building IoT prototypes. Students will learn how to create an end-to-end system by connecting to IoT cloud, perform IoT Analytics and understand cloud security.

Course Objectives

The objective of this course is to provide both conceptual and hands-on knowledge to students for IoT systems. Students will learn how to build and use end-to-end IoT systems, perform analytics on the data collected and understand security aspects of an IoT system.

Course Outcomes:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand fundamental concepts and building blocks of an IoT system.
CO2: Understand and implement IoT prototypes using system-on-chip devices.
CO3: Understand and develop end-to-end systems by syncing with Cloud.
CO4: Understand security aspects of an IoT system.

Curriculum Content

Unit 1: Introduction, IoT Architecture, Sensing, Communication and Actuation, Hardware and Software setup
Unit 2: GPIO pins setup and programming, Serial Communication in IoT, SPI and I2C in IoT. (15L)
Unit 3: Data transmission in Cloud, IoT Analytics and Visualization
Unit 4: IoT Security, IoT Project execution and demonstration

12. Bibliography

Textbook: No Textbook. Instructors will provide reading materials.

Cyber Security and Privacy

S. No.	Course Code	Course Title (Proposed)	Credits: L T P C
1.	CSF352	Number Theory and Cryptology	2 0 1 3
2.	CSF353	Foundation of Cyber Security	2 1 0 3
3.	CSF354	Data Encryption & Network Security	2 0 2 3
4	CSF355	Cyber Crime & Investigation	2 0 2 3
5.	CSF445	Mobile & Wireless Network Security	2 0 2 3
6.	CSF446	Ethical Hacking & Digital Forensics	2 0 2 3

1.	School offering the course	Computer Science and Engineering
2.	Course Code	**CSF352**
3.	Course Title	**Number Theory and Cryptology**
4.	Credits (L:T:P:C)	2:0:1:3
5.	Contact Hours (L:T:P)	2:0:2
6.	Prerequisites (if any)	Basics of Number Theory
7.	Course Basket	Discipline Elective

COURSE OUTLINE:

This course will introduce the basic concepts of cryptography, which includes the Substitution & Transposition Techniques, Public Key and Secret Key Cryptography. The course will consist of assigned reading, weekly lectures, weekly practical, a midterm and final exam, and a sequence of class test and assignments. The goal of the readings and lectures is to introduce the core concepts. The goal of the practical is to give students some exposure to secure code designing.

COURSE OBJECTIVE:

- To introduce the student to elementary number theory, as required for further study of important cryptographic protocols.
- To introduce the student to the fundamentals of modern symmetric cryptography.
- To enable the student to appreciate the significance of cryptography as a means of securing information in the modern world.

COURSE OUTCOMES:

At the end of the course, the student will be able to:
CO 1. Understand the significance of cryptography to the modern world and the internet.
CO 2. Understand the rationale behind block cipher designs.
CO 3. Utilize the cryptanalysis of a simple block ciphers.
CO 4. Solve elementary problems in number theory relating to cryptography.

CURRICULUM CONTENT

UNIT 1: (6L)

Basic Cryptography Concepts- Basic Cryptography Concepts, Purpose of Cryptography Need for security, Security Goals, Principles of security,Types of attacks.

Encryption Techniques: Plaintext, Cipher text, Substitution & Transposition Techniques,

Classical methods: Caesar cipher, Vigenere cipher, The one-time pad, Mechanical rotor systems, Vernam Cipher, Affine Cipher, Hill Cipher, Playfair Cipher, Rail Fence Cipher, Columnar Cipher

UNIT 2: (6L)

Modern ciphers: Block ciphers and their applications, Structure of a block cipher, The Fiestel structure, Key and block size length, The Data Encryption Standard (DES), Double DES, Triple DES, AES.

UNIT 3: **(5L)**

Elementary Number Theory: Finite fields, Modular arithmetic, Efficient algorithms for modular arithmetic, Fermat's little theorem, Euler's criteria, Euler's totient function.

UNIT-4 **(5L)**

Advanced Number Theory: Primality testing, prime factorisation, The Chinese remainder theorem, Quadratic residues and calculating modular square roots and cube roots.

UNIT- 5: **(5L)**

Public Key Cryptography &Key Distribution: The key distribution problem, The Diffie-Hellman method, RSA and related methods, Linear cryptanalysis, Differential cryptanalysis, Meet-in-the-middle attacks, Symmetric &Asymmetric key together.

TEXT BOOKS

1. Stallings, −Cryptography and Network Security- Principles and Practice‖, Pearson Ed., 2017.
2. Â NealKoblitz, ―A Course in Number Theory and Cryptography‖, Springer 2006
3. Jill Pipher, Jeffrey Hoffstein, Joseph H. Silverman, ―An Introduction to Mathematical Cryptography‖, Springer, 2008.

REFERENCES

1. Niven, Zuckerman and Montgomery, ―An Introduction to theory of numbers‖, Wiley 2006.
2. Kahate, ―Cryptography and Network Security‖, McGraw-Hill Higher Ed., 2009.

1. Department offering the course	Computer Science and Engineering
2. Course Code	**CSF353**
3. Course Title	**Foundation of Cyber Security**
4. Credits (L:T:P:C)	3:0:0:3
5. Contact Hours (L:T:P)	3:0:0
6. Prerequisites (if any)	
7. Course Basket	Discipline Elective

COURSE OUTLINE:

This course aims to give an outline of cyber security. The course will equip students with a vibrant view of the existing cyber security landscape considering not only technical measures and defenses, but also the other theme areas including legal, management, crime, risk, social and human factors.

COURSE OBJECTIVE:

- To understand the crucial necessity of cyber security in computer systems, networks and enlighten numerous threat scenarios.
- To understand the well-known cyber-attack events, clarify the attack scenarios, and enlighten mitigation techniques.
- To understand the variance between Systems Cyber Security, Network Cyber Security, and cryptography, crypto-protocols etc.
- To analyses the cyber threats to critical structures.

COURSE OUTCOMES:

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

CO1: Understand the cyber threat landscape, both in terms of recent developing issues and those issues which persist over time.

CO2: Outline the roles and effects of governments, commercial and other organisations, citizens and criminals in cyber security affairs.

CO3: Analyze the general values and policies that can be functional to systems to make them more vigorous to attack.

CO4: Choose key factors in cyber security from different corrective views including computer science, management, law, criminology

CURRICULUM CONTENT

UNIT-1: INTRODUCTION TO CYBER SECURITY (8L)

Overview of Cyber Security, Cyber Threats & Crime, Cyber Espionage, Internet Governance, Challenges and Constraints, necessity for a Comprehensive Cyber Security Policy, necessity for a Nodal Authority, necessity for an International convention on Cyberspace.

UNIT-2: SECURITY THREATS AND VULNERABILITIES (8L)

Overview, vulnerabilities in software, Intrusion, Physical Theft, Abuse of Privileges, Malware infection, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness.

UNIT -3: SECURITY PRACTICES & SECURITY SAFEGUARDS (7L)

Security Practices: Security Management, Security Policy, Risk Management, Information Classification Process, Security Procedures and Guidelines, Business Continuity and Disaster Recovery.

Security Safeguards: Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Anti-Malware software.

UNIT -4:INTRUSION DETECTION &SECURING WEB (7L)

Intrusion detection and Prevention Techniques, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges, Network based Intrusion detection & Prevention Systems.

UNIT -5: SECURITY LAWS, STANDARDS & FORENSIC (7L)

Security Laws & Standards: Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy,

Cyber Forensic: Digital Forensics Essentials: Principles of Digital Forensics and its challenges, Steps taken by computer forensic specialists, Benefits of Professional Forensic Methodology, Industry standards and reporting.

TEXT BOOKS

1. Micki Krause, Harold F. Tipton, ―Handbook of Information Security Management‖, Vol 1-3, CRC Press LLC, 2004.

REFERENCES

1. Bill Nelson, ―Computer Forensics and Investigations‖, Cengage Learning, India Edition, 2016.
2. Matt Bishop ―Computer Security Art and Science‖, Pearson/PHI, 2002.

1. Department offering the course	Computer Science and Engineering
2. Course Code	**CSF354**
3. Course Title	**Data Encryption and Network Security**
4. Credits (L:T:P:C)	2:0:1:3
5. Contact Hours (L:T:P)	2:0:2
6. Prerequisites (if any)	Programming experience in C/C++ or JAVA
7. Course Basket	Discipline Elective

COURSE OUTLINE:

The course deals with the underlying principles of cryptography and network security. Starting from the classical encryption techniques to the more advanced tools of network security, the course imparts an immense coverage of the authentication and practices for securing network. The course deals with user/message authentication, IP security fundamentals. The course wraps up with the understanding of ACL, Firewalls and VPNs.

COURSE OBJECTIVE:

This course will cover the concept of security, types of attack experienced, encryption and authentication for deal with attacks, what is Network Perimeter Security, Access Control Lists and Virtual Private Networks.

COURSE OUTCOMES:

At the end of the course, the student will be able to:
CO1: Understand the significance of authentication process using digital signature.
CO2: Understand the significance of hash functions in data security.
CO3: Understand the concept of IP security and significance of Access control lists in network security.
CO4: Understand the concept of Communication Model, Network Perimeter Security Lists and Virtual Private Networks.

CURRICULUM CONTENT

UNIT 1: (6L)

Symmetric & Asymmetric Key Cryptography: Algorithm types & Modes, Substitution and Transposition Ciphers

User Authentication Mechanism: Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

UNIT 2: (6L)

Message Authentication and Hash Function: Approaches to Message Authentication, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, secure hash algorithm (SHA).

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME

UNIT 3: **(5L)**

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management.

Network Perimeter Security Fundamentals: Introduction to Network Perimeter, Multiple layers of Network Security, Security by Router.

UNIT-4 **(5L)**

Access Control Lists: Ingress and Egress Filtering, Types of Access Control Lists, ACL types: standard and extended, ACL commands.

Firewalls: Firewall Basics, Types of Firewalls, Network Address Translation Issues.

UNIT- 5: **(5L)**

Virtual Private Networks: VPN Basics, Types of VPN, IPsec Tunneling, IPsec Protocols. VLAN: introduction to VLAN, VLAN Links, VLAN Tagging, VLAN Trunk Protocol (VTP).

TEXT BOOKS

1. Forouzan, B.A., ―Cryptography & Network Security‖, Tata McGraw-Hill Education, 2010.
2. Stallings, –Cryptography and Network Security- Principles and Practice‖, Pearson Ed., 2017.

REFERENCES

1. Kahate, A., ―Cryptography and Network Security‖, McGraw-Hill Higher Ed., 2009.
2. Godbole, N., ―Information Systems Security: Security Management, Metrics, Frameworks and Best Practices‖ John Wiley & Sons India, 2009.

1. Department offering the course	Computer Science and Engineering
2. Course Code	**CSF355**
3. Course Title	**Cyber Crime & Investigation**
4. Credits(L:T:P:C)	3:0:0:3
5. Contact Hours(L:T:P)	3:0:0
6. Prerequisites(ifany)	
7. CourseBasket	Discipline Elective

COURSE OUTLINE:

This course provides an impression of cybercrime and the investigation practices put in place to respond to them. The course will emphasis on the types and extent of present cybercrimes, how the justice system responds to these crimes, the various legal protections afforded to computer users, the regulation and policies that govern cybercrime detection and prosecution, and related machineries.

COURSE OBJECTIVE:

1. To describe the nature and area of cybercrime.
2. To grow knowledge of key incidents of cybercrime and their subsequent influence.
3. To study and debate national and global digital law implementation efforts.
4. To categorize and assess the precise technology that enables cybercrime and digital law enforcement.
5. To assess the influence of cybercrime on information professions.

COURSE OUTCOMES:

Having successfully completed this course, students will be able to reveal facts and understanding of:

CO1: Analyse the essential concepts of cybercrime and forensics.

CO2: Distinguish the object and causes for cybercrime, detection and handling.

CO3. Understand the extents affected by cybercrime and investigation.

CO4: Demonstrate tools used in cyber forensic.

CO5: Apply their knowledge of report writing and forensic ethics in day-to-day use of applications.

CURRICULUM CONTENT

UNIT-I: PRINCIPLES AND CONCEPTS OF CYBER CRIMINOLOGY (8L)

Crime, Offence, Misdemeanour, Cyber Space, Cyber Crime, Cyber Criminology, Information Security, Penetration Testing, Incident Response, GRC, Conventional crimes vs. Cyber Crimes, White Collar Crimes, Economic Offences, Organized Crimes, Terrorism, Crime and Media and other contemporary forms of crimes.

UNIT-II: PSYCHOLOGY OF CYBER CRIMINALS (7L)

Types of Cyber Criminals, Modus Operandi of Cyber Criminals, Profiling of Cyber Criminals, Tools and Techniques adopted by Cyber Criminals, Psychological theories relating to cyber criminals, Causes of Cyber Crimes, Criminological Theories and Cyber Crime, Routine Activity Theory, Social Learning Theory, Differential Association Theory, Differential Opportunity Theory, Media and Crime and latest theories and other related theories.

UNIT-III: DIGITAL INVESTIGATION (7L)

Digital Evidence and Computer Crime, History and Terminology of Computer Crime Investigation, Technology and Law, The Investigative Process, Investigative Reconstruction, Motive and Technology, Digital Evidence in the Courtroom.

UNIT-IV: COMPUTER FORENSIC & UNDERSTANDING INFORMATION (7L)

Computer Forensic Fundamentals: Applying Forensic Science to computers, Computer Forensic Services, Benefits of Professional Forensic Methodology, Steps taken by computer forensic specialists. **Methods of storing data:** number systems, character codes, record structures, file formats and file signatures, Word processing and graphic file formats, Structure and Analysis of Optical Media Disk Formats, Recognition of file formats and internal buffers, Extraction of forensic artefacts, understanding the dimensions of other latest storage devices, SSD Devices.

UNIT-V: TYPES OF COMPUTER FORENSICS TOOLS AND TECHNOLOGY (7L)

Tools and Types of Military Computer Forensics Technology, Tools and Types of Law Enforcement Computer Forensic Technology, Tools and Types of Business Computer Forensic Technology.

TEXT BOOKS

1. SunitBelapure and Nina Godbole. ―Cyber Security: Understanding Cyber Crime, Computer Forensic and Legal Perspectives‖, Wiley India Pvt Ltd, ISBN: 978-81-265-2179, publish date 2013.
2. Bil Nelson, Amelia Philips and Christopher Steuart, ―Guide to Computer Forensics and Investigation‖, 4th Edition, Cengage Learning 2015.

REFERENCES

1. Thomas J Mowbray, ―Cybersecurity Managing Systems, Conducting Testing, and investigating Intrusions‖, copyright 2014 by John Wiley & sons, ISBN: 978-1-118-84965, 2014.
2. James Graham, Ryan Olson, Rick Howard, ―Cyber Security Essentials‖, CRC press, 15 Dec 2010.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1. Department offering the course	Computer Science and Engineering
2. Course Code	**CSF445**
3. Course Title	**Mobile and Wireless Network Security**
4. Credits (L:T:P:C)	3:0:0:3
5. Contact Hours (L:T:P)	3:0:0
6. Prerequisites (if any)	
7. Course Basket	Cyber Security

COURSE OUTLINE:

This course will introduce students about Mobile and Wireless Networks, Vulnerabilities of Wired and WirelessNetworks. It also includes overview of Fundamental Security Mechanisms, Hash functions, Electronic signatures and MAC, Cryptographic protocols. Topics would also include Wi-Fi Security Dedicated Architectures and Bluetooth Security.

COURSE OUTCOMES:

The purpose of this course is to provide In-depth knowledge about cellular design concepts and understanding of 3G Wireless network. It also provides an understanding of various security concerns and protocols in wireless networks (e.g., WiFi and mobile cellular networks) and mobile systems and applications.

COURSE OUTCOMES:

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the security threats and vulnerabilities in wireless and mobilesystems. CO2: Understand the security mechanisms and authentication procedures.

CO3: Understand the strategies for developing secure mobile applications.

CO4: Select mobile security penetration tools for evaluating the robustness of mobile applications.

CO5: Understand various models, design principles and solutions used in wireless network security to obtain authentication.

CURRICULUM CONTENT

Unit 1: Introduction to Mobile and Wireless Networks (8L)

Introduction, Cellular network basic concepts and Applications, First generation (1G) mobile, Second generation (2G) mobile, Third generation (3G) mobile, IEEE wireless networks, WLAN: IEEE 802.11, WPAN: IEEE 802.15, WMAN: IEEE 802.16, WMAN mobile: IEEE 802.20, MIH: IEEE 802.21, WRAN: IEEE 802.22, Macro mobility, Micro mobility, NEMO and MANET networks

Unit 2: Vulnerabilities of Wired and Wireless Networks (7L)

Introduction, Security in the digital age, Threats and risks to telecommunications systems, Homogenity vs. heterogeneity, The Internet and security

Unit 3 Fundamental Security Mechanisms (7L)

Basics on security, Symmetric and asymmetric cryptography, Hash functions, Electronic signatures and MAC, Cryptographic protocols, Secure communication protocols and VPN Implementation, Secure Socket Layer (SSL) and Transport Layer Security (TLS), IPsec protocol suite, Comparison between SSL and IPsec security protocols, IPsec VPN and SSL VPN, Authentication, Access control, Firewalls, Intrusion detection

Unit-4 (8L)

Wi-Fi Security Dedicated Architectures: Introduction,Hot spot architecture: captive portals, Captive portal overview, Security analysis, Wireless intrusion detection systems: architecture, events, example; Wireless honeypots: design, requirements.

Wi-Fi Security: Introduction, Attacks on wireless networks, Passive attacks, Active attacks, TCP attacks, Trojan attack, Dictionary attacks, Security in the IEEE 802.11 standard, IEEE 802.11 security mechanisms, WEP (Wired Equivalent Privacy), WEP shortcomings, Attacks, Security in 802.1x, Authentication in wireless networks, RADIUS, EAP authentication procedures, PKI, Level 3 VPN, IPsec

Unit- 5: (7L)

Bluetooth Security: Introduction, Organization of Bluetooth nodes in the network, Bluetooth technical specification, Radio physical layer, Baseband, Link controller, Bluetooth device addressing, HCI layer, L2CAP layer, Bluetooth security, Bluetooth encoding, Attacks.

TEXT BOOKS

1. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, Chapman & Hall/CRC Cryptography and Network Security Series, 2nd edition 2014.
2. Frank Adelstein, Sandeep K.S. Gupta, Golden G. Richard III, and Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, 2005.

REFERENCES

1. LeventeButtyán and Jean-Pierre Hubaux, Security and Cooperation in Wireless Networks, 2008.
2. James Kempf, Wireless Internet Security: Architectures and Protocols, 2008.
3. PatrickTraynor, Patrick McDaniel, and Thomas La Porta, Security for Telecommunications Networks, 2008.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1. Department offering the course	Computer Science and Engineering
2. Course Code	**CSF446**
3. Course Title	**Ethical Hacking and Digital Forensics**
4. Credits (L:T:P:C)	2:0:1:3
5. Contact Hours (L:T:P)	2:0:2
6. Prerequisites (if any)	None
7. Course Basket	Cyber Security

COURSE OUTLINE:

This course will introduce students about Hacking windows, Network hacking, Password hacking, TCP / IP – Checksums, Dos attacks – SYN attacks, Smurf attacks, UDP flooding, DDOS Models. Firewalls, Packet filter firewalls, Packet Inspection firewalls, Application Proxy Firewalls. Batch File Programming, Fundamentals of Computer Fraud, Strategic Planning Process, Architecture strategies for computer fraud prevention, Penetrating testing process, Key Fraud Indicator selection process customized taxonomies, Computer Forensics, Accounting Forensics, Journal risk and control matrix, Misuse detection and Novelty detection

COURSE OBJECTIVE:

This course provides an introduction the concepts of Ethical Hacking and provides an understanding of Computer forensics fundamentals. This course will provide the opportunity to learn about different tool and techniques in Ethical Hacking and will analyse various computer forensics technologies and methods for data recovery.

COURSE OUTCOMES:

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

CO1: Identify and analyse the stages an ethical hacker requires in order to compromise a target system.

CO2: Understand the concepts of computer forensics fundamentals and types of computer forensics.

CO3: Evaluate security techniques used to protect system and user data.

CO4: Illustrate the methods for data recovery, evidence collection and data seizure.

CURRICULUM CONTENT

UNIT 1: (6L)

Hacking windows – Network hacking – Web hacking – Password hacking. A study on various attacks – Input validation attacks – SQL injection attacks – Buffer overflow attacks - Privacy attacks.

UNIT 2: (6L)

TCP / IP – Checksums – IP Spoofing port scanning, DNS Spoofing. Dos attacks – SYN attacks, Smurf attacks, UDP flooding, DDOS – Models. Firewalls – Packet filter firewalls, Packet Inspection firewalls– Application Proxy Firewalls. Batch File Programming.

UNIT 3: (5L)

Fundamentals of Computer Fraud – Threat concepts – Framework for predicting inside attacks – Managing the threat – Strategic Planning Process.

UNIT-4: **(5L)**

Architecture strategies for computer fraud prevention – Protection of Web sites – Intrusion detection system – NIDS, HIDS – Penetrating testing process – Web Services – Reducing transaction risks.

UNIT- 5: **(5L)**

Key Fraud Indicator selection process customized taxonomies – Key fraud signature selection process – Accounting Forensics – Computer Forensics – Journaling and it requirements – Standardized logging criteria – Journal risk and control matrix – Neural networks – Misuse detection and Novelty detection.

TEXT BOOKS

1. Stuart McClure, Joel Scambray and Goerge Kurtz, ―Hacking Exposed 7: Network Security Secrets & Solutions‖, Tata McGraw Hill Publishers, 2010.
2. Bensmith, and Brian Komer, ―Microsoft Windows Security Resource Kit‖, Prentice Hall of India, 2010.

REFERENCES

1. Kenneth C.Brancik, ―Insider Computer Fraud‖ Auerbach Publications Taylor & Francis Group, 2008.
2. Ankit Fadia, ― Ethical Hacking‖ 2nd Edition Macmillan India Ltd, 2006 MTCF -202 Database S
3. Stuart McClure, Joel Scambray and Goerge Kurtz, ―Hacking Exposed Network Security Secrets & Solutions‖, 5th Edition, Tata McGraw Hill Publishers, 2010.

Computer Vision and Biometrics

S. No.	Course Code	Course Title (Proposed)	Credits: L T P C
1.	CSF344	Machine Learning	2 0 2 3
2.	CSF356	Digital Image Processing	2 0 2 3
3.	CSF357	Satellite Image Processing	2 0 2 3
4	CSF358	Computer Vision	2 0 2 3
5.	CSF447	Information Retrieval	2 0 2 3
6.	CSF448	Biometrics Security	2 0 2 3

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	**Department offering the course**	Computer Science and Engineering
2.	**Course Code**	**CSF356**
3.	**Course Title**	**Digital Image Processing**
4.	**Credits (L:T:P:C)**	2:0:1:3
5.	**Contact Hours (L:T:P)**	2:0:2
6.	**Prerequisites (if any)**	Introduction to Statistics
7.	**Course Basket**	Computer Vision & Biometrics

COURSE SUMMARY

This course will introduce students to the basis of digital image processing, various types of image models, and conversion from one model to another. They can learn about spatial and frequency domain models for image processing and will be able to implement various image enhancement techniques like filtering, object extraction. They will also be able to understand the classification of objects through feature extraction.

COURSE OBJECTIVES

The participants will learn the basic concepts of digital image processing, working with images using spatial and frequency domain, implementing various image enhancement techniques like filtering to an image using these domains. Moreover, the classification of content presents in an image through objects detection and feature extraction from the given input image will be clear.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: Understand the basis of image processing.

CO2: Understand the spatial domain and frequency domain approaches of digital image processing.

CO3: Implement various techniques associated with image filtering i.e. smoothing and sharpening.

CO4: Learn and implement the image enhancement techniques.

CO5: To understand the approaches for the enhancement of color images.

CO6: Implement the concepts of classification through object detection followed by feature extraction.

CURRICULUM CONTENT

Unit-1: Introduction [5L]

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, a Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit-2: Image Enhancement in Frequency Domain [4L]

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Lowpass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low pass Filters; Sharpening Frequency Domain Filters – Gaussian high pass filters; Homomorphism Filtering.

Unit-3: Segmentation **[5L]**

Region Extraction, Pixel-Based Approach, Multi-level Threshold, Local Threshold, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking, and Edge Following, Edge Elements Extraction by Threshold, Edge Detector Performance, Line Detection, Corner Detection, Image Registration.

Unit-4: Color Image Processing **[6L]**

Color Fundamentals, Color Models, and Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation. Morphological Image Processing: Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit-5: Feature Extraction **[6L]**

Representation, Topological Attributes, Geometric Attributes Description, Boundary-based Description, Region-based Description, and Relationship. Object Recognition, Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

TEXTBOOKS :

1. Digital Image Processing (3rd Edition) Rafael C. Gonzalez, Richard E. Woods Prentice Hall, 2007

REFERENCES :

1. Robert J. Schalkoff, Digital Image Processing, and Computer Vision, John Wiley and Sons, NY, 1st Edition, 1989.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall, Upper Saddle River, NJ

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF357**
3.	Course Title	**Satellite Image Processing**
4.	Credits (L: T:P:C)	2:0:1:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	
7.	Course Basket	Computer Vision & Biometrics

COURSE SUMMARY

This course will introduce students to the basis of digital image processing, various types of image models, and conversion from one model to another. They can learn about spatial and frequency domain models for image processing and will be able to implement various image enhancement techniques like filtering, object extraction. They will also be able to understand the classification of objects through feature extraction.

COURSE OBJECTIVES

The objective of the course is to de about the procedure of satellite data acquisition and analysis. Moreover, interpretation and classification of content present in a satellite image through objects detection and feature extraction from the given input image.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Select the type of remote sensing techniques/data for the required purpose.
CO2: Identify the earth's surface features from satellite images.
CO3: Analyse the energy interactions in the atmosphere and earth surface features.
CO4: Get familiar with various image enhancement and image processing techniques.

CURRICULUM CONTENT

Unit 1: Fundamentals (5L)

Remote Sensing ComponentsElectro-Magneticic Spectrum; Radiometric quantities; Atmospheric window; Spectral reflectance of vegetation, soil and, water–atmospheric influence on spectral response patterns; Satellite systems and data-acquisition-storage-orbits-Data formats-Data products-Image processing system-factors to be considered-Image display systems-Image sampling and quantizationBasic relationship between pixels.

Unit 2: Sensor and Data Model (5L)

Classification of remote sensors – selection of sensor parameters - resolution concept - Spectral, Radiometric and temporal resolution – Image formation – Histogram - spatial statistics – Image registration and ortho- rectification - Geometric and radiometric correction. Quality of images in optical systems – imaging mode – photographic camera – optomechanical scanners – push broom and whiskbroom cameras – Panchromatic, multispectral, hyperspectral scanners – geometric characteristics of scanner, imagery - Landsat, SPOT, IRS, World View.

Unit 3: Image Enhancements (5L)

Spectral signatures – Image characteristics, feature space sscattergram point, local and regional operation – spatial feature and multi-image manipulation techniques - principle component analysis - Optimal Rotation Transformation – Scale-space transforms, wavelet transform. Multi-image fusion. Sources of errors in received data – referencing scheme – data product output medium – GeoTIFF, and HDF formats.

Unit-4 : **Information Extraction (5L)**

Data products and their characteristics – Elements of visual interpretation – Digital image processing – Pre-processing – Image rectification – Image enhancement techniques – Image classification – Supervised and unsupervised classification algorithms for multispectral and hyperspectral images – Accuracy assessment. parametric Classification -Decision tree – other Non - parametric classifiers - subpixel and super-pixel classification.

Unit- 5: Image Analysis and Change Detection (6L)

Pattern recognition - boundary detection and representation - textural and contextual analysis - decision concepts: Fuzzy sets - evidential reasoning -Hyperspectrall image analysis – Accuracy assessment. Expert system - Artificial Neural Network – Case studies General Steps required while performing Change Detection, Land-Use/Land Cover Classification System, Remote Sensing System Consideration, and Change Detection Algorithm.

TEXTBOOKS :

1. Lilliesand and T.M. and Kiefer, R.W., "Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994
2. Mather M. Paul “Computer Processing of Remotely-Sensed Images: An Introduction”, 3rd Edition, 2005.

REFERENCES :

1. Charles Elachi and Jakob J. van Zyl Introduction To The Physics and Techniques of Remote Sensing, Wiley Series in Remote Sensing and Image Processing, 2006.
2. George Joseph, Fundamentals of Remote Sensing, Second Edition, Universities Press (India) Pvt Ltd, Hyderabad, 2005, ISBN: 8173715351, 9788173715358
3. Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W.H.Freeman& Co,1978

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF358**
3.	Course Title	**Computer Vision**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	Basic Mathematics-calculus, linear algebra (Eigen analysis, matrix inverse), Fourier transform and probability). Introduction to Image Processing
7.	Course Basket	Computer Vision & Biometrics

COURSE SUMMARY

Computer vision is the science and technology of machines that can see. As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models to the construction of computer vision systems. Various research areas include: Applications in Display Technology, Computer Vision for Navigation, Metrology, High Level Video Analysis, and Human-Computer Interfaces.

COURSE OBJECTIVES

This course is designed to provide knowledge about computer vision algorithms, methods, and concepts; which will enable the students to implement computer vision systems with an emphasis on applications and problem-solving.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: To recognize and identify specific faces among others.

CO2: Learn how to install OpenCV and explore basic image processing concepts.

CO3: To develop techniques to separate foreground and background in images, create stunning panoramas, calibrate camera and automatically detect common objects like faces or people in images.

CO4: To build a 3D representation of a scene using stereoscopic images.

CURRICULUM CONTENT

Unit 1: (4L)

Introduction of Image Formation, Geometric Camera Models, Light and Shading, Human Color perception, Linear filters, Local image features, texture. Binary Image Analysis and Segmentation: Properties, digital geometry, Segmentation. Machine learning for machine vision: Learning and inference in vision, modeling complex data densities, regression models, Classification models.

Unit 2: (6L)

Image segmentation by clustering: Basic Clustering methods, watershed algorithm, segmentation using K-means, Mean Shift: Finding Local Modes in Data, Clustering, and Segmentation with Mean Shift, Segmentation, Clustering and Graph, Hough Transformation. Motion segmentation: Optical flow and motion, flow models, motion segmentation with layers; Model Selection: Cross-Validation.

Unit 3 **(8L)**

Tracking: Tracking by detection, Tracking translation by matching, Affine transformation; The Kalman filter, Forward-backward Smoothing; Data association; Particle filtering Classification Strategies: Mahalanobis distance, Class-Conditional histograms, Naïve Bayes, Nearest Neighbours, Linear Support vector machine, Kernel Machines, Boosting and AdaBoost Object detection in Images: Sliding window methods: Face detection, detecting Humans, Detecting boundaries; detecting deformable Objects.

Unit-4 **(8L)**

Image processing for feature detection and Image synthesis, edge detection, corner detection, line and curve detection, SIFT operator, Image-based modeling and rendering, Mosaics, snakes Stereo: shape from shading, photometric stereo, texture, Occluding contour detection, motion analysis: Motion detection and optical flow structure from motion; Object recognition: Hough transforms and other simple object recognition.

TEXTBOOKS :

1. David A. Forsyth and Jean Ponce. Computer Vision: A Modern Approach. Second Edition Pearson 2015.
2. Robert Haralick and Linda Shapiro. Computer and Robot Vision. Vol-I/II, Addison Wesley, 1993.

REFERENCES :

1. Milan Sonka, Vaclav Hlavac, and Roger Boyle. Image Processing, Analysis, and Machine Vision. Fourth Edition. CENGAGE Learning.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in MS Teams. Refer to your course in Moodle for details.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	Department offering the course	Computer Science and Engineering
2.	Course Code	**CSF447**
3.	Course Title	**Information Retrieval**
4.	Credits (L:T:P:C)	3:0:0:3
5.	Contact Hours (L:T:P)	3:0:0
6.	Prerequisites (if any)	Core programming and algorithm skills Basic probability and Statistics
7.	Course Basket	Computer Vision & Biometrics

Course Summary

Information retrieval is the process through which a computer system can respond to a user's query for text-based information on a specific topic. IR was one of the first and remains one of the most importantproblems in the domain of natural language processing (NLP). Web search is the application of information retrieval techniques to the largest corpus of text anywhere, the web and it is the area in which most people interact with IR systems most frequently.

Course Objectives

The aim is to give students an understanding of the fundamental techniques for hypermedia architectures, design and usability, document management and retrieval, metadata management, and searching the web. In this course, we will cover basic and advanced techniques for building text-based information systems, including the Efficient text indexing, Boolean and vector-space retrieval models, Evaluation and interface issues, IR techniques for the web, including crawling, link-based algorithms, and metadata usage, Document clustering and classification, Traditional and machine learning-based ranking approaches.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

a Knowledge and understanding

1) Be familiar with the fundamentals of hypermedia systems, and hypermedia design and usabilitymethodologies.
2) Understand the difficulty of representing and retrieving documents.
3) Understand the latest technologies for linking, describing and searching the Web.
4) Understand the relationship between IR, hypermedia, and semantic models.

b Cognitive skills (thinking and analysis)

1) Be familiar with classical techniques of Information Retrieval, and the additional techniques employed by Web search engines sufficient to understand how Web search engines work and how they could be improved.
2) Be familiar with techniques for conveying the meaning of documents or hypermedia content,for example, metadata, thesauri, and classification taxonomies
3) Sufficient to understand their application to the "semantic Web".

c Communication skills (personal and academic)

1) Be familiar with the fundamentals of hypermedia systems sufficient to know how to develop a good Web hypermedia and why a Web site is good or bad.

d Practical and subject specific skills (Transferable Skills)

1) Be able to implement techniques for the preprocessing needed for information retrieval systems.
2) Be able to develop a small information retrieval system.

Curriculum Content

Unit-1: Introduction to Information Retrieval (8L)

The nature of unstructured and semi-structured text. Inverted index and Boolean queries.
Text Indexing, Storage and Compression; Text encoding: tokenization, stemming, stop words, phrases, index optimization. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zapf‘s Law. Index construction. Postings size estimation, merge sort, dynamic indexing, positional indexes, n-gram indexes, real-world issues.

Unit-2: Retrieval Models (6L)

Boolean, vector space, TFIDF, Okapi, probabilistic, language modelling, latent semantic indexing. Vector space scoring. The cosine measure. Efficiency considerations. Document length normalization. Relevance feedback and query expansion.

Unit-3: Performance Evaluation (8L)

Evaluating search engines. User happiness, precision, recall, F-measure. Creating test collections: kappameasure, interjudge agreement.
Text Categorization and Filtering: Introduction to text classification. Naive Bayes models. Spam filtering. Vector space classification using hyper planes; centroids; k Nearest Neighbours. Support vector machine classifiers. Kernel functions. Boosting.

Unit-4: Text Clustering (7L)

Clustering versus classification. Partitioning methods. K-means clustering. Mixture of Gaussians model.Hierarchical agglomerative clustering. Clustering terms using documents.

Unit-5: Web Information Retrieval (7L)

Hypertext, web crawling, search engines, ranking, link analysis,
PageRank, HITS.Retrieving Structured Documents, XML retrieval,
semantic web

Text Books

1.Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze. 2008. Introduction toInformation Retrieval, Cambridge university press

Reference Books

1.David Lowe and Wendy hall, Hypermedia and the Web: an Engineering Approach, John Wiley, 1999,ISBN: 0-417-98312-8
2. R.K. Belew, Finding out about--A cognitive perspective on search engine technology and the www,Cambridge University Press, 2001

Teaching and Learning Strategy

The teaching of students will be conducted through power point lectures, tutorials, short classroom exercises aimed at solving real life problems. The lecture material will be availed to the students in Moodle to enable them have appropriate reading.

Hardware and Software Requirement: Not Applicable

List of Experiments: Not Applicable

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF448**
3.	Course Title	**Biometric Security**
4.	Credits (L: T:P:C)	3:0:0:3
5.	Contact Hours (L: T:P)	3:0:0
6.	Prerequisites (if any)	Basic Mathematics- calculus, probability, statistics; MATLAB/C/C++
7.	Course Basket	Discipline Core

COURSE SUMMARY

Biometrics is the science of identifying or authenticating an individual's identity based on behavioral or physiological characteristics. Government Ids, secure electronic banking, retail sales, and health and social services all have benefited from the use of biometric technology and will continue to do so as biometric research advances. This course introduces students to the basic principles and methods used for biometric identification. The objective is to provide students with the scientific foundations needed to design, implement, and evaluate large-scale biometric identification systems.

COURSE OBJECTIVES

The aim is to give students an understanding of biometric systems based on a number of biometric traits such as the face, fingerprint, iris, and hand shape. In this course, we will cover basic and advanced techniques for biometrics applications using MATLAB, biometric system modalities such as face recognition, fingerprint recognition, iris recognition, hand shape recognition, Biometric system design, and performance evaluation, multi-modal biometric systems, and privacy and ethical issues.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: Basic information on the fundamental physical and organic science and designing standards of biometric frameworks.

CO2: Understand biometric frameworks and be able to examine and design for essential biometric framework applications.

CO3: Understand various Biometric security issues.

CO4: Describe Cryptography security and Fuzzy models.

CURRICULUM CONTENT

Unit 1: (9L)

Introduction- Authentication systems, Development of biometric authentication. Basic terms, biometric data, biometric characteristics, biometric features, biometric templates and references. Expected properties of biometric identifiers. Basics in biometric errors estimation. Enrolment, verification and identification. How Authentication Technologies work, Benefits of biometrics over traditional authentication systems, How Biometrics work. Applications of Biometrics.

Unit 2: (9L)

Fingerprints and Hand Geometry: Technical description, Characteristics, Competing technologies, Strengths–Weaknesses, Deployment. Face and Voice Recognition: Technical description, Characteristics, Strengths-Weaknesses, Deployment.

Unit 3 **(9L)**

Biometric System Security: Secure transfer of biometric data. Secure storage, use of smart cards, principles of match-off-card and match-on-card techniques. Biometrics in the cloud. Points of attack. Privacy models. Spoofing: Static and dynamic liveness features. Liveness detection in biometrics. Selected liveness detection techniques, frequency analysis for paper printouts detection.

Unit-4 **(9L)**

Protection: Overview of principles from cryptography to secure fuzzy data. Template protection strategies: feature protection, key-binding, key-generating, hybrids. Overview of fuzzy vaults, fuzzy commitment, fuzzy extractors and revocable bio tokens. Bio cryptographic infrastructures for secure template management.

TEXT BOOKS :

1. John D. Woodward, Jr. Nicholas M. Orlans Peter T. Higgins, "Biometrics", dream tech, 2003
2. Samir Nanavathi, Michel Thieme, Raj Nanavathi,"Biometrics -Identity verification in a network", Wiley Eastern, 2002

REFERENCES :

1. John Chirillo and Scott Blaul," Implementing Biometric Security", Wiley Eastern Publications, 2005

Cloud Computing and Blockchain

S. No.	Course Code	Course Title (Proposed)	Credits: L T P C
1.	CSF349	Cloud Computing	2 0 2 3
2.	CSF354	Data Encryption and Network Security	2 0 2 3
3.	CSF361	Introduction to Blockchain Technologies	2 0 2 3
4	CSF362	Design & Development of Blockchain Technologies	2 0 2 3
5.	CSF363	Blockchain Ecosystems & Governance	2 0 2 3
6.	CSF364	Container Technologies	2 0 2 3

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF349**
3.	Course Title	**Cloud Computing**
4.	Credits (L: T:P:C)	2: 0: 2 :3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	Internet Technology, Computer Network
7.	Course Basket	DE

COURSE SUMMARY

This course is designed to teach students the basic concepts and terminology of cloud computing. After establishing the definition of cloud computing, this course describes the various service delivery models of cloud computing architecture, and the ways in which clouds can be deployed as public, private, hybrid and community clouds. Students also learn about the security challenges that cloud deployments experience, and how these are addressed.

COURSE OBJECTIVES

This course is designed to provide knowledge about basic concepts of Cloud computing. Public cloud and its service and deployment models, private cloud and its need and challenges, Multi-cloud and business cloud, security threats in the cloud.

COURSE OUTCOMES

Course Outcomes (COs): After the completion of the course, students will be able to:

CO1: Elaborate cloud computing its service and deployment models.

CO2: Formulate the importance of virtualization, multi-tenancy in the cloud environment.

CO3: Define and examine different cloud computing services.

CO4: Categorize the different security threats and challenges faced by cloud provider, and Demonstrate the different types of business cloud and its uses.

CURRICULUM CONTENT

UNIT 1 **(6L)**

Overview of cloud computing and Distributed Computing: What is a cloud, Definition of cloud, Definition of cloud, characteristics of cloud, Traditional vs. Cloud Computing, Importance of Cloud Computing, Cloud service models (IaaS, PaaS & SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing. Introduction, Examples of distributed computing, Concurrent Programming, Characteristics & Properties of Distributed Systems, client-server model, centralized vs distributed computing, Resource Sharing and the Web Challenges, security issues.

UNIT 2 **(7L)**

Private Cloud: Concept of Hypervisor, Basics of virtualization, Virtualization technologies, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing. Business cases for the need of Cloud computing environment, Concept of Private Cloud, Characteristics of Private Cloud, Private Cloud deployment models, Private Cloud Vendors, Virtual Private Cloud. Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services.

UNIT 3 **(7L)**

Public Cloud: Concept of Public Cloud, Importance of Public Cloud, when to opt for Public Cloud, Public Cloud Service Models, and Public Cloud players. Infrastructure as a Service Offerings, IaaS Vendors, PaaS offerings, PaaS vendors, Software as a Service. Implementing public cloud AWS, Introduction, Service Offered, Creation of EC2 instance, Microsoft Azure: Introduction, Service Offered, Creation of DB instance. Implementing Security in public Cloud, Comparison of Public Cloud Vendors (AWS, Microsoft, Google, IBM, Salesforce).

UNIT 4 **(6L)**

Multi-Cloud: Concept of multi-cloud management, Challenges in managing heterogeneous clouds, benefits of multi-cloud management systems. Case study on Multi-Cloud Management System (Right Scale Cloud Management System). Business Clouds: Cloud Computing in Business, Various Biz Clouds focused on industry domains (Retail, Banking and Financial sector, Life Sciences, Social networking, Telecom, Education).

UNIT 5 **(7L)**

Cloud Security: Cloud security reference model, Principal security dangers/risks to cloud computing, Internal security breaches, Data corruption, Malicious Insiders, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile, Steps to reduce cloud security breaches, Identity management: Detection and forensics, Identity management: Detection and Identity management, Benefits of identity, Encryption techniques, Encryption & Encrypting data, Attacks on VM, Abuse and Nefarious Use of Cloud Computing.

TEXTBOOK(S)

3. R. Buyya, C. Vecchiola, S. T. Selvi, Matering Cloud Computing, Ed. Third reprint, 2013.
4. B. Sosinsky, Cloud computing Bible, Ed. Reprint Willy India Pvt. Ltd, 2014.
5. Carlin, Sean, and Kevin Curran. "Cloud computing security." Pervasive and Ubiquitous Technology Innovations for Ambient Intelligence Environments. IGI Global, 2013. 12-17.

REFERENCES :

1. M. Miller, Cloud Computing, Pearson education in South Asia, Ed. 9th 2014.
2. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, eds. Cloud computing: Principles and paradigms. John Wiley & Sons, 2010.

Laboratory work: Installation and demonstration of OS virtualization on single machine and multiple OS along with the case study on Amazon EC2/Microsoft Azure/Google Cloud Platform. Implementation and demonstration of VPN setup on the windows environment.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF361**
3.	Course Title	**Introduction to Blockchain Technologies**
4.	Credits (L: T:P:C)	2:1:0:3
5.	Contact Hours (L: T:P)	2:1:0
6.	Prerequisites (if any)	Distributed Systems
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the basic basic components of blockchain, concept of distributed system, consensus mechanism and its importants and basic of cryptocurrency.

COURSE OBJECTIVES

This course objective is to explain basic components of a blockchain (types, mechanics: transaction, block, block header, chain and terminology) its operations (processes, verification, validation, and consensus model) underlying algorithms, and essentials of trust to understand how blockchain systems (mainly Bitcoin and Ethereum) work.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1: Recognize foundational concepts of blockchain and learn about the decentralized peer-to-peer network.

CO2: Understand the formal definition of distributed consensus and apply these concepts on the blockchain.

CO3: Assess Blockchain applications in a structured manner.

CO4: Understand the meaning and properties of cryptoeconomics: cryptography and economics.

CURRICULUM CONTENT

Unit 1: Distributed Systems (6L)

Blockchain architecture, Basic components (blocks, nodes, etc.), Distinction between public and private blockchains, benefits and drawbacks, Fundamental traits and characteristics, Distributed Database, CAP theorem, the Byzantine Generals Problem and Fault Tolerance.

Unit 2: Cryptography in Blockchain (6L)

Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Blockchain Network, Mining Mechanism.

Unit-3: Consensus (6L)

Distributed Consensus, Merkle Patricia Tree, Gas Limit, Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof, Transactions and Fee.

Unit 4: Blockchain Design Principle **(6L)**

Consensus, Security, and Operating Protocols, Blockchain Design Principle, Public and Private DLTs, Alternative Consensus Mechanisms to Bitcoin's Proof-of-Work, Proof-of-Stake, Proof-of-Burn, Voting-Based Consensus Algorithms, and Federated Consensus, Sybil Attack, Energy Utilization.

Unit-5 Cryptoeconomics **(6L)**

Property of cryptoeconomics: cryptography and economics, Integration of cryptography and pseudo-anonymity in public blockchains, cryptoeconomics with respect to distributed systems fundamentals (liveness, safety, data availability).

TEXT BOOKS :

1. Kube N. Daniel Drescher: Blockchain basics: a non-technical introduction in 25 steps, 2018.

REFERENCES :

1. Warburg B, Wagner B, Serres T. Basics of Blockchain: A Guide for Building Literacy in the Economics, Technology, and Business of. Animal Venturs LLC; 2019..

Tutorial: Naive Blockchain construction, Memory Hard algorithm - Hashcash implementation, Direct Acyclic Graph.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF362**
3.	Course Title	**Design & Development of Blockchain Technologies**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	Distributed Systems
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the the basics of Ethereum platform, smart contracts and its purpose and programming in solidy language.

COURSE OBJECTIVES

This course aims to educate students, Ethereum, basics of smart contracts, decentralized apps, decentralized anonymous organizations (DAOs), and solidity as a programming language.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand the Ethereum platform and Dapps and DAOs
CO2: Understand smart contracts and its designing structure.
CO3: Design Smart contracts using solidity programming language.
CO4: Define decentralized appas and its applications.

CURRICULUM CONTENT

Unit 1: Introduction to Ethereum: (4L)

concepts of Smart Contracts, Dapps, And DAOs, Ethereum Virtual Machine (EVM).

Unit 2: Ethereum Technology: **(4L)**

Overview, Architectural Overview Ethereum Block chain Platform, Current and Potential Uses of Ethereum.

Unit 3: Introduction to Programming Smart Contracts: (8L)

A Simple Smart Contract, Structure of a Contract, Types, Units and Globally Available Variables, Input Parameters and Output Parameters, Control Structures, Function Calls, Order of Evaluation of Expressions, Assignment, Scoping and Declarations, Error handling: Assert, Require, Revert and Exceptions.

Unit 4: Solidity Programming: (8L)

Basics of Solidity, Layout of a Solidity Source File & Creating Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address), Visibility and Getters, Function Modifiers, Constant State Variables, Functions, Inheritance, Abstract Contracts, Interfaces, Libraries.

Unit 5: Introduction to Decentralized Apps (Dapps): (6L)

Decentralized Application Architecture, connecting to the Block chain and Smart Contract, Decentralized Apps – Coding Details, Voting Contract, Coding Style Guide, Design Patterns, Coding Style Guide, Code Layout, Naming Conventions, Common Design Patterns, Withdrawal from Contracts, State Machine.

TEXT BOOKS :

1. Antonopoulos AM, Wood G. Mastering ethereum: building smart contracts and dapps. O'reilly Media; 2018 Nov 13.
2. Bistarelli S, Mazzante G, Micheletti M, Mostarda L, Sestili D, Tiezzi F. Ethereum smart contracts: Analysis and statistics of their source code and opcodes. Internet of Things. 2020 Sep 1;11:100198.

REFERENCES :

1. Troxell C. Writing Smart Smart Contracts. Access on 4th March 2022.
2. Solorio K, Kanna R, Hoover DH. Hands-on Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment. O'Reilly Media, Incorporated; 2019.

Laboratory work: Creating a simple Blockchain in any suitable programming language. Smart Contract construction.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF363**
3.	Course Title	**Blockchain Ecosystems & Governance**
4.	Credits (L: T:P:C)	2:1:0:3
5.	Contact Hours (L: T:P)	2:1:0
6.	Prerequisites (if any)	Distributed Systems
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the comparison between traditional and blockchain system. Some cases of blockchain implementation with some advantages and disadvantages, future of blockchain, etc.

COURSE OBJECTIVES

This course enables the students to understand the broader blockchain ecosystem, other blockchain platforms, application use cases, and challenges such as privacy and scalability

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

CO1- Understand permissioned blockchain, and concept of hyperledge and Blockchain as a service.

CO2- Define various use cases on realtime applications using blockchain and concept of cryptocurrency.

CO3- Understant the concepts of regulations and anonilty and legal aspects attached with technology.

CO4- Define and understand the future of blockchain globally and Indian scenario.

CURRICULUM CONTENT

Unit 1: Enterprise Blockchain: Real-World Applications: (6L)

Permissioned Blockchains: The Linux Foundation's Hyperledger and Microsoft Azure's Blockchain as a Service, JP Morgan's Quorum, Ripple, and Tendermint.

Unit 2: Blockchain use Cases: (6L)

Challenges and solutions Applications of blockchain, Business and industry use cases: cybersecurity, the integrity of information, E-Governance, Climate Change, Biodiversity, Energy, Internet of Things, Medical Record Management System, Sustainability and other contract enforcement mechanisms etc.

Unit 3 Scaling Blockchain (Cryptocurrency): (6L)

Bitcoin as a payment method, comparison with traditional forms, Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Vulnerability, Attacks, Namecoin, Vertical scaling (e.g. blocksize increases, Segregated Witness and the Lightning Network), Horizontal Scaling (e.g. sidechains, sharding).

Unit-4 Regulation and Anonymity: (6L)

Anti-Money Laundering (AML) and Know Your Customer (KYC) Regulations, Anonymity goals, and government techniques for deanonymization of entities on blockchain, stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy.

Approved by the Academic council in its 22nd Meeting held on 06.03.2023

Unit- 5: Blockchain Future: **(6L)**

Global Status on Blockchain, Historic stance of the Indian Government, Current Scenario, Myths vs reality of blockchain technology, Understanding and working knowledge of the emerging blockchain technology**,** Do-main Name Service and future of Blockchain: venture capitalism, ICOs, and crowdfunding.

TEXT BOOKS :

1. Jun, M. Blockchain government - a next form of infrastructure for the twenty-first century. J. open innov. 4, 7 (2018). https://doi.org/10.1186/s40852-018-0086-3
2. Nijalingappa, Pradeep, and Mangesh Manikrao Ghonge, eds. Blockchain Technologies and Applications for Digital Governance. IGI Global, 2021.

REFERENCES :

1. Savirimuthu J. Blockchain and the law: The rule of code., 2019

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF364**
3.	Course Title	**Container Technologies**
4.	Credits (L: T:P:C)	2: 0: 2 :3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	Cloud Computing & Virtualization Technology
7.	Course Basket	DE

COURSE SUMMARY

This course is designed to teach students the basic concepts and terminology of cloud computing. After establishing the definition of cloud computing. This course describes the basics of container technologies used in cloud computing, dockers, concept of Orchestration and kurbernetes

COURSE OBJECTIVES

This course provides the opportunity to learn concepts and design Containerization and build an Orchestration of containers. It also provides an ability to promote the cost effective light weight virtualization using container orchestration management tools and techniques.

COURSE OUTCOMES

Course Outcomes (CO): After the completion of the course, students will be able to:

CO1. Elaborate the container technology

CO2. Formulate and Design containers using Docker.

CO3. Categorize and demonstrate the concept of containerization using Docker files and Compose

CO4. Categorize and design an Orchestration of nodes.

CURRICULUM CONTENT

UNIT 1 **(6L)**

Introduction Container Technology: Containerization, History of Containers, Namespaces and C-groups, Containers vs Virtual Machines, Types of Containers. Docker: Overview, Installing Docker on Linux, Installation, Hub, Images, Containers, Features of Docker, Components of Docker.

UNIT 2 **(7L)**

Creating Containerized Services: Working with Containers, Architecture, Container & Hosts, Configuring, Containers & Shells, File, Building Files, Public Repositories, Managing Ports, Private Registries, Building a Web Server Docker File.

UNIT 3 **(7L)**

Managing Containers: Instruction Commands, Container Linking, Storage, Networking, Setting Node.js, Setting MongoDB, Setting NGINX, Toolbox, Setting ASP.Net, Docker Cloud, Logging, Docker – Compose, Docker - Continuous Integration.

UNIT 4 **(7L)**

Orchestration in Docker: Create and run multi-container applications using Docker Compose and manage clusters of Docker nodes using Docker Swarm. Topics: Docker Compose, Docker Swarm, Docker Service, Placement Rolling Update and Rollback Docker Stack, Deploy a Multi-container Application using Compose, Running Docker in Swarm mode, deploying a Service in Swarm Scale, Services, Service Placement, Rolling Updates and Rollbacks Docker Stack.

UNIT 5 **(6L)**

Introduction to Kubernets: Understanding Kubernetes architecture, Introduction to Kubernetes objects, using basic Kubernetes objects, Using the kubectl command, Leveraging Kubernetes.

TEXT BOOKS :

1. Antonopoulos, Nick, and Lee Gillam. Cloud computing. London: Springer, 2010.
2. Comer, Douglas E. The Cloud Computing Book: The Future of Computing Explained. Chapman and Hall/CRC, 2021.
3. Raj, Pethuru, Jeeva S. Chelladhurai, and Vinod Singh. Learning Docker. Packt Publishing Ltd, 2015.
4. Luksa, Marko. Kubernetes in action. Simon and Schuster, 2017.

REFERENCES :

1. Foster, Ian, and Dennis B. Gannon. Cloud computing for science and engineering. MIT Press, 2017.
2. Chaudhary, Sanjay, Gaurav Somani, and Rajkumar Buyya, eds. Research advances in cloud computing. Springer Singapore, 2017.
3. Turnbull, James. The Docker Book: Containerization is the new virtualization. James Turnbull, 2014.
4. Sayfan, Gigi. Hands-On Microservices with Kubernetes: Build, deploy, and manage scalable microservices on Kubernetes. Packt Publishing Ltd, 2019.
5. Protechgurus, Dockers containers ultimate beginners guide, Independently published , August 18, 2018

Laboratory work: Installation and setting of Docker Container for Windows/Linux and create a container with complete software application using Docker file.

Full Stack and DevOps

S. No.	Course Code	Course Title (Proposed)	Credits: L T P C
1.	CSF349	Cloud Computing	2 0 2 3
2.	CSF364	Container Technologies	2 0 2 3
3.	CSF371	Front-End Engineering	2 0 2 3
4	CSF372	Advance Topics in Front-End Engineering	2 0 2 3
5.	CSF373	Server Side Engineering	2 0 2 3
6.	CSF374	DevOps	2 0 2 3

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF371**
3.	Course Title	**Front End Engineering**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L:T:P)	2:0:2
6.	Prerequisites (if any)	None
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the basic terminologies related to web applications. They will be able to design and develop web applications using JAVA technologies.

COURSE OBJECTIVES

To become familiar with components of front-end web application development: User interfaces, Event and State handling, Languages/tools such as HTML, CSS, JavaScript.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand the concept of technology used to design a simple web page.
CO2: Demonstrate the use script and events handling in web page.
CO3: Demonstrate the process to connect with server.
CO4: Design an application to store data on remote location and access it.

CURRICULUM CONTENT

UNIT 1: Introduction to HTML (4L)

HTML Basics, Elements, Attributes, Styles, Forms, Form Elements, Input Element Types, Input Attributes, File Paths, Script tag, HTML & XHTML.

UNIT 2: Introduction to CSS (4L)

CSS Introduction, Syntax, Selectors, Styling, Pseudo class, Pseudo Elements, CSS Tables, CSS Box Models, CSS Opacity, CSS Navigation Bar, Dropdowns.

UNIT 3: Introduction to JavaScript (4L)

JavaScript Statements, Keywords, Functions, JavaScript Programs, Operators, Functions, Function Parameters, Function Return Types, Data Types, Primitive Types.

UNIT 4: NodeJS and Application Desigm (10L)

Introduction to Node JS: Introduction to Node JS, Advantages of Node JS, What is Node JS, Node.js Process Model, Traditional Web Server Model, Node JS Modules: Functions, Buffer, Module, Modules Types, Core Modules, Local Modules, Modules Exports, Node Package Manager: What is NPM, Installing Packages Locally, Installing package globally, Adding dependency in package json, Updating packages, Creating Web Server: Creating Web Server, Sending Requests, Handling http requests, File System: reading, writing, updating files, and the concept of chunks, buffers, and uploading files synchronously and asynchronously.

UNIT 5: Introduction to MongoDB (10L)

Overview of MongoDB, Design Goals for MongoDB Server and Database, MongoDB tools, Understanding the following: Collection, Documents and Key/ Values, etc., Schema Design and Data Modelling Goal: Manage Data Model in MongoDB. Skills, Understand Data Modelling Schemas, Design Data Model relationships and tree structures, Apply Data Modelling in various real-time contexts, CRUD Operations.

TEXTBOOK(S)

1. Mark Sapp, Front-end Web Developer (Careers in Technology Series): JavaScript, HTML5 and CSS3, Addison Wesley, 2018.
2. Bruno Joseph D'Mello, Mithun Satheesh, Jason Krol, Web Development with MongoDB and Node, Pact Publishing, 3rd Edition, 2017.

REFERENCES :

1. Julie Meloni, Jennifer Krynin, Sams Teach Yourself HTML, CSS and JavaScript All in One, Pearson, 3rd Edition, 2015.
2. Jennifer Robbins, Learning Web Design: A Begginer's Guide to HTML, CSS< JavaScript and Web Graphics, O'Reilly, 5th Edition, 2018.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF372**
3.	Course Title	**Advanced Concepts in Front End Engineering**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	None
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the advanced concepts related to designing of web applications.

COURSE OBJECTIVES

Provide opportunity to design a full fledge one-spage web-application.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand the concepts advance JAVA script.
CO2: Understand and design an interface using class and object of advance JAVA script.
CO3: Demonstrate the use of style sheet in one-page application.
CO4: Design and develop a complete MVC application.

CURRICULUM CONTENT

UNIT 1: Advance JAVA Script (6L)

Revising basic concept of JavaScript, Function Hoisting, Function within Function, Function Expressions Passing function as arguments, Mouse and Keyboard Events , Propagation of Event ,Closures, const and let, Let in for loops, Arrow Functions , Bindings in Arrow Function.

UNIT 2: Classes and Constructors (6L)

This Keyword, This in Strict Mode, Function to create Objects , Object constructor, Adding Behaviour to Objects, Objects, Class, Properties and Methods, Class Expressions and Hoisting , Exports and Imports declaration.

UNIT 3: Introduction to React (4L)

What is React, What are components, SPA vs MPAs, React vs others, Tools and Installation of tools, The terminal Create-react-app, Folder structure, Installing react developer tools, Understanding JSX, JSX Restrictions, Creating a Functional Component.

UNIT 4: Styling React components and Elements (12L)

Working with Components & Re-Using Them, Outputting ,Dynamic Content, Working with Props, Understanding the "children" Prop, Understanding & Using State, Props & State, Handling Events with Methods, Events Listening, Manipulating the State, Function Components Naming, Using the use State() Hook for State Manipulation, Stateless vs Stateful Components, Passing Method References Between Components, Adding Two Way Binding, Adding Styling with Stylesheets, Working with Inline Styles, Working with list and conditions, Outlining the Problem Set, Setting Styles Dynamically, Setting Class Names Dynamically, Adding and Using Radium, Using Radium for Media Queries, Introducing Styled Components, More on Styled Components, Styled Components & Dynamic Styles, Working with CSS Modules, CSS Modules & Media Queries, React Hooks.

TEXTBOOK (S) :

1. Julie Meloni, Jennifer Krynin, Sams Teach Yourself HTML, CSS and JavaScript All in One, Pearson, 3rd Edition, 2015.
2. Robun Wieruch, The Road to REACT, CreateSpace Independent Publishing Platform, 2017.

REFERENCES :

1. Alex Banks, Eve Porcello, Learning React: Modern Patterns for Developing React Apps, O'Reilly, 2nd Edition, 2020.
2. Zac Gordon, React Explained, OS Training, 2019.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF373**
3.	Course Title	**Server-Side Engineering**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	None
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will gain familiarity with what server-side programming is and what it can do

COURSE OBJECTIVES

Provide Opportunity to student to learn the concepts of MVC application and design a full fledge CRUD application.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand and design an application using Maven.
CO2: Design an MVC application using Spring framework.
CO3: Design and develop a Restfull service.
CO4: Design a CRUD based application.

CURRICULUM CONTENT

UNIT 1: Maven (6L)

What is Maven, Why command line, Dependency Resolution, Configurations, Installation Approach - Archetype, RAD,Setup Commands, Download from GIT, Life cycles, Phases and Goals, Profiles, Parent-Child Module, Dependency Plugins, Local Maven Repository Vs Project Centralise Repository.

UNIT 2: Spring Framework Overview (8L)

Introduction to Spring, Installation, First application, Spring Container and Dependency Injection: Spring Container types, Working of Spring container, Dependency Injection by Constructor, Injecting string-based values. Bean Implementation: Introduction and Scope, creating source file, Implement Collections, Implement Java Based Configuration. **Aspect Oriented Programming**: Spring AOP, Implement Aspect Oriented Programming.

UNIT 3: Spring Data Access and Transaction Management (4 L)

Spring JDBC, JDBC Template, Spring Transaction. Develop Web Application using Spring: Spring Web MVC Overview, Advanced MVC Features, Development of Spring Web Application

UNIT 4: Spring ORM (12L)

Hibernate + JPA, Introductions, DataSource Configurations, Object Relational, Mapping, About Maven Dependencies and Configs, Entity classes and Session Factory, CRUD Operations – APIs, Hibernate Configurations, Session Factory, Sessions, Mapping XML, Entities, Annotation Based, First/Second Level Caching , Transient, Persistent and Detached Objects

TEXTBOOK(S) :

1. Balaji Varanasi, Introducing Maven: A Build Tool for Today's JAVA Developers, Apress, 2nd Edition, 2019.
2. Craig Walls, Spring in Action, Manning Publications, 5th Edition, 2019.

REFERENCES :

1. Marten Deinum, Daniel Rubio, Josh Lang, Gary Mak, Spring 5 Recipes: A Problem-Soluiton Approach, Appress, 4th Edition, 2017.

Course Structure& Syllabus of MCA
Applicable for Batch: 2024-2026

1.	School offering the course	School of Computing
2.	Course Code	**CSF374**
3.	Course Title	**DevOps**
4.	Credits (L: T:P:C)	2:0:2:3
5.	Contact Hours (L: T:P)	2:0:2
6.	Prerequisites (if any)	None
7.	Course Basket	Discipline Elective

COURSE SUMMARY

The students will learn the aspects of the principles of continuous development and deployment, software development operations, continuous integration, automation of configuration management and learn the various tools like Git, Docker, Jenkins, Ansible etc.

COURSE OBJECTIVES

Provide opportunity to students to learn concepts of Devops and tools used at different stages of Software Automations

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:
CO1: Understand the concept of DevOps.
CO2: Understand the concept of retrieval and operation on project file at remote location.
CO3: Understand about integration of complete project using Jenkins.
CO4: Learn to configure node resources using Ansible.

CURRICULUM CONTENT

UNIT 1: Introduction to DevOps (10L)

Principle, DevOps Engineer Skills in the market, Delivery Pipeline, Market trend of DevOps, Technical Challenges, Tools use in DevOps, CALMR Model. DevOps and Other Frameworks: Agile Framework, Lean Framework, Waterfall Model, Scrum / Kanban Framework, DevOps Roles and Considerations: DevOps Roles, DevOps Responsibilities In An Organization DevOps Improvements, DevOps Practices: RACI Model, RCA Process, DevOps And Automation, Continuous Integration, Continuous Testing, Continuous Delivery / Deployment, Continuous Monitoring, Continuous Feedback.

UNIT 2: Version Control using GIT (10L)

Git – A CLI, Essentials of GIT in industry, How to setup GIT, Installing Git, First-Time Git Setup, Getting a Git Repository, Working with various commands in GIT, Recording Changes to the Repository How to check the Status of Your Files, How to track New Files, Staging our modified files, Ignoring Files from GIT, Viewing Your Unstaged and Staged Changes How to commit Your Changes, Skipping the Staging Area and commit, Removing Files from GIT, Viewing the Commit History, Limiting Log Output, Using a GUI to Visualize History, Undoing Things, Changing Your Last Commit, Unstaging a Staged File.

UNIT 3: Continuous Integration with Jenkins (7L)

An Overview Of JENKINS, Getting Started with JENKINS and Installation of JENKINS, Plugins and Its Uses, Setting Up Your Build Jobs, Using Metrics to Improve Quality, Nodes and Master-Slave Configuration, Performing Automated Deployment and Continuous Delivery, Pipeline Execution Of CI CD Jobs, JENKINS Administration Activities.

UNIT 4: Infrastructure Management using Ansible (7L)

Introduce Ansible, Describe the terminology and architecture of Ansible, Deploy Ansible Install Ansible and run ad hoc commands, Write Ansible plays and execute a playbook. Manage variables and inclusions Describe variable scope and precedence, manage variables and facts in a play, and manage inclusions. Implement task control Manage task control, handlers, and tags in Ansible playbook.

TEXTBOOK(S):

1. Emily Freeman, DevOps for dummies, Wiley, 2019.
2. Scott Chacon, Ben Straub, Pro Git, Apress, 2nd Edition, 2014.
3. John Ferguson Smart, Jenkins: The Definitive Guide, O'Reilly, 2011.
4. Michael Heap, Ansible: From Beginner to Pro, Apress, 2016

REFERENCES:

1. Michael Hutterman, DevOps for Developers, Apress, 2012, doi: https://doi.org/10.1007/978-1-4302-4570-4 (Accessed: March 2022).
2. Jesse Liberty, Jon Galloway, Git for Programmers: Master Git for effective implementation of version control for your programming projects, Packt publishing, 2021.
3. Jonathan McAllister, Mastering Jenkins, Packt Publishing, 1st Edition, 2015.

MCA Bride Course (CAF651)

Objectives: This hands-on bridge course provides introduction to algorithms, language fundamentals and builds a strong foundation of programming skills in C.

UNIT-I

Introduction to algorithm, Flow charts, Algorithms for basic problems like Factorial, Fibonacci series, Prime numbers, etc. and other simple problems, basic searching & sorting techniques.

UNIT II

C language fundamentals: Character set, Key words, Identifiers, data types, Constants and variables, Statements, Express ions and Operators, Precedence and Associativity of operators, Side effects, Type conversion, input and output. Control structures: Decision making, branching and looping.

UNIT -III

Arrays and strings, functions in C, formal vs. actual arguments.

UNIT IV

Pointers: Pointer variable and its importance, Pointers and arrays, Pointer and character strings, Pointers and functions, Array of pointers, pointers to pointers

Passing Criteria: Pass with a minimum of 50% marks.

Evaluation Scheme: Quiz -20%, Labs -40%, Assignment - 40%. No Mid Term Exam or End Term Exam to be conducted.

Text books:

1. Behrouz A. Forouzan and Richard F. Gilberg. Computer Science: A Structured Approach Using C, Third Edition, 2007, CENGAGE Learning India Pvt. Ltd., New Delhi.
2. E. Balguruswamy, "Programming in ANSI C', 4th edition, 2007, McGraw-Hill Publication, New Delhi.

Reference books;

1. Let us C-Yashwant Kanetkar.
2. K.R. Venugopal, S.R. Prasad, " Mastering C, McGraw-Hill Education India
3. K.N. King,"C Programming-A modern approach", W.W. Norton
4. S. Prata,"C Primer plus", 5th Edition, Pearson Education India