



St Joseph's University

Bengaluru

Re-accredited by NAAC "A++" Grade

Course Structure and Syllabus

of

Master of Computer Application

(M.C.A)

CHOICE BASED CREDIT SYSTEM

(2023-24 ONWARDS)

MCA - I Year: Choice Based Credit System (CBCS)					
I Semester			II Semester		
CA 7123	E1	Database Management Systems	CA 8123	E1	Cloud Computing with Amazon Web Services
	E2	Database Design and Implementation		E2	Grid and Cluster Computing
	E3	NoSQL with MongoDB		E3	High Performance Computing
CA 7223	E1	Data Structures & Analysis of Algorithms	CA 8223	E1	Software Engineering and UML
	E2	Data Structures & Graph Theory		E2	Object Oriented Software Engineering
	E3	Advanced Data Structures and Algorithms		E3	Agile Software Development
CA 7323	E1	Object Oriented Programming with Java	CA 8323	E1	Mobile Application Development using Android
	E2	Enterprise Computing with Advanced Java		E2	Cross Mobile App Development with React Native
	E3	Enterprise Computing: Java EE Frameworks		E3	Mobile App Development for iOS with Swift
CA 7423	E1	Web Design with HTML5, CSS, Java Script	CA 8423	E1	Natural Language Processing
	E2	Web Programming with PHP & MySQL		E2	Image Processing & Pattern Recognition
	E3	Web Application Development using Python		E3	Bioinformatics Algorithms, Databases and Tools
CA 7523	E1	Probability and Stochastic Processes	CA 8523	E1	Data Warehousing & Data Mining
	E2	Operations Research		E2	Business Intelligence and Advanced Data Mining
	E3	Modeling and Simulation		E3	Data Science and Analytics
CA 7P1 & CA 7P2	DBMS and Data Structures Lab		CA 8P1 & CA 8P2	Cloud Computing and Mobile App Development Lab	
CA 7P3 & CA 7P4	Advanced Java & Web Application Development Lab		CA 8P3 & CA 8P4	Machine Learning and Data Mining Lab	
CA 7623	Entrepreneurship and Innovation		CA 8623	Fundamentals Of Cyber Security	
-----	Technical Seminar		-----	Technical Writing and Presentation - I	

MCA – II Year: Choice Based Credit System (CBCS)				
III Semester			IV Semester	
CA 9123	E1	Functional Programming Paradigm	CA 9723	Industry Internship
	E2	Internet of Things and Applications Development		Project Work
	E3	Augmented and Virtual Reality		Research Project / Dissertation
CA 9223	E1	Web Development with Angular.js, Node.js	Add On / Certificate Courses/ Value added Programmes offered	
	E2	Content Management with WordPress	C1	IIC by MHRD to promote Innovation Activities
	E3	Blockchain Technology with Ethereum	C2	Entrepreneurship programme from Wadhvani Foundation
CA 9323	E1	Computing with C# and .NET Framework	C3	Mule Soft Developer Certification by Sales Force
	E2	Web Technologies & .NET Framework	C4	Infosys Campus Connect – InfyTQ
	E3	Cross-Platform Development using .NET Core	C5	TCS Analytics Center for Big Data Analytics
CA 9423	E1	Cognitive Computing and Artificial Intelligence	C6	Dell - EMC- Programmes on Cloud and Big Data
	E2	Computational Intelligence and Machine Learning	C7	IBM Industry Aligned Programmes / Certifications
	E3	Deep Learning and Neural Networks	C8	VMWare IT Academy Certification Programmes
CA 9523	E1	Big Data Analytics: MapReduce and Hadoop	C9	UniCourt Academia Initiative for Functional Programming
	E2	Big Data Analytics with Scala and Spark	C10	Amazon Web Services (AWS) Certification
	E3	Big Data Visualization using Tableau	C11	STEP –The Hindu English Proficiency Test
CA 9P1 & CA 9P2	Web Application Development & .NET Lab		C12	ICT Academy Workshops / seminars / Certifications
CA 9P3 & CA 9P4	Machine Learning & Big Data Lab		C13	Seminars from NASSCOM, FICCI, CII, ASOCHEM
CA 9623	Business Consultancy Project		C14	IEEE & IEE CS / CSI / ISTE Student member
---	Technical Writing and Presentation – II		C15	Rural Immersion Programme

Scheme of Examination

I Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	CA 7123 (E1)	Database Management Systems	HC	4	3	---	50	50	100
	CA 7123 (E2)	Database Design and Implementation							
	CA 7123 (E3)	NoSQL with MongoDB							
2	CA 7223 (E1)	Data Structures & Analysis of Algorithms	HC	4	3	---	50	50	100
	CA 7223 (E2)	Data Structures & Graph Theory							
	CA 7223 (E3)	Advanced Data Structures and Algorithms							
3	CA 7323 (E1)	Object Oriented Programming with Java	HC	4	3	---	50	50	100
	CA 7323 (E2)	Enterprise Computing with Advanced Java							
	CA 7323 (E3)	Enterprise Computing: Java EE Frameworks							
4	CA 7423 (E1)	Web Design with HTML5, CSS, Java Script	HC	4	3	---	50	50	100
	CA 7423 (E2)	Web Programming with PHP & MySQL							
	CA 7423 (E3)	Web Application Development using Python							
5	CA 7523 (E1)	Probability and Stochastic Processes	SC	3	3	---	50	50	100
	CA 7523 (E2)	Operations Research							
	CA 7523 (E3)	Modeling and Simulation							
6	CA 7P1 & CA 7P2	DBMS and Data Structures Lab	HCL	2	---	3	50	50	100
7	CA 7P3 & CA 7P4	Java & Web Development Lab	SCL	2	---	3	50	50	100
8	CA 7623	Entrepreneurship and Innovation	SC	3	3	---	50	50	100
		Total		26			400	400	800

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab SCP – Soft Core Project

II Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	CA 8123 (E1)	Cloud Computing with Amazon Web Services	HC	4	3	---	50	50	100
	CA 8123 (E2)	Grid and Cluster Computing							
	CA 8123 (E3)	High Performance Computing							
2	CA 8223 (E1)	Software Engineering and UML	HC	4	3	---	50	50	100
	CA 8223 (E2)	Object Oriented Software Engineering							
	CA 8223 (E3)	Agile Software Development							
3	CA 8323 (E1)	Mobile Application Development using Android	HC	4	3	---	50	50	100
	CA 8323 (E2)	Cross Mobile App Development with React Native							
	CA 8323 (E3)	Mobile App Development for iOS with Swift							
4	CA 8423 (E1)	Natural Language Processing	SC	4	3	---	50	50	100
	CA 8423 (E2)	Image Processing & Pattern Recognition							
	CA 8423 (E3)	Bioinformatics Algorithms, Databases and Tools							
5	CA 8523 (E1)	Data Warehousing & Data Mining	SC	3	3	---	50	50	100
	CA 8523 (E2)	Business Intelligence and Advanced Data Mining							
	CA 8523 (E3)	Data Science and Analytics							
6	CA 8P1 & CA 8P2	Cloud Computing and Mobile App Development Lab	HCL	2	----	3	50	50	100
7	CA 8P1 & CA 8P2	Advanced Computing and Data Mining Lab	SCL	2	---	3	50	50	100
8	CA 8623	Fundamentals of Cyber Security	SC	3	3	---	50	50	100
		Total		26			400	400	800

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab SCP – Soft Core Project

III Semester

Sl No	Subject Code	Subject Title	Type	Credits	Theory Exam duration (hours)	Practical Exam duration (hours)	Max Marks for Internal Assessment	Max. Marks for Term End Exam	Total Marks
1	CA 9123 (E1)	Functional Programming Paradigm	HC	4	3	---	50	50	100
	CA 9123 (E2)	Internet of Things and Applications Development							
	CA 9123 (E3)	Augmented and Virtual Reality							
2	CA 9223 (E1)	Web Development with Angular.js, Node.js	HC	4	3	---	50	50	100
	CA 9223 (E2)	Content Management with WordPress							
	CA 9223 (E3)	Blockchain Technology with Ethereum							
3	CA 9323 (E1)	Computing with C# and .NET Framework	HC	4	3	---	50	50	100
	CA 9323 (E2)	Web Technologies & .NET Framework							
	CA 9323 (E3)	Cross-Platform Development using .NET Core							
5	CA 9423 (E1)	Cognitive Computing and Artificial Intelligence	SC	4	3	---	50	50	100
	CA 9423 (E2)	Computational Intelligence and Machine Learning							
	CA 9423 (E3)	Deep Learning and Neural Networks							
6	CA 9523 (E1)	Big Data Analytics: MapReduce and Hadoop	SC	3	3	---	50	50	100
	CA 9523 (E2)	Big Data Analytics with Scala and Spark							
	CA 9523 (E3)	Big Data Visualization using Tableau							
4	CA 9P1 & CA 9P2	Web Application Development & .NET Lab	HCL	2	----	3	50	50	100
7	CA 9P3 & CA 9P4	Machine Learning & Big Data Lab	SCL	2	---	3	50	50	100
8	CA 9623	Business Consultancy Project	HCP	3	---	---	50	50	100
		Total		26			400	400	800

* HC – Hard Core SC – Soft Core HCL – Hard Core Lab SCL – Soft Core Lab HCP – Hard Core Project

IV Semester

Sl. No.	Subject Code	Subject Title	Credits	Max. Marks
1.	CA 9723	Dissertation I (SRS & SDD)	5	100
2.		Dissertation II (Mid Term Evaluation)	5	100
3.		Dissertation III (Record Reading)	5	100
4.		Viva-voce	5	200
		TOTAL	20	500

I Semester

CA 7123 [E1]: DATABASE MANAGEMENT SYSTEMS

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives: This is a course about data and its management. The design of files and databases and the use of database management systems are integral and critical parts of developing and using information systems. Today, virtually every information system will include the database design and implementation or the use of an existing database.

- Introduction to database management systems
- Foundation on Relational model, Relational Algebra.
- Concepts on Basic SQL as a universal Database language.
- Knowledge on File Structure, Indexing and Query processing.
- Knowledge on Transaction and Database architecture.

Learning Outcomes: After you have finished this course, you should have

- Very good understanding about data and database systems.
- Describe the fundamental elements of relational database management systems
- Understand the design of relational databases through the use of Entity-Relationship Diagrams and Normalization procedures
- develop basic skills in the use of SQL in defining and creating a database, inserting and modifying entries in a table,
- Effective way of manipulating the database to produce useful decision-making information for management & analytics.

Unit I

Overview of Database Systems: Historical Perspective, Levels of Data Abstraction, File Systems, Limitations of File system, Files Vs Database, Characteristics of Database System, Concept of Database Management, Advantages of DBMS, Users of Database, Database Administration

Database Architecture: Database Schema, Three schema architecture, Data Independence, Database Tools and Languages. Centralized database system and Client/server DBMS

(10 hrs)

Unit II

Data Modeling: Concept of Data Model, Purpose/importance of Data model, Types of data model: Hierarchical and Network model: concept, features and uses

Database design and ER Model: Entities, Attributes, Relationship, Types of relationships, Keys, Cardinality, Degrees, ER-Diagram notations

Overview of ER Model: ER-Diagrams, ERD Issues, Extended E-R Features, ERD for Company and Student Admission system

Relational database model- Introduction to Relational model, Relational Algebra: Set oriented operations : Union, Intersection, Difference and Cartesian Products, Relation oriented operations: Selection, Projection, Join and Division, **Constraints** : Concept of Constraints, types of constraints, Data Integrity, Business rules, Implementing constraints and business rules.

(10 hrs)

Unit III

Normalization: Concept of Normalization, Benefits of normalization: function dependency and determinants, normalization theory- **Normal forms:** 1 NF, 2NF, 3NF and BCNF,

Structured query language- Characteristics of SQL, types of SQL, **components of SQL:** DDL, DML, DCL and DQL, basic queries in SQL, adding constraints, altering and dropping constraints, adding business rules. single-table and multi-table retrievals, Joins: Outer joins, Inner Joins and Cross Joins

Nested Queries: Concept of subquery, features of subquery, creating subquery

(10 hrs)

Unit IV

Views: Definition, purpose, types of views, Advantages and disadvantages of views, creating views in SQL, Altering and dropping views

Functions: Scalar and aggregate functions, types of scalar functions, **Conversion functions:** TO_CHAR, TO_NUMBER, TO_DATE, Aggregate Functions, Using SET operators: UNION, INTERSECT, MINUS

Indexes: Concept of index, advantages and disadvantages of indexes, types of indexes, creating indexes in SQL

(9 hrs)

Query processing and optimization: Concept, purpose, Translating queries into relational algebra operator, Query Trees and Heuristics for query optimization Limitations of SQL, Concept of PL/SQL, writing a simple program in PL/SQL (9 hrs)

Unit V

Transaction management and Concurrency control : Transaction, states of transaction, ACID properties, serializability, Concurrent transaction: Lost Update, dirty read, Inconsistent summary, unrepeatable read, Concurrency control mechanism : database lock, types of locks, Locking protocol (2PL), Deadlocks, Time stamping methods, deadlock prevention algorithms : wait die and wound wait, optimistic methods

Failure in Database/Transaction : Transaction failure, recovery of transactions, 2 PC protocol, database backup.

Distributed database: Components, distribution transparencies, **Issues in DDBMS:** Fragmentation, Replication and Allocation, DDBMS architecture: SPSD, SPMD, MPMD **(10 HRS)**

TEXT BOOKS

1. Raghurama Krishnan, Johannes Gehrke ,Data base Management Systems, 3rd Edition, 2014, Mc Graw Hill Education,
2. A.Silberschatz, H.F. Korth, S.Sudarshan, Data base System Concepts, VI edition, 2006, McGraw Hill,

References

3. Peter Rob, Carlos Coronel, Database System Concepts, 5th Edition, 2015, Cengage Learning
4. Ashima Bhatnagar Bhatia, Vaibhav Bansal, Database Management System, First Edition 2015, Narosa Publishing House Pvt. Ltd
5. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, 2018, Pearson India Education Services Pvt. Ltd,
6. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, 2014, McGrawHill Education,
7. Arun Majumdar & Pritimoy Bhattacharya, DATABASE MANAGEMENT SYSTEMS , 2007, TMH.
8. Gerald V. Post, DATABASE MANAGEMENT SYSTEMS 3rd edition, TMH.

CA 7123 [E2]: DATABASE DESIGN AND IMPLEMENTATION

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Course objectives

This course is designed to enable students to achieve a comprehensive understanding of data, information and knowledge. How an efficient management system, helps to create database. Design tables, manipulate data values, maintaining integrity constraints and so on and also this course stresses on writing queries to generate different reports, how to optimize queries, creating views and cursors. Prepare the students to understand the power Query languages and also writing stored procedure and triggers at the back end.

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

- Understand the limitations of traditional file management systems

- Understand the need for an efficient management system to administer the data repository of any organization
- Importance of data consistency and also how data integrity ignorance affects any business organization
- Providing data security through different means (such as Views)
- Identifying the power of Query language - generating flexible and customized reports
- Providing complex integrity constraints through the use of Triggers
- Know the Power of procedural SQL, writing Stored procedures, functions and packages
- Gain knowledge about the emerging trends in database technology
- Implementation of active database rules and also object relational features

Learning Outcomes: After you have finished this course, you should have

- Very good understanding about data and database systems and its design issues
- Describe the fundamental elements of relational database management systems
- Understand the design of relational databases through the use of Entity-Relationship Diagrams and Normalization procedures
- develop basic skills in the use of SQL in defining and creating a database, inserting and modifying entries in a table,
- Effective way of manipulating the database to produce useful decision making information for management & analytics.
- Handling the distributed database and understanding the issues related to data distribution
- Introduces to the concept of Big data domain and Schema-less storage

UNIT-I

Introduction-Database System Applications: Purpose of Database Systems, View of Data – Data, Data Abstraction, Three Schema Architecture, Data Independence, Database Users and Administrators, Data Models : Hierarchical, Network, ER

Introduction to Data base design :ER model : Entities, Attributes and Entity sets, relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises. **(10 hrs)**

Unit II

Relational Model : Foundations of Relational model, Basics of Relational Algebra and Calculus,

Relational algebra: Introduction, Basic Operations : Union , Intersection, Cartesian Product , Difference, **Relational Algebraic Operations :** Projection, Join, Selection and Division, Relational model constraints : Domain constraints, Key constraints, Entity integrity, referential integrity

SQL : Components of SQL : Data Definition Language, Data Manipulation Language, Data Control Language, Data Query Language

Creating Tables, Altering Tables and Schema, Manipulation of Data, Querying Single Table and Multiple Tables, Adding./Altering Constraints and Business Rules, Sorting, Join Operation, Data Dictionary

Integrity Rules, Constraints and Business Rules, Implementation of Constraints and Business Rules **(10 hrs)**

UNIT III

Normalization : Concept of normalization, Need for Normalization, Anomalies in DB, Normalization Process, Functional Dependency, Full Functional Dependency, Partial Dependency, 2NF, 3NF, BCNF, Join and Multivalued Dependency. Denormalization, Database design with Normal forms

Views : Concept, purpose of views, types of views, Advantages and disadvantages of views, Implementing views in SQL, Altering Views

Nested queries : Features of sub query, Rules , types of sub-query

Set operators in SQL : Using Union, Union All, Intersect and Minus

Functions : Scalar and aggregate functions, types of scalar functions, Aggregate functions : MIN, MAX, AVG, SUM and COUNT,using HAVING, **Conversion functions** : TO_CHAR, TO_NUMBER, TO_DATE **(10 hrs)**

UNIT IV

File Organization : Heap Files, Sequential Access Methods, Indexed Sequential Access method, Indexes: Purpose Index, Types of Indexes, Advantages and Disadvantages of creating Indexes, Multi-level indexes, Creating Indexes in SQL, purpose of Index, types of indexes, Implementing Indexes in SQL, Sequences

Transactions: Concept of Transaction, States of Transaction, ACID properties, Concurrent Transaction : Lost update, Dirty Read, Unrepeatable Read, Inconsistent summary, Concurrency control Mechanism: Data base Lock, 2 PL : Basic 2 PL, Strict 2 PL, Rigorous 2 PL, Time stamp: Dead lock, deadlock prevention algorithms : Wait-Die and Wound-Wait

Failures in DB/Transaction: Reasons for Database failures, Catastrophic failure, Transaction Log, Backup, transaction Failure, Deferred update, Immediate update, Log based recovery

PL/SQL: A Programming Language: History – Fundamentals – Block Structure – Comments – Data Types, Assignment operation – Bind variables, Conditional statement, Branching and Looping, **Transaction Control statements**, DCL : Commit and Rollback **(09 hrs)**

UNIT- V

PL/SQL Cursors and Exceptions: Cursors – Implicit & Explicit Cursors and Attributes – Cursor FOR loops, Cursor with Parameters – Cursor Variables – Exceptions – Types of Exceptions. Stored Procedures and Triggers

Distributed Database Systems: Components, Advantages over centralized database system, Transparencies in DDB, Issues in DDB: Fragmentation, Replication and Allocation, DDB architecture : SPSD, MPSD, MPMD, Distributed query processing, 3-phase commit protocol

Big data : Concept of Big Data, 4 V's of Big Data, ACID vs BASE, NoSQL, Types of NoSQL Data

(09 hrs)

Text Books

- [1] R. Elmasri and S.B. Navathe: "Fundamentals of Database System", Pearson, 7th Edition, 2018
- [2] Raghurama Krishnan, Johannes Gehrke, Data base Management Systems, 3rd Edition, 2014, McGrawHill Education,

Reference Books:

- [1] Alexis Leon, Mathew Leon, "Database Management System", Vikas Publishers
- [2] Peter Rob, Carlos Cornel, "Database Systems: Design & Management", Cengage
- [3] J A Hoffer, Mary B Prescott, H Topi, "Modern Database Management Systems", Pearson
- [4] Saeed K Rahimi, Frank S Haug, "Distributed Database Management Sytem: A Practical Approach", Wiley India Publishers
- [5] Bipin C. Desai, "Introduction to Database Systems", Galgotia Publications.
- [6] Date, C. J. , "An introduction to database systems", 3rd Edition, Narosa publishing house.
- [7] Hansen & Hansen, "Database Management and Design", Prentice Hall of India ltd.
- [8] Ullman, J. D., "Principals of Database systems", Galgotia publications
- [9] Narang, "Database Management System", Prentice Hall of India Ltd
- [10] Nilesh Shah, "Database Systems using ORACLE: A simplified guide to SQL, and PL/SQL", 2nd Edition, Prentice Hall of India Ltd.
- [11] Ivan Bayross "SQL, PL/SQL : The programming language of Oracle", BPB Publications

CA 7123 [E3]: NoSQL with MongoDB

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives

Most of the students are thinking data and its storage in terms of relational model. With the inception of big data and unstructured data storage, retrieval and querying has become very cumbersome. This course will help students to understand handling data, when data is not in the form of table and data which has no strict schema. The introduction of NoSQL opens a new world in the big data domain. Storage of unstructured and semi structured data and its manipulations puts no restriction/constraints on the user. This course is designed to provide knowledge and skills to become a successful MongoDB expert. The course covers a range of NoSQL and MongoDB topics such as CRUD Operations, Schema Design and Data Modeling, Scalability etc.

Learning Outcomes

After successful completion of the course students should be able to

- Understand that data need not be structured for storage and retrieval
- Define, compare and use the four types of NoSQL Databases (Document-oriented, Key Value Pairs, Column-oriented and Graph).
- Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
- Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.
- Using NoSQL tools efficiently in the academic projects
- Helps students to change the query writing style and optimization of the query.

UNIT I

Relational Data modeling , Normalization, ACID properties, Data storage and retrieval challenges with Relational data. Types of Data : Structured, semi structured and unstructured data, Data storage and retrieval challenges, Schema and Schema less Databases, Definition of NOSQL, History of NoSQL and Different NOSQL products, CAP and BASE Theorem, Types of NoSQL: Key-value store, Wide-Column store, Document Database and Graph Databases **(10 hrs)**

UNIT II

Replication and sharding:, Concept of Sharding, purpose, Distribution Models, Single Server, Sharding, Purpose of replication, **Types of replication** : Master-Slave Replication, Peer-to-Peer Replication, Combining Shading and Replication, MapReduce on databases.

The Value of Relational Databases, Getting at Persistent Data, Concurrency, Principles of schema design, Nested documents, Collections and capped collections, The Emergence of NoSQL, Popular NoSQL tools **(10 hrs)**

UNIT III

MongoDB : Overview of MongoDB, basic terms used : Database, Collection, Document, Field, Comparison with RDBMS, Advantages of MongoDB over RDBMS, MongoDB Application Areas, MongoDB Environment, Principles of Designing schema, MongoDB Data Modeling, **Basic commands** : Create Database,, **use Command, dropDatabase () Method**, Create Collection, **createCollection() Method**, Drop Collection, creating capped collections

Create Database and Collections, Dropping Databases and Collections, Data types, Insert, Update, Querying document, Relational operators, Logical Operators, **(10 hrs)**

UNIT IV

MongoDB Data types, insert() Method, find() Method, pretty() Method, Logical operators AND, OR, NOT, Using AND and OR together, Update() method, Save() Method, Delete Document, remove() Method, Remove only one, Remove All documents, **MongoDB Projection** :The find()

Method, Limit Records, The Limit() Method, Skip() Method, Sort Documents: The sort() Method, Indexing, The ensureIndex() Method, Aggregation , aggregate() Method, Group functions, string functions : Sconcat, \$strcasecmp, \$substr, \$toLower, \$toUpper, set operators: \$setEquals, \$setIntersection, \$setDifference, \$setUnion,\$setIsSubset **(9 hrs)**

UNIT V

Indexing and Query Optimization, Indexing rules, Simple index, compound index, single-key indexes, compound-key indexes, **Indexing types** : unique indexes, sparse indexes, multi-key indexes, hashed indexes, creating and deleting indexes

Query optimization, text search and pattern matching, Sharding :overview, purpose of sharding, distributing databases to shards, sharding within collections, MongoDB Replication, Creating backup and Restoring data, Comparing MongoDB with other NoSQL. **(9 hrs)**

Text Books

- [1] Rick Copeland.. MongoDB Applied Design Patterns, , First Edition, 2013, OREILLY
- [2] Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, MongoDB in Action, Second Edition, , 2016 dreamtech press

References

- [1] Samse Pub1 , NoSQL with MongoDB in 24 Hours, 1st Edition, Kindle Edition
- [2] Amol Nayak, MongoDB Cookbook Paperback – 2014, Publisher: Packt Publishing
- [3] Doug Bierer,, MongoDB 4 Quick Start Guide, First Edition, 2018, Packt Publishing,
- [4] Shannon Bradshaw, Eoin Brazil & Christina Chodorow, MongoDB The Definitive Guide,3RD Edn, 2019, , O'REILLY
- [5] Subhashini Chellappan, MongoDB Recipes, 1st Edition, 2015

CA 7223 [E1]: DATA STRUCTURES AND ANALYSIS OF ALGORITHMS

Total No. of Lectures: 48	Total Marks: 100	[L – T – P – S]
No. of Lectures/Week: 4	Credits: 4	[3 – 1 – 0 – 2]

Course Objectives:

- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees
- To choose an appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.

Course Outcomes:

- Ability to choose appropriate data structures to represent data items in real world problems.
- Ability to analyze the time and space complexities of algorithms.
- Ability to design programs using a variety of data structures such as stacks, queues, hash tables, binary trees, search trees, heaps, graphs, and B-trees.
- Able to analyze and implement various kinds of searching and sorting techniques.

UNIT - I

Introduction: Notion of algorithm: - Properties of algorithm, Issues in writing algorithm, how to write an algorithm, what kinds of problem solved by algorithms. Designing algorithm. Analysis of algorithm – Space complexity, Time complexity, Measuring an input Size, Measuring running time, Order of growth, Best, Worst and Average Case analysis. Growth of Functions – Big Oh, Omega, Theta Notation. Complexity Analysis Examples.

Structures, Functions, Pointers, new and delete operators, class and object, access specifiers ,constructors and destructor.

Single, two dimensional arrays, sparse matrices-array,

Introduction to Data structure types - Linear and Non Linear, Static and Dynamic data structures, primitive and Non primitive data structures. **(10 HRS)**

UNIT - II

Stack Data structure, Stack using array, Stack applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue - definition, array and linked Implementations, Circular queues-Insertion and deletion operations, Double Ended Queue using array, Priority Queue using array. **(9 HRS)**

UNIT - III

Singly Linked Lists- Operations-Insertion, Deletion, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion.

Polynomial addition using linked list, Ordered list, Stack using list, Queue using List. **(9 HRS)**

UNIT - IV

Trees – definition, terminology, Binary trees-definition, Properties of Binary Trees, representation of Binary Trees-array and linked representations, Binary Tree traversals, Representation of expressions using tree, Threaded binary trees – Right in threaded binary tree .

(10 HRS)

UNIT - V

Searching - Linear Search, Binary Search, Hashing-Introduction, hash tables, hash functions, Overflow Handling, Comparison of Searching methods.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Merge sort.

(10 HRS)

TEXT BOOKS:

- [1] Data structures, using C and C++, 2nd Edition, Yedidyah Langsam, Aaron M. Tenenbaum. Pearson
- [2] Design and Analysis of Algorithms By A.A.Puntambekar Technical Publications, 2010

REFERENCE BOOKS:

- [1] Data structures with C++, J. Hubbard, Schaum's outlines, TMH.
- [2] Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
- [3] Data structures and Algorithm Analysis in C++, 3rd edition, M. A. Weiss, Pearson.
- [4] Classic Data Structures, D. Samanta, 2nd edition, PHI.

CA 7223 [E2]: DATA STRUCTURES AND GRAPH THEORY

Total No. of Lectures: 48	Total Marks: 100	[L - T - P - S]
No. of Lectures/Week: 4	Credits: 4	[3 - 1 - 0 - 2]

Course Objectives:

- To understand the basic concepts such as Abstract Data Types, Linear and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose an appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.

Course Outcomes:

- Ability to choose appropriate data structures to represent data items in real world problems.
- Ability to analyze the time and space complexities of algorithms.
- Ability to design programs using a variety of data structures such as stacks, queues, hash tables, binary trees, search trees, heaps, graphs, and B-trees.
- Able to analyze and implement various kinds of searching and sorting techniques.

UNIT I

Introduction: Introduction to structures, functions, Pointers, Classes and Objects, Memory Allocation - New and Delete. Introduction to one dimensional array, two-dimensional array, character array – string operations, sparse matrix and its operations

What is data structure, different types of data structures, Application of data structures?

(10 HRS)

UNIT II

Stack: stack as an ADT, Representing Stack using C++, Stack Applications – infix to postfix, postfix evaluation, Decimal to binary conversion, Recursion

Queue: Queue as an ADT, Queue implementation using C++, Queue Applications, Queue Types – Circular Queue, Double Ended Queue, Priority Queue – Implementation using array.

Lists: Introduction to lists, Types of linked list, Node Structure, list operations – insert and delete, circular linked list – insert and delete operations, Double ended and double ended circular queue – insert and delete operations.

(10 HRS)

UNIT III

Representation of Exponential equation and addition of exponential equations. Ordered singly linked list.

Trees: Introduction to trees, Binary trees – Operations on binary trees, Applications of Binary trees – duplicate value deletion, expression representation and traversal. Binary tree representation – Node Representation of binary trees, implicit array representation of binary trees, binary tree traversals, Threaded binary trees. Binary Search trees. Self-balancing trees - AVL trees.

(10 HRS)

UNIT IV

Searching – Linear Search, Binary Search, Hashing – insertion and searching using hashing.

Sorting – Bubble sort, insertion sort, selection sort, radix sort, merge sort, quick sort, heap sort, address calculation sort.

(09 HRS)

UNIT V

Graphs–Definitions, Graph Representations- Adjacency matrix, Adjacency lists, warshall's algorithm, shortest path algorithm, Graph traversal methods – Depth First Search and Breadth First Search, Graph spanning tree – prims algorithm and kruskal's algorithm.

(09 HRS)

TEXT BOOKS:

- [1] Data structures, using C and C++, 2nd Edition, Yedidyah Langsam, Aaron M. Tenenbaum. Pearson
- [2] Design and Analysis of Algorithms, A.A.Puntambekar Technical Publications, 2010

REFERENCE BOOKS:

- [1] DATA STRUCTURES THROUGH C IN DEPTH by S. K. srivastava and Deepali Srivastav BPB Publications.
- [2] Data Structures – R Venkateshan, S. Lovelyn rose – Second Edition – Wiley
- [3] DATA STRUCTURES AND ALGORITHMS MADE EASY by Narasimha Karumanchi - Careermonk Publications; 5th ed. edition (2016)
- [4] Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.

CA 7223 [E3]: ADVANCED DATA STRUCTURES AND ALGORITHMS

Total No. of Lectures: 48
No. of Lectures/Week: 4

Total Marks: 100
Credits: 4

[L – T – P – S]
[3 – 1 – 0 – 2]

Course Objectives:

- To understand the basic applications of data structures, Linear and Non Linear Data structures.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose an appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To understand and analyze graphs theory and its applications.

Course Outcomes:

- Ability to choose appropriate data structures to represent data items in real world problems.
- Ability to use different advanced algorithms in different time efficient cases.
- Ability to design programs using a variety of data structures such as stacks, queues, hash tables, binary trees, search trees, heaps, graphs, and B-trees.
- Able to analyze and implement various kinds of searching and sorting techniques.
- Able to use graph in different applications such as maps, finding shortest path and finding spanning trees.

UNIT I

Introduction: Introduction to structures, functions, Pointers, Classes and Objects, Memory Allocation - New and Delete. Introduction to one dimensional array, two dimensional array, character array – string operations, sparse matrix and its operations

What is data structure, different types of data structures, Application of data structures.

(10 HRS)

UNIT II

Stack: stack as an ADT, Representing Stack using C++, Stack Applications – infix to postfix, postfix evaluation, Decimal to binary conversion, Recursion

Queue: Queue as an ADT, Queue implementation using C++, Queue Applications, Queue Types – Circular Queue, Double Ended Queue, Priority Queue – Implementation using array.

Lists: Introduction to lists, Types of linked list, Node Structure, list operations – insert and delete, circular linked list – insert and delete operations, Double ended and double ended circular queue – insert and delete operations.

Representation of Exponential equation and addition of exponential equations. Ordered singly linked list. **(10 HRS)**

UNIT III

Trees: Introduction to trees, Binary trees – Operations on binary trees, Applications of Binary trees – duplicate value deletion, expression representation and traversal. Binary tree representation – Node Representation of binary trees, implicit array representation of binary trees, binary tree traversals, Threaded binary trees. Binary Search trees.

(10 HRS)

UNIT IV

Self-balancing trees -AVL trees, B trees, splay trees, KD tree, Huffman Coding, Quad tree, 2-3 tree, Red Black trees, Knapsack problem.

Searching – Linear Search, Binary Search, Hashing

Sorting – Bubble sort, insertion sort, selection sort, radix sort, merge sort, quick sort, heap sort, address calculation sort.

(09 HRS)

UNIT V

Graphs–Definitions, Graph Representations- Adjacency matrix, Adjacency lists, warshall's algorithm, shortest path algorithm, Graph traversal methods – Depth First Search and Breadth First Search, Graph spanning tree – prims algorithm and kruskal's algorithm.

(09 HRS)

TEXT BOOKS:

- [1] Data structures, using C and C++, 2nd Edition, Yedidyah Langsam, Aaron M. Tenenbaum. Pearson
- [2] M. A. Weiss, "Data Structures and Algorithm Analysis in C", 2nd ed, Pearson Education Asia.

REFERENCE BOOKS:

- [1] Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures – A Pseudocode Approach with C", Thomson Brooks / COLE.

- [2] Aho, J. E. Hopcroft and J. D. Ullman, "Data Structures and Algorithms", Pearson education Asia. Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
- [3] Data structures and Algorithm Analysis in C++, 3rd edition, M. A. Weiss, Pearson.
- [4] Classic Data Structures, D. Samanta, 2nd edition, PHI.

CA 7323 [E1]: OBJECT ORIENTED PROGRAMMING WITH JAVA

Total No. of Lectures : 48 **Total Marks : 100** **[L - T - P - S]**
No. of Lectures / Week : 4 **Credits : 4** **[3 - 1 - 0 - 2]**

Learning Objectives:

- Provide in depth knowledge of Object oriented programming starting from basics.
- Explore the OOP concepts like constructors, method overloading, objects as parameters and nested classes.
- Explore some more advanced OOP concepts like inheritance, interfaces, packages, exception handling, multithreading and generics to understand their use and implementation.

Learning outcomes: The candidate will be able to understand

- Understand the Object Oriented Concepts well with real world problems and will be able to model the requirements to solutions.
- Students will be able to build Java applications where they can read from and write to files.
- End of the course student will be able to develop and deliver the power of multithreaded programming and handle the packages well.

UNIT-I

Principles of Object Oriented Programming: A look at procedure oriented programming – characteristics, Object Oriented programming paradigm, Basic concepts of OOP, Benefits and application of OOP.

Java Programming Fundamentals: Features of Java, The Java Keywords, Identifiers in Java, The Java's Primitive Types, The Scope and Lifetime of Variables, Operators, Type conversion, Control structures – if, if – else and nested if, The if-else-if Ladder, The Switch Statement, Looping structures - for Loop, while Loop, The do-while Loop, Use of break and continue statements, Nested Loops and labelled loops. **(9 HRS)**

UNIT -II

Classes, Objects and Methods: Class Fundamentals, Creating Objects – the new operator, Reference Variables and Assignment, Methods, Getters and Setters, Using Parameters – this Keyword.

Constructors – default, Parameterized Constructors, Garbage Collection and Finalize method. Controlling Access to Class Members, Passing Objects to Methods, Returning Objects, and Method Overloading, Overloaded Constructors, Static members, Introducing Nested and Inner Classes.

Arrays and Strings: Arrays in Java, Multidimensional Arrays, Using the Length Member, the For-Each Style for Loop. String class Fundamentals, The String Constructors, String class methods, StringBuffer and StringBuilder classes. **(10 HRS)**

UNIT -III

Inheritance: Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, using super under different contexts, Different types of inheritance, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final keyword.

Interfaces: Interface Fundamentals, creating an Interface, implementing an Interface, Using Interface References, Implementing Multiple Interfaces. Package Fundamentals, Packages and Member Access, Importing Packages **(10 HRS)**

UNIT -IV

Exception Handling: Exception Handling Fundamentals, try...catch block, using Multiple catch clauses, Nested try blocks, throwing an Exception, Throwable class, using throw, throws, finally, creating user defined exceptions and its use.

Multithreaded Programming: Multithreading fundamentals, Thread life cycle, creating a Thread - Thread Class and Runnable Interface, Creating Multiple Threads, Thread Priorities, Synchronization. **(9 HRS)**

UNIT -V

File Input/Output: - Byte Streams and Character Streams, Reading and Writing Files, BufferedInputStream, BufferedOutputStream, ObjectOutputStream, ObjectInputStream

Generics: Introduction, defining a Generic class – general form, type parameters, generic method, bounded wildcards, Generics Inheritance, and Subtypes **(10 HRS)**

Text Book:

[1] Herbert Schildt, “Java: The Complete Reference”, 8th Edition, Indian Edition, Oracle Press, McGraw- Hill.

[2] Paul Deitel, Harvey Deitel, “Java How to Program”, 8th Edition, PHI

Reference books:

[1] Cay Horstman, Gary Cornel, “Core Java: Fundamentals”, 8th Edition, 2010, Pearson Asia.

[2] Jana, Debashish, “Java and Object Oriented Programming Paradigm”, PHI Learning

[3] Joyce Farrell, “Java For Beginners”, Cengage Learning India

[4] Rashmi Kanta Das, “Core Java for Beginners”, Vikas Publishing House Pvt. Ltd.

- [5] Khalid A. Mughal, Rolf W. Rasmussen, "A Programmer's Guide to Java SCJP Certification", 3rd Edition, Pearson
- [6] Walter Savitch, "Java An Introduction to Problem Solving and Programming", Pearson
- [7] "Java 7 Programming Black Book", Kogent Learning Solutions Inc., Dreamtech Press.

CA 7323 [E2]: ENTERPRISE COMPUTING WITH ADVANCED JAVA

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives: This course is introduced to familiarize with Java EE Architecture; Learn how to use Servlet and JSP; Be able to create and use custom JSP tags; An overview of database access and details for managing information using the JDBC API

Learning outcomes: Upon successful completion of this course, students are expected to

- Develop server side programs using JSP and Servlets
- Update and retrieve the data from the databases using Derby
- Create session and entity beans using EJB

UNIT - I

Overview of Java EE Architecture: Java EE platform highlights, Java EE Application model, Distributed Multitier applications, Java EE components, Java EE Clients, Web Components, Business Components, Java EE containers, Web Services support. **(9HRS)**

UNIT - II

Servlets: MVC Architecture, Introduction to Servlet, Features of Java Servlets, Servlet tasks, Servlet package, Life Cycle of Servlet, Get() and Post() methods, Reading form parameters, Client HTTP Request, Server HTTP Response, Cookies handling, Session Tracking **(9HRS)**

UNIT - III

Java Server Pages (JSP): Java Server Pages (JSP) Introduction, Advantages of JSP, Differences between JSP and Servlets; JSP Architecture, JSP Page life cycle; Elements of JSP, JSP Directives, JSP Actions elements, JSP Form processing- GET() and POST() methods, JSP Cookies handling and Session tracking **(10 HRS)**

UNIT - IV

JDBC - JDBC Architecture-Types of JDBC Drivers, The Connectivity Model, The java.sql package, Navigating the ResultSet object's contents, Manipulating records of a ResultSet object through User Interface, The JDBC Exception classes, Database Connectivity, Data Manipulation, Data navigation. **(10 HRS)**

UNIT V

EJB – EJB architecture and concepts, Responsibilities of EJB Container and Server, Classification of EJB, Anatomy of Session and Entity beans, Differences between CMP and BMP, Annotations, Dependency Injection

(10 hrs)

Text Books:

- [1] Antonio Gonsalvis, “Beginning Java EE 7”, Apress
- [2] Kogent Solutions Inc, “Java Server Programming Java EE 7 Black Book”, Dreamtech Press

Reference Books:

- [1] Joe Wigglesworth, Paula McMillan, “Java Programming: Advanced Topics”, 3rd. Edition, 2011, Cengage
- [2] Santhosh Kumar, “JDBC, Servlets, JSP Black Book”, 2008, Wiley Dreamtech
- [3] George Reese, “Database Programming with JDBC and Java”, 2nd Edition, O’Reilly
- [4] Subrahmanyam Allamaraju, Cedric Buest and others, “Professional Java Server Programming J2EE 1.3 Edition”, Apress
- [5] K Somasundaram, “Advanced Programming in Java2: Updated To J2SE6 with Swing, Servlet and RMI”, Jaico Publishing House

CA 7323 [E3]: ENTERPRISE COMPUTING: JAVA EE Frameworks

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives:

- To understand Java EE Architecture and MVC Framework
- To understand Servlets, JSP, JSTL, EJB
- To Build Java applications that use Hibernate to create, retrieve, update, and delete objects.

Learning Outcomes:

- Developing web applications using Servlet, JSP, JSF
- Develop enterprise applications using EJB
- Accessing databases with JDBC
- Map Java classes to database tables using Hibernate

UNIT - I

Java EE: Overview of Java EE Architecture; Framework and their advantages; MVC Framework Methodologies;

Servlets: Introduction to Servlet, Features of Java Servlets, Servlet tasks, Servlet package, Life Cycle of Servlet, Get() and Post() methods, Reading form parameters, Client HTTP Request, Server HTTP Response,

Java Server Pages(JSP): Java Server Pages (JSP) Introduction, Advantages of JSP, Differences between JSP and Servlets; JSP Architecture, JSP Page life cycle; Elements of JSP, JSP Directives, JSP Action Elements, JSP Form processing- GET() and POST() methods

(10 hrs)

UNIT - II

JSP Standard Tag Library (JSTL): Expression language syntax, Core tag library, XML tag library, Formatting tag library, SQL Library

JDBC: Architecture, Driver types, Connections, Statement, ResultSet, Transactions, Exceptions, Batch Processing, CRUD operations using Servlets, JSP and JSTL

(10 hrs)

UNIT - III

EJB – EJB architecture and concepts, Responsibilities of EJB Container and Server, Classification of EJB, Anatomy of Session and Entity beans, Differences between CMP and BMP, Annotations, Dependency Injection

(9 hrs)

UNIT - IV

JSF: Overview, Benefits, JSF UI Component model, JSF Life Cycle, JSF Managed Beans, Page Navigation, Basic Tags, Facelet tags, Converter tags, Validator tags, Data tables and various operations

(9 hrs)

UNIT - V

Hibernate: Origins of Hibernate and Object-Relational Mapping, Architecture of Hibernate, Hibernate Sessions, Persistent class, Mapping Files, Mapping Types, Hibernate annotations, Querying in Hibernate: HQL, Criteria Queries, Native SQL, Hibernate Caching. Batch Processing, Hibernate Interceptors

(10 hrs)

Text books:

- [1] Joe Wigglesworth, Paula McMillan, "Java Programming: Advanced Topics", 3rd Edition, Cengage Learning International

[2] Kogent Solutions Inc, "Java Server Programming Java EE 7 Black Book", 1st Edition, Dreamtech Press

Reference books:

[1] Richard Reese, "EJB 3.1 Cookbook", 1st Edition, 2013, SPD/ Packt Publishers

[2] Santhosh Kumar, "JDBC, Servlets and JSP Black Book", New Edition, Dreamtech

[3] Antonio Gonsalvis, "Beginning Java EE 7", 1st Edition, Wiley Apress

[4] Subrahmanyam Allamaraju, Cedric Buest and others, "Professional Java Server Programming J2EE 1.3 Edition", Apress

[5] Dave Minter, Jeff Linwood "Beginning Hibernate From Novice to Professional", Apress

CA 7423 [E1]: WEB DESIGN with HTML 5, CSS, Java Script

Total No. of Lectures : 48 **Total Marks : 100** **[L - T - P - S]**

No. of Lectures / Week : 4 **Credits : 4** **[3 - 1 - 0 - 2]**

Learning Objectives:

- Students will learn to develop web pages using HTML
- They will apply styles to the web pages using CSS
- They can bring dynamic behavior to the web pages using JavaScript

Learning Outcomes: At the end of the course, the

- Students will be able to develop websites and web based projects.
- Students can be employed on entry-level jobs of web development in software industry.
- Students will be able to develop interactive and dynamic webpages

Unit - I

HTML - Introduction, elements, attributes, headings, paragraphs, styles, formatting, quotations, comments, colors, links, images, image maps, tables, lists, blocks, classes, id, iframes.

HTML - Layout elements, computercode, entities, symbols

(10 hrs)

Unit - II

Html Form - form element, input types, input attributes, Html Canvas - draw line, circle, draw text, stroke text. HTML SVG - draw circle, rectangle, star. Play audio and video in Html.

(9 hrs)

Unit - III

CSS - syntax, selectors, ways to insert CSS, backgrounds, borders, margins, padding, width, height, box-model, outline, fonts, links, lists, tables, display, position, overflow, float, inline-block.

(10 hrs)

Unit - IV

CSS – navigation bars, dropdowns, forms. JavaScript – introduction, syntax, variables, operators, data types, functions, events, string manipulation, handling numbers, Arrays

(10 hrs)

Unit - V

JavaScript – Date, switch, loops, break, continue, type conversion, regular expressions, this, classes, form validation.

(9 hrs)

Text Books:

- [1] Jon Duckett, "Beginning HTML, XHTML, CSS, and JavaScript", Wiley INDIA Edition
- [2] Elizabeth Castro, Bruce Hyslop, "HTML and CSS", 8th Edition, Pearson

References:

- [1] Scott Duffy, "JavaScript A Beginners Guide", Dreamtech Press
- [2] Ian Pouncey, Richard York, "Beginning CSS Cascading Style Sheets for Web Design", Wiley
- [3] Chris Bates, "Web Programming Building Internet Applications", 2nd Edition
- [4] Rachel Andrew, "The CSS3 Anthology Take your sites to new Heights", SPD
- [5] Elizabeth Castro, "HTML for the World Wide Web", 5th Edition, Peachpit Press
- [6] Marco Casario & others, "HTML5 Solutions Essential Techniques for HTML5 Developers"
- [7] Ben Frain, "Responsive Web Design with HTML5 & CSS3", 2nd Edition, Packt Publishing
- [8] Zak Ruvalcaba, Anne Boehm, "HTML5 and CSS3", SPD

CA 7423 [E2]: WEB PROGRAMMING WITH PHP and MYSQL

Total No. of Lectures : 48 Total Marks : 100 [L - T - P - S]

No. of Lectures / Week : 4 Credits : 4 [3 - 1 - 0 - 2]

Learning Objectives:

- To produce dynamic, animated, interactive and database driven web sites to prepare students for internet marketing and web site administration.
- Students will learn different languages like HTML5, CSS, JavaScript and PHP (Server Side Programming ;)
- Students will work with different technologies and software components like web browsers, web servers (Apache) and database connectivity's.

Learning Outcomes:

- To create personal and / or business websites following current professional and /or industry standards or responsive web sites with use of HTML, CSS and java script.

- To know client side scripting using Java script with its features like event handling and form validations.
- To create effective scripts using JavaScript and JQuery to enhance the end user experience.
- Get know about server side scripting using PHP and its essentials.
- To develop interactive and dynamic website using PHP and MySQL database connectivity.

Unit I

HTML 5: Internet and its applications, Browsers and web servers, Hyper Text Transfer Protocol (HTTP), Difference between HTML and HTML5, HTML tags and Formatting elements, HTML Lists – Ordered and Unordered, Creating Hyperlink and Anchor. HTML Page layout and Navigation – Tables and forms and media.

CSS: Introduction to CSS, CSS Rules, Pseudo classes and pseudo elements, Selectors, Precedence of Selectors; Cascading; Creating an Embedded Style Sheet; Creating an External Style Sheet; Adding Inline Styles; Using CSS box model for spacing, borders, and backgrounds; Using CSS for page layout; Dealing with fonts, text, images and hyperlinks; Using Lists as Hierarchical Navigation. Styling Forms with CSS. **(10 HRS)**

Unit II

Java Script: Syntax, Client-side v/s server-side java scripting, Native objects, security. Operators – assignment, bitwise, string, ternary, unary and comma. Statements – control, looping, Debugger, Function, Var, Throw and try-catch-finally.

Super Global Objects - \$_GET, \$_POST, \$_REQUEST, \$_FILES, \$_SESSION, \$_COOKIE, \$_SERVER and \$_ENV. **(9 HRS)**

Unit III

Java Script Objects: Methods to create Objects and defining methods, Array, String, Date, Math and Number. JS Browser objects – Windows, History, Navigator and Screen. Document Objects. JS form Validation. JS Cookies and Events.

jQuery UI: Overview of jQuery; Using jQuery Selectors and Filters; Selecting Single and Multiple Elements. Operating on Wrapped Sets; Method Chaining; Accessing Attributes of an Element; Adding and Removing Elements; Setting up JQueryUI; JQueryUI -Interactions, Widgets and Effects. **(10 HRS)**

Unit IV

PHP Basics: Introduction, Principles, Embedding PHP code inside HTML; Types and operators; Integer division, Generating Random numbers; Comparing values with the Spaceship operator; Condition and Looping statements; Arrays and Multi-dimensional arrays; Strings and String functions; Regular Expressions; Date and Time function; Mathematical functions; User-Defined Functions; Return type declarations with compound Types; Scalar Type Hinting; Scalar Parameter and Return Type declarations;

Working with web forms; PHP POST & GET form elements; Validating form data; Understanding magic quotes; Setting default values in forms; Handling Errors, Throwing and Catching Exceptions. Logging exceptions. **(10 hrs)**

Unit V

PHP Intermediate: Classes and Objects Constructors and Destructors Access Specifiers, Static and final modifiers Inheritance and its types Polymorphism, Abstract and Final classes. Anonymous Classes, Generator Return expressions, Generator Delegation.

Using MySQL: Database Basics, Configuring PHP for Database Support, Managing Database Connections, PHP's Database & SQL APIs, Performing Queries, Processing Result Sets, PDO. PHP cookie handling; PHP session handling; Reading & writing; files with PHP; Processing uploaded files; Retrieving uploaded files; Mail functions. **(9 hrs)**

Textbook:

- [1] Robin Nixon, "Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5", 5th Ed, 2018, O'Reilly Publishers.
- [2] Christopher Murphey, R Clark, "Beginning HTML 5 and CSS 3", 1st Ed, 2015, Wiley Apress.

Reference Books:

- [1] Steve Prettyman, "Learn PHP 7: Object Oriented Modular Programming using HTML5, CSS3, JavaScript, XML, JSON, and MySQL", 2016, Apress.
- [2] Vaibhav Vinayak, Hiren Jayantilal, Rajendra Patil, "Web programming with HTML5, JavaScript and PHP", 2017, SPD Pvt. Ltd.
- [3] Simon Sarris, "HTML5 Unleashed", 2014, Pearson Education.
- [4] Piotr Sikora, "Professional CSS3", 2016, Packt Publishing.
- [5] Joel Murach, Ray Harris, "Murach's PHP and MySQL", 2nd Ed, 2014, Mike Murach & Associates
- [6] Anirudh Prabhu, "Beginning CSS Preprocessors: With SASS and Less", 2015, Apress.
- [7] Eric Sarrion, "jQuery UI", 2014, Oreilly Publishers.

CA 7423 [E3]: WEB APPLICATION DEVELOPMENT USING PYTHON

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives:

- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Indicate the use of regular expressions and built-in functions to navigate the file system.
- Infer the Object-oriented Programming concepts in Python.
- Learn to build web applications using Djnago framework

Learning Outcomes: At the end of this course students will be able

- To understand why Python is a useful scripting language for developers.

- To learn how to design and program Python applications.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to use indexing and slicing to access data in Python programs.
- To define the structure and components of a Python program.
- To learn how to write loops and decision statements in Python.
- To learn how to write functions and pass arguments in Python.
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- To learn how to design object oriented programs with Python classes.
- To learn how to use class inheritance in Python for reusability.
- To learn how to use exception handling in Python applications for error handling.
- To develop a secure and robust web applications using Django framework

Unit I

Introduction to Python: Installation and Working with Python, Understanding Python variables, basic operators, blocks. Declaring and using Numeric data types: int, float, complex, using string data type and string operations, defining list and list slicing, Use of Tuple data type.

Program Flow Control & Functions: Conditional blocks using if, else and elif, for loops in, for loop using ranges, use of while loops in python, Loop manipulation using pass, continue, break and else. Organizing python codes using functions, organizing python projects into modules, importing own module as well as external modules, Understanding Packages.

(10 hrs)

Unit II

String, List, Dictionary & File handling: Understanding in-built string methods, List manipulation, Dictionary manipulation. Programming using string, list and dictionary in-built functions. Reading files in python, writing files in python, Understanding read and write functions, manipulating file pointer using seek, Programming using file operations.

OO Programming & Regular Expressions: Concept of class, object and instances, constructor, class attributes and destructors, Inheritance, overlapping and overloading operators, Adding and retrieving dynamic attributes of classes. Pattern matching and searching, Power of pattern searching using regex in python, Pattern finding programs using regular expression.

(10 hrs)

Unit III

Exception Handling & Database Interaction: Avoiding code break using exception handling, Safe guarding file operation using exception handling, Handling and helping developer with

error code. SQL Database connection using python, Creating and searching tables, Reading, storing and updating information on database. **(10 hrs)**

Unit IV

Web development using Python and Django Framework: Introduction to Python Web Development, Libraries, Various Python Frameworks for Web Development and their features, Introduction to Django Framework, Django installation and configuration, Django project structure **(9 Hrs)**

Unit V

Django Models and HTML forms:, Django Models , Registering the models with the admin site, generic class-based views, adding session framework, user authentication and permissions, Working with HTML forms in Django **(9 hrs)**

TEXT BOOK

- [1] R. Nageswara Rao, "Core Python Programming", 2nd Edition, Dreamtech Press
- [2] Michel Anders , "Python 3 Web Development Beginner's Guide", Packt Publishing

REFERENCE BOOKS:

- [1] Eric Matthes, "Python Crash Course, 2nd Edition: A Hands-On, Project-Based Introduction to Programming", No Starch Press; 2 edition
- [2] Zed A. Shaw, "Learn Python 3 the Hard Way", Addison Wesley, 2017
- [3] John M Zelle, "Python Programming: An Introduction to Computer Science", Ingram short title
- [4] Jeff Forcier, Paul Bissex, Wesley J Chun "Python Web Development with Django"
- [5] Sanjeev Jaiswal, Ratan Kumar "Learning Django Web Development", PACKT publishing

CA 7P1 & CA 7P2: DBMS and Data Structures Lab

CA 7P3 & CA 7P4: Advanced Java & Web Application Development Lab

CA 7523 [E1]: STATISTICAL TECHNIQUES FOR COMPUTING

Total no of lectures: 39	Total marks : 100	[L – T – P –S]
No of lectures / week: 3	Credits: 3	[3 – 1 – 1 – 1]

Learning Objectives:

The objective of this course is to frame real life problems in appropriate statistical terms in order use data to make better decisions. This also gives make sense of data along with the basics of regression analysis They will develop critical and integrative thinking in order to communicate

the results of the analysis clearly in the context of the problem. This course will help to unambiguously articulate the conclusions and limitations of the analysis with a clear separation between data and judgment.

Learning outcomes:

- Select appropriate statistical techniques for summarizing and displaying data
- Analyze and draw inferences from data using appropriate statistical methods.
- Analyze the dispersion in the data and draw inference.
- Understand the concept of a frequency distribution for sample data, and be able to summarize the distribution by diagrams and statistics.
- Understand correlation and regression, and be able to make predictions and understand their limitations.

UNIT I

Classification, tabulation and graphical representation of data: types of data, measurement of data, Classification of data, preparation of tables, presentation of data, Data summarization, frequency distribution, Relative frequency, cumulative frequency,

Data Visualization: Tables, Graphs, Charts, Histograms: when do we use them and the interpretation, bar charts: need and importance, simple bar, composite bar, double bar charts, Pie charts, stem and leaf display, scatter plot and Storytelling with Data.

10hrs.

UNIT II

Measure of central tendency: need, importance and Characteristics, Mean: Arithmetic mean, Geometric mean, Harmonic mean, Weighted mean, Combined mean, Median, Mode of grouped and ungrouped data, quartiles, deciles, percentiles, merits and demerits, properties and applications.

10hrs.

UNIT III

Measure of Dispersion: need, importance and properties, range, interquartile deviation, quartile deviation, mean deviation, variance, standard deviation, coefficient of variation, combined variance of grouped and ungrouped data, Identifying outliers: boxplot, merits and demerits.

9hrs.

UNIT IV

Regression: scatter diagram and interpretation, Simple linear regression model definition and assumptions, regression line x on y and y on x , regression coefficients, method of least squares to fit a regression line, properties of regression coefficient, multiple regression (2 independent variables), applications.

9hrs.

UNIT V

Correlation: Graphical representation and interpretation, correlation coefficient, correlation of bivariate data, relationship between correlation coefficient and regression coefficients, rank correlation, and problem of tied observations.

Analysis of categorical data: two-way Contingency table, odd's ratio, measure of association: types of association, Yule's Coefficient of Association, Coefficient of Colligation, test of independence: Chi Square test. **10hrs.**

Text books:

1. Mathematical Statistics and data Analysis, Rice, John A, Cengage learning, 2014
2. Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, John Wiley & Sons, Inc, 2011

Reference books:

1. Probability & Statistics for Engineers & Scientists, N Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, 9th edition, Prentice Hall, 2011.
2. A Modern Introduction to Probability and Statistics Understanding Why and How, F.M. Dekking C. Kraaikamp H.P. Lopuhaa, L.E. Meester, Springer, 2005.
3. Introduction to the Statistical Analysis of Categorical Data, Erling B. Andersen, Springer, 1997.

CA 7523 [E2]: PROBABILITY AND STOCHASTIC PROCESS

Total no of lectures: 39

Total marks: 100

[L - T - P - S]

No of lectures / week: 3

Credits: 3

[3 - 1 - 1 - 1]

Learning Objectives: This course deals with basic concepts of probability theory and random variables, How to deal with multiple random variables? Conditional probability and conditional expectation, joint distribution and independence.

Learning outcomes:

- Introduction to the basic concepts of probability and their importance.
- Understand the principles of probability and the concept of probability distributions,
- To be familiar with Binomial, Poisson, Geometric, Normal and Exponential probability distributions and their applications.
- To be familiar with the random variables and their use.
- Understand the concept of Markov chains and study the transition diagram.

UNIT I

Introduction to basic concepts: Elements of set theory: subset, proper subset, Cartesian product and its properties, Venn diagram and operation on sets, permutations and combinations. Trial, random experiment, sample space, random sampling with and without replacement, Event- types, independent events, dependent events, mutually exclusive events, equally likely events, Birthday paradox **9hrs**

UNIT II

Probability: Mathematical, statistical and axiomatic definition, addition theorem of probability, multiplicative(compound) theorem of probability, odds in favor and odds against, conditional probability, De-Morgan's law, Results of probability and their proofs, Bayes' theorem, Applications. **9hrs**

UNIT III

Random variables: one Dimensional random variables, discrete and continuous, probability mass function, probability density functions, distribution function. Expectation: properties, mean, variance. Two dimensional random variable: joint density and mass function, joint distribution function, marginal distribution, conditional distribution, independence of random variables. **9hrs**

UNIT IV

Probability distributions: Discrete distribution and their properties, Bernoulli, Binomial: mean, variance, approximation to Poisson distribution, fitting of binomial distribution. Poisson: mean and variance, approximation to Normal distribution, fitting of Poisson distribution. Geometric: mean and variance, memory less property and its application, Continuous distribution: exponential mean, variance distribution function, fitting of exponential distribution, Normal: mean, variance distribution function, fitting of normal distribution. **11hrs**

UNIT V

Stochastic process: introduction, classification of stochastic process based on state and parameter space, Markov chains, transition probability and matrix, Gambler ruin, Brand switching, Chapman-Kolmogorov equations, Period of a state, classification of states and chains: transient and persistent, positive recurrent and null recurrent, reducible and irreducible, ergodic, regular and stationary distribution. **10hrs**

Text books:

[1] Probability and Statistics for Computer Scientists, Michael Baron, CRC press, 2014.

- [2] Applied Probability and Stochastic Processes, Frank Beichelt, CRC press, 2016.
- [3] Fundamentals of Probability with Stochastic processes, Saeed Ghahramani, CRC press, 2015.

Reference books:

- [1] Probability and statistics, Degroot, Morris H;Schervish, Mark J, Pearson Education,2017.
- [2] Probability and statistics, Kumar, Mukesh; Singh, A P; Kumar, Ashok; Chauhan, Anand, 2018
- [3] Probability and statistics with reliability queuing and computer science applications, Trivedi, Kishor S, Wiley India Pvt Ltd, 2014.

CA 7523 [E3]: OPERATIONS RESERACH

Total no of lectures: 39	Total marks: 100	[L - T - P - S]
No of lectures / week: 3	Credits: 3	[3 - 1 - 1 - 1]

Learning Objectives: This course deals with the various techniques to find the optimal solution. It helps to introduce how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science. This course focuses on mathematical modeling. A strong emphasis will be given to model formulation.

Learning outcomes:

- Proficiency with tools for optimization
- Facility with mathematical and computational modeling of real decision-making problems.
- To proficiently allocate scarce resources to optimize and maximize profit or minimize loss
- Facilitates the optimal method of allocating jobs to persons.
- Turn real life problems into formulation of models to be solved by linear programming

UNIT I

Introduction: Nature and Significance of OR in Decision Making, definitions, phases of operations research, Scientific Methods in Operations Research, Models in Operations Research, Application Areas of OR in Management.

Linear programming: Formulation, Assumptions, Standard and matrix form, Graphical solution, Simplex method (Maximization case) – unique solution, multiple solution and unbounded solution, Use of case studies for Illustration.

10hrs

UNIT II

Transportation Problem: Concepts, Formulation of Transportation Problem, Mathematical form, LPP form, Balanced and Unbalanced Problems, Minimization and Maximization Problems, North -West Corner Rule, matrix minima method, row minima method, column minima method, Vogel's Approximation method (VAM) initial solution, MODI method for optimality, unique solution, multiple solutions, unbalanced problems, prohibited routes, degeneracy – initial and intermediate stage, maximization.

10hrs

UNIT III

Assignment Problem: Concepts, Mathematical Formulation of an Assignment Problem Mathematical form, LPP form, special case of Transportation problem, The Assignment Algorithm Hungarian method – unique solution, multiple solutions, Balanced and Unbalanced Assignment Problems, restricted assignment problems, case of maximization. Travelling Salesman problem as an Assignment Problem

10hrs

UNIT IV

Decision theory: Decision making process, types of decision making, One stage decision making problems, payoff and regret tables. Decision making under uncertainty – Laplace principle, maximin or Minimax principle, Maximax or Minimin principle, Hurwicz Principle. Decision making under risk –expected monetary value, expected monetary loss, expected value of perfect information, posterior probabilities and Bayesian analysis. Multistage decision making problems- decision tree, Illustrations.

9hrs

UNIT V

Job sequencing: Sequencing problem, Johnson's Algorithm for processing n jobs through 2 machines, Algorithm for processing n jobs through 3 or more machines, Processing n jobs through m machines.

Queuing theory: Introduction, components, structure, characteristics, measures of performance, Kendall 's notation, classification of queuing models: MM1: FCFS / ∞ / ∞ , M/M/1: FCFS/N/ ∞ , MMC: FCFS/ ∞ / ∞ , Applications to real life problems.

9hrs

Text books:

- [1] Operations research, Mote, Vasant Lakshman; Madhavan, T, Wiley Pvt ltd, 2016
- [2] Operations research an introduction, Handy A Taha ,Pearson education, 10th edition, 2019.

Reference Books:

- [1] Operations Research Theory and Applications, J K Sharma, Macmillan publishers, 5th edition, 2013.
- [2] Optimization techniques in operations research, Gupta C B, I K international publishing house,
- [3] Operations Research, Prem Kumar Gupta, D S Hira , S. Chand Publishing, Year: 2014.

CA 7623: ENTREPRENEURSHIP AND INNOVATION**Total no of lectures: 36****Total marks: 100****[L - T - P -S]****No of lectures / week: 4****Credits: 3****[3 - 1 - 0 - 1]**

About the Course: This course is the first of a two-part entrepreneurship development curriculum from Wadhvani Foundation. It is aimed at empowering you with an entrepreneurial mindset and business skills to enhance your job prospects, help you develop intrapreneurship skills, and get you started on the entrepreneurship journey. You will also learn about the risks and rewards in choosing entrepreneurship as a career option.

This is not a theoretical course – you will actually start your venture and build it as you progress through this course. The course follows the “Watch – Think – Do – Explore – Collaborate” pedagogy in a highly experiential learning format. Every lesson has one or more videos/animations to help you understand and master key entrepreneurship concepts. The videos have been interspersed with knowledge check questions at strategic points – these will help you reflect on the concepts presented, and internalize them. You also get to experience entrepreneurship through the activities and assignments provided throughout the course. Additionally, if you want to dig deeper and learn more, read through the reference materials provided.

You will start this course by discovering yourself and your entrepreneurial style. You will then identify a problem “worth” solving, delve into the problem to understand it better through Design Thinking principles, generate ideas to solve that problem using Brainstorming, and go on to develop your Business Model.

1. **Self-Discovery** : Finding your flow, Effectuation, Principles of Effectuation, Class Activity – Take stock of your means; Case Study on Effectuation, Entrepreneurial Style – Entrepreneurial Style Introduction, Different Entrepreneurial Styles, Class Activity – Entrepreneurial Style Quiz; Master Class – Team Formation, Student Handout – Form Teams and Assign Roles – Process Flow, Form Teams and assign roles – Framework. Case Study – Entrepreneurial Journey

2. **Opportunity Discovery** – Identify Problems worth Solving, Class Activity – Identifying Problems worth Solving; Design Thinking – Introduction to Design Thinking, Value of Design Thinking, Design Thinking Process, Student Activity – Applying Design Thinking, Case studies; Look for Solutions – Brainstorming Concept, Class Activity – Brain Storming. Case Studies
3. **Customer and Solution** – Customers and Markets; Customer Vs Consumer, Types of Start ups, Class Activity – Customer Vs Consumer; Market Types; Identify your Customer Segments and Niche – Segmentation and Targeting, Identify your customer segment, Niche Marketing, Class Activity – Find your Niche; Identify Jobs, Pains and Gains and Early Adopters – Value Proposition Design, Introduction and Concept; Customer Segment Concept and Example; Class Activity – Customer Jobs, Pains and Gains; Identify your Early adopters, Creating Personas. Craft your Value Proposition – Value Proposition and assessing Fit, Value Proposition Examples, Student Activity – Craft my value proposition; Outcome driven innovation – Class activity on Outcome driven Innovation; Present your value proposition Canvas (VPC). Case studies.
4. **Business Model** – Business Models, Tesla Case study, Lean Approach, Identifying the problem, solution and Customer segments to the venture; Observe / Research Business Models; Capture your Business Model; Business Models, Sketching the Lean Canvas; Lean Canvas Template, Case Studies – Airbnb, Facebook, Starbucks; Risks and Assumptions, Tips to prioritize the Risks and Assumptions, Identifying the Riskiest Assumptions; Pitch your Business Model; Case Studies.
5. **Validation** – Blue Ocean Strategy, Blue Ocean Strategy Example; Plot the strategy Canvas, Build your Solution Demo and conduct Solution Interviews; Class Activity – Build your Solution Demo Mock ups; Problem Solution Fit; Building an MVP -MVP How to build a start up, Difference between Solution Demo and MVP, Class Activity – Identify your MVP and Build it; Tips for prototyping and MVP, Class Activity – Compile your results from MVP interviews; Present your MVP
6. **Money** – Cost Structure, Basic Financial Template, Class Activity – Estimate your Costs; Pricing; Revenue Streams; Class Activity – Identify your Secondary Revenue Stream, Estimate your revenue and Price; Profitability Checks; Bootstrapping – Sources and Uses of Funds; Case Studies on Bootstrap Finance; Student activity – Identify Sources and use of funds; Practice Pitching; Case Studies – How to Bootstrap and get initial funding for the company; Best Practices for pitching with investors.
7. **Team** - Shared Leadership, Adopting Shared Leadership Student Activity – Adopting Shared Leadership, Shared Leadership and Team Building; Hiring & Fitment, Team Role

and Responsibilities – Identifying Co-Founders and Hiring a Team; Student Activity – Identify Job roles for Hiring. Practice Pitching; Collaboration Tools and Techniques.

8. **Marketing Sales** - Positioning and Branding – What is Branding, Create Brand Strategy, Creating your Positioning statement; Channels, Selecting your Channels, Sales Planning – Why Customers wont Buy? -Introduction, Switching Costs, Psychological Biases, How Customers Buy – Patterns; Customer Acquisition, Make your Sales Plan and Sales Pitch; Selling Skills – One to One Selling Skills,
9. **Support** – Project Management, Project Tracking, List of Required Registrations, Compliance Checklist, Interviewing Entrepreneurs and Business Owners; Why Compliance; Types of Organizations and setting up; Business Structures and Legal Entities; Different Legal Entities- A comparative note; Getting Started with your Venture – How to get help to get started. Case Studies

Text Book:

- [1] Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters, Dean A. Shepherd, “Entrepreneurship, 6th Edition, 2013, Tata McGraw Hill Publishers
- [2] Rajeev Roy, “Entrepreneurship”, 2nd Edition, 2011, Oxford University Press
- [3] C B Gupta, N P Srinivasan, “Entrepreneurship Development in India”, 1st Ed, 2013, Sultan Chand

Reference Books:

- [1] Bruce R Barrianger, “Entrepreneurship: Successfully Launching New Ventures”, 3rd Ed, 2011, Pearson
- [2] Arya Kumar, “Entrepreneurship: Creating and Leading an Entrepreneurial Organization”, 2012, Pearson
- [3] D F Kuratko, Rao, “Entrepreneurship: A South Asian Perspective”, 1st Ed, 2012, Cengage Learning
- [4] N V R Naidu, T Krishana Rao, “Management and Entrepreneurship”, 1st Ed, 2008, IK International
- [5] Jack m Kaplan, “Patterns of Entrepreneurship”, 1st Edition, 2007, Wiley India
- [6] Madhurima Lal, shikha Shai, “Entrepreneurship”, 2nd Ed, 2008, Excel books

II Semester

CA 8123 [E1]: CLOUD COMPUTING WITH AMAZON WEB SERVICES

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives:

Unhindered by typical IT restraints like configuring servers, storage and virtual machines, developers at born-on-the-cloud start-up companies can move from concept to development to market in a matter of weeks, taking home Internet-sized returns on byte-sized investments. Sure, it works for start-ups. But is it possible to create a “lean” enterprise? So, the students are exposing to learn the newest technology like AWS. With cloud computing in education, you get powerful software and massive computing resources where and when you need them. Analyze the components of cloud computing showing how business agility in an organization can be created ,

Learning Outcomes

- Understand the basic concepts of cloud computing, cloud security and Technologies required for enabling cloud computing
- Learn about AWS terminology and identity access management
- Acquaint yourself with important elements of the cloud with features such as computing, ELB, and VPC
- Back up your database and ensure high availability by having an understanding of database-related services in the AWS cloud
- Integrate AWS services with your application to meet and exceed non-functional requirements
- Create and automate infrastructure to design cost-effective, highly available applications

Unit 1

Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies. Virtualization : Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology **(10 hrs)**

Unit II

Cloud Computing Architecture, Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and

Fault Tolerance Security, Trust, and Privacy Organizational Aspects, Principles of Parallel and Distributed Computing- Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing **(10 hrs)**

Unit III

Energy efficiency in clouds . Energy-efficient and green cloud computing architecture, Market-based management of clouds, Market-oriented cloud computing, Reference model, A reference model for MOCC , Technologies and initiatives supporting MOCC , Federated clouds/InterCloud-Characterization, Cloud federation stack, Aspects of interest, Technologies for cloud federations, Third-party cloud services. Cloud Applications- Scientific applications(Healthcare, Biology, Geoscience), Business and consumer applications **(10 hrs)**

Unit IV

Designing Cloud Applications: Introducing cloud-based multitier architecture , Designing for multi-tenancy , Understanding cloud applications design principles Understanding emerging cloud-based application architectures , Estimating your cloud computing costs , A typical e-commerce web application, AWS Components, Managing costs on AWS Cloud, Application development environments **(9 hrs)**

Unit V

Scalability: Objectives, Designing scalable application architecture, Leveraging AWS infrastructure services for scalability, architecture –increasing loads, Event handling at scale . High Availability: Objectives, Nature of failures, AWS High availability architecture, Security – Security objectives, Best practices in implementing AWS security **(9 hrs)**

Text Books

- [1] Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, “Mastering Cloud Computing”, 1st Edition, 2015, Tata Mcgraw Hill Publishing Co Ltd
- [2] Aurobindo Sarkar, Amith Shah “Learning AWS” Second edition 2018, Packt Publishing Ltd

Reference Books

- [1] Atul V. Mistry ,”Expert AWS Development”, Packt Publishing Ltd ,First edition 2018
- [2] Kris Jamsa, “Cloud Computing”, 1st Edition, 2013, Jones & Bartlett Publishers
- [3] Anthony T Velte, “Cloud Computing: A practical Approach”, 1st Ed, 2010, Tata McGraw Hill.
- [4] Fern Halper, Kaufman, Bloor Robin, Hurwit, “Cloud Computing for Dummies”, 1st Ed, 2010, Wiley
- [5] Joshy Joseph , Craig Fellenstein, “Grid Computing”, 4th Ed, 2013, PearsonAsia
- [6] Ahmar Abbas, “Grid Computing: A Practical Guide to technology and Applications”, 2010, CRC Press
- [7] Kaittwang Geoffrey C.Fox, Jack J Dongrra, “Distributed and Cloud Computing”, 1st Ed, 2012, Elsevier

CA 8123 [E2]: Grid and Cluster Computing

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives:

The Learning objectives are to:

- Expose the characteristics of cluster and grid computing.
- Explore the design principles of grid computing;
- Illustrate security mechanisms in grid computing applications
- Illustrate data management in grid computing applications

Learning Outcomes:

At the end of the course students are able to

- understand fundamentals of cluster computing and Environments
- To enable resource sharing across networks.
- To integrate heterogeneous computing systems and data resources with the aim of providing a global computing space.
- To manage and schedule the resources in grid environments.
- To know the standards and protocols used.
- To Know the middleware in grid computing.
- To understand the latest advances in the field of computation to optimize the utilization of resources.

UNIT 1

Overview of Cluster Computing, Cluster Computer and its Architecture, Clusters Classifications, Components for Clusters, Cluster Middleware and SSI, Resource Management and Scheduling, Programming, Environments and Tools, Cluster Applications, Cluster Systems

(9 hrs)

UNIT II

Introduction to grid computing, cluster computing, parallel computing and high performance computing. **Types of grids** :: departmental grids, enterprise grids, extraprise grids, global grids, compute grids, data grids and utility grids. **Grid environment** : standard environment, local implementation, remote implementation, **Layered grid architecture**, **OGSA** : service instance semantics, service data semantics, OGSA porttypes future discussion on OGSA, **WSRF**:: Introduction to WSRF, the WS-Resource concept, the implied WS-Resource pattern, Grid computing challenges, Grid applications characteristics

(10 Hrs)

UNIT III

Grid Monitoring Architecture (GMA) :: consumer – consumer steps , the directory service – functions supported by directory service, producers – producer steps and monitoring data- time related data , information flow data and monitoring categories

An Overview of Grid Monitoring Systems – GridICE –

overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

JAMM –overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

MDS3 – overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

Network Weather Service –overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

R GMA – overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

Ganglia and GridMon: overview, general architecture ,scalability and fault tolerance, monitoring and extensibility , data request and presentation, searching and standards , security , software implementation

Hawkeye: overview, general architecture, scalability and fault tolerance, monitoring and extensibility, data request and presentation, searching and standards, security , software implementation

Network weather service: overview, general architecture, scalability and fault tolerance, monitoring and extensibility, data request and presentation, searching and standards, security, software implementation

(10 Hrs)

UNIT IV

Security primer, - confidentiality, integrity, availability, authentication, authorization, assurance, non repudiation, auditability , trust , reliability and privacy

cryptography :: introduction, symmetric cryptosystems, asymmetric cryptosystems, digital signatures, public key certificate, certification authority , firewalls,

Grid security

The grid security infrastructure (GSI) – Gsi, introduction, mutual authentication through digital certificates , credential delegation and single sign on

Authentication modes in GSI:: Server side authorization, client side authorization

Job scheduling and resource management: Scheduling Paradigms - centralized scheduling, Distributed scheduling and Hierarchical scheduling. How scheduling works – Resource discovery , resource selection, schedule generation, job execution

Job scheduling and resource management: A review of condor, Condor platforms, the architecture of condor pool, Daemons in a condor pool, job life cycle in condor, security management in condor , job management in condor , resource management in condor, job scheduling policy in condor , resource matching in condor, condor support in globus. Condor G review of SunGridEngine;The SGE architecture, Daemons in an cluster, job management in SGE, job runtime environments in SGE, job selection and resource matching in SGE

Review of The Portable Batch System: The PBS architecture, Daemons in PBS, job selection and resource matching in PBS

Job scheduling and resource management: Grid scheduling with QOS :: apples, scheduling in GrADS, Nimrod/G, scheduling with heuristics **(10 Hrs)**

UNIT V

Data Management –Categories and Origins of structured Data, Data management Challenges, Architectural Approaches – Collective Data Management Services- Federation Services

List of globally available grid Middlewares – Case Studies-Current version of Globus

Toolkit and gLite - Architecture, Components and Features. **(09 Hrs)**

Text Book:

- [1] Maozhen Li , Mark Baker ,The grid core technologies , 1st edition, 2005Wiley-India edition
- [2] Laurence T.Yang, Minyi Guo – High Performance Computing Paradigm and Infrastructure John Wiley

Reference Books:

- [1] www.globus.org
- [2] Joshy Joseph , Craig Fellenstein Grid Computing ,Pearson Education
- [3] Grid computing : a practical guide to technology and applications , AHMAR ABBAS
- [4] Distributed data bases principles and systems by Ceri & Pelagatti (McGraw Hill Publications)
- [5] A.D. Kshemkalyani, M. Singhal, [Distributed Computing: Principles, Algorithms, and Systems](#), Cambridge University Press
- [6] Joshy Joseph and Craig Fellenstein , “Grid Computing” Pearson Education, 2004. 4.Ian Foster, et al,“The Open Grid Services Architecture”, Version 1.5 (GFD.80). Open Grid Forum, 2006.

CA 8123 [E3]: HIGH PERFORMANCE COMPUTING

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objective:

Parallel programming is ubiquitous in today's multi-core era and solves many real-world scientific problems. Massive parallelism entails significant hardware and software challenges. The course is structured so that the participants understand challenges in efficient execution of large-scale parallel applications & design, analysis, and implementation, of high performance computational science and engineering applications. The assignments will be designed to strengthen understanding of parallel programming.

Learning Outcomes:

At the end of the course, the candidate will be able to

- To Study various computing technology architecture.
- To know Emerging trends in computing technology.
- To highlight the advantage of deploying computing technology.
- demonstrate understanding of learned concepts of parallel algorithm design, performance evaluation, communication operators by writing algorithms and programs exploiting parallel architecture
- analyze the efficiency of parallel algorithms designed for matrix, graph and sorting operations

UNIT I

Introduction: Computational Science and Engineering: Computational Science and Engineering Applications; characteristics and requirements, Review of Computational Complexity, Performance: metrics and measurements, Granularity and Partitioning, Locality: temporal/spatial/stream/kernel, Basic methods for parallel programming, Real-world case studies (drawn from multi- scale, multi-discipline applications) **(10 hrs)**

UNIT II

High-End Computer Systems : Memory Hierarchies, Multi-core Processors: Homogeneous and Heterogeneous, Shared-memory Symmetric Multiprocessors, Vector Computers, Distributed Memory Computers, Supercomputers and Petascale Systems, Application Accelerators / Reconfigurable Computing, Novel computers: Stream, multithreaded, and purpose-built. **(10 hrs)**

Unit III

Introduction to Parallel Computing and Programming: Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism, Limitations of Memory system performance, Dictionary

of Parallel Computing Platforms Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process – Processor Mapping and Mapping Techniques.

(10 hrs)

Unit IV

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overloads, Parallel Algorithm Models.

(09 hrs)

Unit V

Sorting and graph algorithms: Matrix Vector Multiplication, Matrix – Matrix Multiplication, Issues in sorting on Parallel Computers, Sorting Networks, Bubble Sort and its variants, Quick Sort, **Graph Algorithms:** Definitions and Representation, Minimum Spanning Tree, Prim’s Algorithm, Single Source shortest path : Dijkstra’s Algorithms All-pairs shortest paths, Transitive closure, Connected Components.

(09 hrs)

Text Book:

- [1] A Grama et.al – Introduction to Parallel Computing, 2nd ed. Pearson Education, New Delhi 2003.
- [2] Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman & Hall/CRC Computational Science Series, 2007

Reference Books:

- [1] M.J. Quinn – Parallel Computing : Theory and Practice, 2nd ed., McGraw Hill, New York, 1994.
- [2] Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
- [3] DE Culler, A Gupta and JP Singh, Parallel Computer Architecture: A Hardware/Software Approach Morgan-Kaufmann, 1998.
- [4] Marc Snir, Steve W. Otto, Steven Huss-Lederman, David W. Walker and Jack Dongarra, MPI - The Complete Reference, Second Edition, Volume 1, The MPI Core.
- [5] L Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Ed., Morgan Kaufmann/Els India, 2006.

CA 8223 [E1]: SOFTWARE ENGINEERING and UML

Total No. of Lectures: 48	Total Marks: 100	[L – T – P – S]
No. of Lectures/Week: 4	Credits: 4	[3 – 1 – 0 – 2]

Learning Objectives: Knowledge of basic SW engineering methods and practices, and their appropriate application. A general understanding of software process models such as the

waterfall and evolutionary models. Understanding of software requirements and the SRS documents. The student shall be able to take up a software projects and plan, develop and estimate its cost.

Learning outcomes: Upon completion of this course, students should be able to:

- Plan and deliver an effective software engineering process, based on development lifecycle models.
- Employ group working skills including general organization, planning and time management and negotiation.
- Apply software engineering principles and techniques.
- Understand the principles of large-scale software systems, and the processes that are used to build them
- Analyze a problem, and identify and define the computing requirements appropriate to its solution.
- Design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- Function effectively on teams to accomplish a common goal.

Unit – I

Introduction: Software, Software Engineering - Definition; Phases in the Software Engineering; Key Challenges in Software Engineering; Software Engineering Life Cycle.

Basics of Software Engineering: Software process models; Software Engineering Terminologies, software cost estimation.

Software Requirements: Software Requirements, Feasibility Study, Requirements Elicitation; Requirement Analysis, Analysis Patterns, Requirement Specification - SRS, Requirement Validation, Requirement Management, Requirement Engineering Tools. **(9 Hrs)**

Unit – II

Software Process: Process and Process Models, Component software process, Process Specification, Characteristics of Software process, Predictability, Process Improvements and Feedback, Comparison of Process Models.

Software Requirements Analysis and Specification: Software Requirements, Need for SRS, Requirement Process, Problem Analysis – Informal Approach, Data Flow Modeling; Data Flow Diagrams and Data Dictionary; The Structured Analysis Method, Object-Oriented Model.

Requirement Specification: Characteristics of an SRS, Components of an SRS – Functional Requirements, Performance Requirements, Design Constraints, External Interface Requirements; Specification Language. UML Diagrams with Notation. **(10 Hrs)**

Unit – III

Software Design: Software Design Process, Software Design Documents (SDD), Design Methodology – Top-Down Design, Bottom-Up Design, Hybrid Design; Software Design Approaches- Structured Design approach, Object-Oriented Design Approach; Design Notations; Software Implementation;

Software Coding: Features of a Software Code; Coding Guidelines, Coding Methodology; Programming Practice; Software Programming, Programming Paradigm; Code Verification Techniques, Coding Tools, Code Documentation;

Software Testing: Basics, Testing Terms, Testing Process, Testing Methods, Test Plan, Test Case Design, Levels of Testing, Testing Strategies, Testing Techniques, Testing Tools, Test Reports, Case Studies. **(10 Hrs)**

Unit – IV

Software Maintenance: Software Maintenance; Types of Software Maintenance; Life Cycle; Models; Techniques; Tools; Activities; Technology Change Management(TCM); Software Maintenance Documentation.

Software Project Management: Project Management Process – Planning, Organizing, Monitoring, Adjusting; Project Management Techniques – COCOMO, Function Point, Simple technique for Object Oriented; Task scheduling; Project Monitoring;

Software Quality: Quality Concepts; Quality Assurance Group; SQA Activities; Software Reviews; Quality Evaluation; CMM; TQM **(10 Hrs)**

Unit – V

Software Metrics: Software Measurement; Software Metrics; Designing Software Metrics; Classification of Software Metrics – Process, Product, Project; Measuring Software Quality;

Software Scheduling: Project scheduling; Project staffing; People Capability Maturity Model; Risk Management;

Software Cost Estimation: Basics of Cost Estimation; Estimation Process; Decomposition Techniques; Estimation Models; Case Studies **(9 Hrs)**

Text Books:

- [1] R. S. Pressman, “Software Engineering – A Practitioner’s approach”, 7th Ed, 2012, McGraw Hill Int. Ed.,
- [2] Ian Sommerville, “Software Engineering”, 10th Edition, 2013, Pearson Education. Published by Dorling Kindersley (India) Pvt. Ltd.

Reference Books:

- [1] Frank Tsui, Orlando Karam and Barbara Bernal, “Essentials of Software Engineering”, Third Edition, 2015, Jones and Bartlett India Pvt. Ltd.
- [2] Kelkar, “Software Engineering”, 1st Edition, 2010, Prentice Hall of India Ltd.
- [3] K.K. Aggarwal and Yogesh Singh, “Software Engineering”, 3rd Edition, New Age International.
- [4] James Peter, W Pedrycz, “Software Engineering”, 4th Edition, 2011, Wiley India.
- [5] Rohith Kurana, “Software Engineering Principles and Practices”, 3rd Edition, 2011, Vikas

CA 8223 [E2]: OBJECT ORIENTED SOFTWARE ENGINEERING

Total No. of Lectures: 48 **Total Marks: 100** **[L – T – P – S]**
No. of Lectures/Week: 4 **Credits: 4** **[3 – 1 – 0 – 2]**

Learning Objectives: Object-Oriented Software Development is an approach/paradigm of developing software by identifying and implementing a set of objects and their interactions to meet the desired objectives. This course introduces the object oriented software engineering, it

will enable the learner how to use the OO technology efficiently in software design and development process.

Learning outcomes: Upon completion of this course, students should be able to:

- Display understanding and the ability to apply object-oriented programming principles.
- Have detailed knowledge of the software development lifecycle.
- Apply skills relevant for academic progression and career development within the sector.
- Explore and analyze different analysis and design models, such as OO Models, Structured Analysis and Design Models, etc.
- Show an ability to use the graphical UML representation using tools.
- Apply software engineering perspective through software design and construction, requirements analysis, verification, and validation, to develop solutions to modern problems such as security, data science, and systems engineering.

Unit - I

Software Engineering: Introduction; Software Life Cycle Models; Object Oriented Concepts and Modeling - Introduction to Class, Object, Inheritance, Polymorphism; Overview of System Analysis and Design.

Requirement Analysis: Introduction to software specification, its needs and importance, formal specification methods, **SRS:** attributes of good SRS and organization of SRS document.

Introduction to Unified Modelling Language (UML); Diagrams – Notations.

(9 Hrs)

Unit - II

Object Methodology & Requirement Elicitation: Introduction to Object Oriented Methodology, Overview of Requirements Elicitation, Requirements Elicitation Activities, Managing Requirements Elicitation.

Requirement Engineering: Introduction; Requirement Engineering Tasks and Process; Analysis - An Overview of Analysis, Analysis Object Models and Dynamic Models; Process Models and Design Models;

Software Engineering Models: Basic structural Modeling - Classes, Relationships, Common mechanisms, Diagrams, Class diagrams; Advanced Structural Modeling - Interfaces, types and Roles Object diagrams, packages.

(10 Hrs)

Unit - III

System Design: An Overview of System Design, System Design Activities; Identifying Design Goals; Documenting System Design and Reviewing System Design.

Basic Behavioral Modeling: Use cases, use case diagrams, Interaction diagram, Activity diagrams, state chart diagrams, component diagrams, deployment diagrams, Sequence Diagram, patterns and frame works.

A Case Study: (Example: - ATM, Trading System, Banking System, Library Information System, Student Information System etc.).

(10 Hrs)

Unit - IV

Object Oriented Analysis and Design: Analysis and design tools - E-R analysis, Decision tree and decision tables, DFD (physical and logical), Data dictionary-definition, component,

advantages; Input and output design; Components of OO Analysis Models; OOA Process; System Design and Object Design Process;

Software Testing: Testing Fundamentals, White Box Testing, Black Box Testing, software testing strategies, verification and Validation, System Testing, Unit testing, Integration testing and Debugging. Software Maintenance – Maintenance Tasks, Characteristics of a good quality software.

Object Oriented Testing: View of Testing; Testing OOA and OOD Models; OOT Strategies; Test case design for OO Software; Testing Method; Inter class test case design; **(10 Hrs)**

Unit – V

Metrics and Quality: Introduction; Software Quality; Metrics - project based metrics and design based metrics, Process, Products, Resources; Measuring quality ; GQM;

Quality of OOD: Principles of OOD - General Principles, Cohesion Principles, Coupling Principles. Metrics for OO Design - Metrics Design Model, MOOD Metrics Model; Evaluation of OO Metrics;

Quality Management: Process and Product Quality; Quality Assurance and Standards; Quality Planning; Quality Control; Software Measurement and Metrics; **(9 Hrs)**

Text Books:

- [1] Bernd Bruegge and Allen H. Dutoit, “Object-Oriented Software Engineering”, 2nd Edition, Pearson.
- [2] Ali Bahrami, “Object Oriented Systems Development”, 2nd Edition, 2012, McGraw Hill Publishers.

References Books:

- [1] Hans Van VLiet, “Software Engineering – Principles and Practice”, Second Edition, Vrije Universiteit, Amsterdam.
- [2] Waman S. Jawadekar, “Software Engineering – Principles and Practice”, Computer Engineering Series, Tata McGraw-Hill Publishing Company Limited.
- [3] Pankaj Jalote, “An Integrated Approach to Software Engineering”, third Edition, Narosa Publishing House.
- [4] Stephen Schach, “Classical Object Oriented Software Engineering with UML and Java”, 2008, McGraw-Hill.
- [5] Graddy Booch, James Rumbaugh, Ivar Jacobson, “The Unified Modeling Language”, 3rd Edition, 2009, Pearson.

CA 8223 [E3]: AGILE SOFTWARE DEVELOPMENT

Total No. of Lectures: 48 **Total Marks: 100** **[L – T – P – S]**

No. of Lectures/Week: 4 **Credits: 4** **[3 – 1 – 0 – 2]**

Learning Objectives: Examine the common agile development practices and methods, including XP and Scrum; Carry out all stages of an agile software process in a team, to produce working software; Continually negotiate project requirements during an ongoing Scrum framework; use

test driven development to ensure software quality; Utilize CASE Tools during the software development process.

Learning outcomes: Upon completion of this course, students are expected to achieve the following learning outcomes:

- Understand concept of agile software engineering and its advantages in software development.
- Recognize various agile methods.
- Articulate the agile principles, practices, and roles of Scrum.
- Perform Scrum Release Planning, and Scrum Sprint Planning.
- Deconstruct user stories into tasks and ideal day estimates.
- End a Sprint with Sprint Reviews and Sprint Retrospectives.
- Use Scrum with multiple, or distributed, project teams.

Unit - I

Introduction: Why Agile? Agile core terminology; Agile Principles; Development in Agile; Advantages; Disadvantages; Agile methods - Rational Unified Process, Scrum, Crystal Clear, Extreme Programming, Adaptive Software Development, Feature Driven Development, and Dynamic Systems Development Method (DSDM); Benefits of Agile;

Software Development: Product Development; Iterative Development; Iterative Planning – Risk Driven and Client Driven; DSDM - Requirements, principles; Extreme Programming(XP) - supporting practices, Feature Driven Development (FDD) - basic activities; **(10 Hrs)**

Unit - II

Agile and Its Significance: The Agile Manifesto and Principles; Agile software development; incremental model; iteration planning; iterative model; Agile software development approaches; Attributes of Agile Requirements; Quality of Agile Requirements; Requirements Engineering in Agile Software Development - Success Factors, Risk Factors;

Roles for Agile Requirements Engineering: The Stakeholders, Product Owner, Development Team, Scrum Master, Project Stakeholder, Requirements Manager, Scrum Master, System Stakeholder, Team Member - Common Agile Roles **(10 Hrs)**

Unit - III

Agile Methodology: Method overview; Lifecycle – Work products, Roles and Practices values, common mistakes and misunderstanding; Adaptive Software Development – Principle, lifecycle phases, Characteristics; Comparison of agile methods; Sample projects, Process Mixtures;

Agile Project Planning: Gathering User Documents; Estimation; Agile Planning; Iteration Management; Creating an Agile Communication Plan; Visual Workspace **(10 Hrs)**

Unit - IV

Creating Agile Software: Time – Time related problems in Software Projects, Time Management of Agile Project – Time Measurements, Prioritizing Development Tasks, Planning Activities; Measures – Measure Definition, Measure Illustration, Case study – Monitoring a Large-Scale Project by measures; Quality – The Agile approach to Quality Assurance, Process Quality, Product Quality, Test-Driven development;

Agile Testing: Test Plan for Agile, Agile Testing Strategies, The Agile Testing Quadrant, QA challenges with agile software development, Risk of Automation in Agile Process, Advantages of Agile Testing, Disadvantages of Agile Testing, Principles of Agile Testing **(9 Hrs)**

Unit - V

Agile Practicing and Testing: Project Management, Environment, Requirements, Test, The agile alliances, The Manifesto, Supporting the Values, Agile Testing, Nine Principles and Six concrete practices for testing on agile teams. **(9 Hrs)**

Text Books:

- [1] Craig Larman, “Agile and Iterative Development - A Manager’s Guide”, Pearson Education.
- [2] Lisa Crispin, Janet Gregory, Mike Cohn, Brain Marick, “Agile Testing: A Practical guide for Testers and Agile Teams”, Addison-wesley publication.

Reference Books:

- [1] Jonathan Rasmusson, “The Agile Samurai – How Agile Masters Deliver Great Software”, Shroff publishers and distributors Pvt. Ltd. July 2016.
- [2] Hazzan and Dubinsky, “Agile Software Engineering, Series: Topics in Computer Science” Springer 2009.
- [3] Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, 1st edition, PHI.
- [4] Alistair, “Agile Software Development Series”, Cockburn Publishers International.
- [5] Kevin C. Desouza, “Agile information systems: Conceptualization, Construction and Management”, Butterworth-Heinemann Publishers.

CA 8323 [E1]: Mobile Application Development using Android

Total No. of Lectures: 48	Total Marks: 100	[L – T – P – S]
No. of Lectures/Week: 4	Credits: 4	[3 – 1 – 0 – 2]

Learning Objectives:

- To understand the development environments, Architectures and programming paradigms of Android devices.
- To develop an understanding of how to design, implement, and debug/test applications for mobile devices.
- To exploit the many capabilities of modern mobile devices to produce creative solutions to everyday challenges.

- Develop applications that effectively combine mobile device capabilities such as communication, computing, and particularly sensing.

Learning Outcomes: Students must be able to

- Understand the architecture, working and environment setup of Android
- Create simple GUI based Android Apps
- Use the Building Blocks of Android Completely according to its necessity
- Use Widgets and components to create professional android applications
- Work with Databases and advanced sensors of the phone

Unit - I

Introduction to Android - Architecture - Features of Android SDK - Introducing the Development Framework, Developing for Android- Android Development Tools- The Android Virtual Device Manager - Android SDK Manager - The Android Emulator - The Dalvik Debug Monitor Service - The Android Debug Bridge. Installing and Configuring Android SDK, ADT and AVD - Android Software Stack, Dalvik Virtual Machine. **(9 hrs)**

Unit - II

Creating Android Applications: Working of Android Application: Android Application Life Cycle; Building User Interfaces - Introducing Activities, Various Layouts, Fragments, and Adapters. Intents, Intent Filters, Controls, Dialogs, Toasts and Notifications: Displaying Pictures and Menus with Views; Adding Interactivity and Handling UI events. **(10 hrs)**

Unit - III

Building Blocks of Android: Activities: Life Cycle and Working; Broadcast Receivers: Creating, Registering and unregistering a Broadcast Receiver. Content Providers: Concept of Content Resolver, Creating and using Content Providers. Services: Bound Services and Unbound Services, Life Cycle of services **(9 hrs)**

Unit - IV

Data Access in Android: Creating, Saving and Retrieving Shared Preferences; Introducing the Preference Framework and the Preference Activity; Including Static Files as Resources; Working with the File System. Introducing Android Databases; Introducing SQLite; Content Values and Cursors; Working with SQLite Databases; Creating and Using Content Providers; Using Native Android Content Providers. **(10 hrs)**

Unit - V

Advanced Android: Introducing Services, Using Background Threads, Using Alarms; Controlling Device Vibration; Introducing Android Text-to-Speech; Using Sensors and the Sensor Manager; Using Accelerometer, Compass and GPS; Audio, Video and Using the Camera; Using Telephony and SMS.

10 hrs

TEXT BOOKS:

- [1] Reto Meier, Ian Lake, "Professional Android", 4th edition, Wiley Wrox Publications, 2018
- [2] Dawn Griffiths, David Griffiths, "Head First Android Development", 2nd Edition, O'Reilly Media, 2017

REFERENCE BOOKS:

- [1] Bill Phillips, Chris Stewart, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", Big Nerd Ranch Guides; 3rd edition 2017
- [2] John Horton, "Android Programming for Beginners", Ingram short title; 2nd edition, 2018

CA 8323 [E2]: Cross Mobile App Development using React Native

Total No. of Lectures: 48	Total Marks: 100	[L - T - P - S]
No. of Lectures/Week: 4	Credits: 4	[3 - 1 - 0 - 2]

Learning Objectives:

- To Introduce a way to develop cross platform apps just using React Native of Facebook
- To develop an understanding of how to design, implement, and debug/test apps with React Native
- To exploit the many capabilities of modern JavaScript libraries to produce creative solutions to everyday challenges.
- Develop applications that effectively run in any Phone running iOS or Android.

Learning Outcomes: Students must be able to

- Write JavaScript code with ease
- Create simple React JS based Apps
- Understand React Native and write apps that simultaneously work in Android and iOS
- Use Widgets and components to create professional mobile applications
- Dig Deeper into the React Native way of developing apps that can run in multiple platforms

Unit - I

Revisiting JavaScript: Javascript: Overview, Syntax, Variables, Operators, Conditionals, Looping, Functions, Events, Page Redirect, Dialog Boxes, Void Keyword, Page Printing, Objects- Number,

Boolean, Strings, Arrays, Date, Math. RegExp, HTML DOM, Error Handling, Validations and Debugging. **(9 hrs)**

Unit - II

ReactJS: Overview, Environment Setup, JSX, Components, State, Props Overview, Props Validation, Component API, Component Life Cycle, Forms, Events, Refs, Keys, Router, Flux concept, Using Flux, Animations, Higher order, Components. **(9 hrs)**

Unit - III

Introduction to React Native: Introduction, Environment Setup, First App, React Native View, React Native State, React Native Props, React Native Style, Height and Width, React Native Button, Layout and Flexbox, Positioning Element with Flex, React Native ScrollView, React Native ListView, React Native FlatList, React Native SectionList. **(10 hrs)**

Unit - IV

Components and APIs in React Native: React Native Touchables, React Native TextInput, ActivityIndicator, React Native Picker, React Native StatusBar, React Native Switch, React Native WebView, ProgressBar, React Native Animation, React Native Image, APIs, React Native Alert, React Native Geolocation **(10 hrs)**

Unit - V

Advanced React Native: React Native Navigation, Configuring Header Bar, Moving Between Screens, Passing Value b/w Screens, Tab Navigation, Adding Icons at Bottom of Tab Navigation, Create Material Top & Bottom Tab Navigator, Drawer Navigation, Storage, AsyncStorage, AsyncStorage Methods, React Native, Google Maps, React Native Modal, React Native Vector Icons, React Native Splash Screen. **(10 hrs)**

TEXT BOOKS:

- [1] Kirupa Chinnathambi, "Learning React: A hands-on guide to building web applications using React and Redux", Addison-Wesley Professional; 2nd edition, 2018.
- [2] Akshat Paul, Abhishek Nalwaya, "React Native for Mobile Development", Apress; 2nd edition 2019

REFERENCE BOOKS:

- [1] Eric Freeman, Elisabeth Robson, "Head First JavaScript Programming: A Brain-Friendly Guide", O'Reilly Media, 2014
- [2] Adam Boduch, "React and React Native: Complete guide to web and native mobile development with React, 2nd Edition", Packt Publishing, 2018.

CA 8323 [E3]: Mobile App Development for iOS with Swift

Total No. of Lectures: 48

Total Marks: 100

[L - T - P - S]

No. of Lectures/Week: 4

Credits: 4

[3 - 1 - 0 - 2]

Learning Objectives:

- To understand the development environment, Architecture and programming paradigm of iOS devices.
- To develop an understanding of how to design, implement, and debug/test applications for Apple mobile devices.
- To exploit the many capabilities of Swift to produce creative solutions to everyday challenges.
- Develop applications that effectively combine mobile device capabilities such as communication, computing, and particularly sensing.

Learning Outcomes: Students must be able to Understand the working of mobile devices and compare the various architectures available

- Do programming with the Swift Language
- Use advanced concepts of Swift to solve complex issues
- Use Widgets and components to create professional iOS applications
- Develop iOS apps to perform the various advanced tasks like Database handling.

Unit - I

Overview of Mobile Devices: Mobile devices vs. desktop devices - ARM and Intel architectures - Development environments; XCode & Android Studio - Native vs. Web Applications. Comparing and Contrasting architectures of – Android and iOS - Underlying OS (Darwin vs. Linux) - Kernel structure and native level programming - Runtime (Objective-C vs. Dalvik) **9 hrs**

Unit - II

Basics of Swift: Overview, Environment, Basic Syntax, Data Types, Variables, Optionals, Tuples, Constants, Literals, Operators, Decision Making, Loops, Strings, Characters, Arrays, Sets, Dictionaries. **10 hrs**

Unit - III

Advanced Swift: Functions, Closures, Enumerations, Structures, Classes, Properties, Methods, Subscripts, Inheritance, Initialization, Deinitialization, ARC Overview, Optional Chaining, Type Casting, Extensions, Protocols, Generics, Access Control. **10 hrs**

Unit - IV

Introduction to iOS: Basics and Overview of iOS, Environment Setup - Overview of Mac, XCode and Apple Developer Account, Understanding the XCode IDE and its functionalities, iPhone Simulator, First iPhone Application, Introduction to Actions and Outlets, Delegates, Understanding Basic UI Elements, Autorotation and Auto sizing. **9 hrs**

Unit – V

Advanced iOS Concepts: Accelerometer, Universal Applications, Camera Management, Location Handling, SQLite Database, Sending Email, Audio & Video, File Handling, Accessing Maps, In-App Purchase, iAd Integration, Storyboards, Auto Layouts, Twitter & Facebook, Memory Management, Application Debugging.

10 hrs

TEXT BOOKS:

- [1] Greg Lim, “Beginning iOS 13 & Swift App Development”, 2019
- [2] Ahmad Sahar, Craig Clayton, “iOS 13 Programming for Beginners”, Packt Publishing Limited; 4th Revised edition, 2020.

REFERENCE BOOKS:

- [1] Abhishek Mishra, “Swift iOS 24-Hour Trainer”, Wiley Publications, 2016
- [2] Wallace Wang, “Beginning iPhone Development with Swift 5: Exploring the iOS SDK”, Apress; 5th edition, 2019.

CA 8423 [E1]: NATURAL LANGUAGE PROCESSING

Total No. of Lectures: 48

Total Marks: 100

[L – T – P – S]

No. of Lectures/Week: 4

Credits: 4

[3 – 1 – 0 – 2]

Learning Objectives:

- To understand natural language processing and to learn how to apply basic algorithms in this field.
- To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
- To design and implement applications based on natural language processing
- To implement various language Models.
- To design systems that uses NLP techniques

Learning Outcomes:

The students will:

- Have a broad understanding of the field of natural language processing.
- Have a sense of the capabilities and limitations of current natural language technologies,
- Be able to model linguistic phenomena with formal grammars.
- Be able to Design, implement and test algorithms for NLP problems
- Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP

- Be able to apply NLP techniques to design real world NLP applications such as machine translation, text categorization, text summarization, information extraction....

Unit - I

Introduction: History of NLP, Generic NLP system, levels of NLP, Knowledge in language processing, Ambiguity in Natural language, stages in NLP, challenges of NLP, Applications of NLP. Evaluation of NLP System. Speech Processing,

Basic English Concepts: Various Grammar- based Language Models, Sentence, Active and Passive voice, Dictionary Features. **(8 hrs)**

Unit - II

Word Level Analysis: Morphology analysis –survey of English Morphology, Inflectional morphology & Derivational morphology, Lemmatization, Regular expression, finite automata, finite state transducers (FST) , Morphological parsing with FST , Lexicon free FST Porter stemmer. N –Grams- N-gram language model, N-gram for spelling correction.

Syntax Analysis : Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank) , Rule based POS tagging, Stochastic POS tagging, Issues –Multiple tags & words, Unknown words. Introduction to CFG, Sequence labeling: Hidden Markov Model (HMM), Maximum Entropy, and Conditional Random Field (CRF). **(10 hrs)**

Unit - III

Parsing Techniques & Grammar: Parsing Process, Algorithm, Efficient Parsing, Types of Parsing Techniques, Transition networks, Human Parsing, Feature Grammar, Parsing with Unification constraints, Parsing Integration and Unification, Prolog Grammar Parser Generator.

(10 hrs)

Unit - IV

Semantic Analysis: Lexical Semantics, Attachment for fragment of English- sentences, noun phrases, Verb phrases, prepositional phrases, Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy, WordNet, Robust Word Sense Disambiguation (WSD) Dictionary based approach Syntax Driven Semantic Analysis Approach.

(10 hrs)

Unit - V

Knowledge Representation for NLP: Human Language Technology, Information Discovery, issues in Semantic Representation.

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG.

Machine Translation: Problems in Machine Translation- Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages

Pragmatics: Discourse –reference resolution, reference phenomenon, syntactic & semantic constraints on coreference **(10 hrs)**

Text Books:

- [1] Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 2nd Ed, 2014, Pearson Education.
- [2] James Allen, "Natural Language Understanding", 2nd edition. Benjamin Cummings publishing.

Reference Books:

- [1] Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
- [2] Manning, Christopher and Heinrich, Schutze, "Foundations of Statistical Natural Language Processing", 2016, Create Space Independent Publishing Platform.
- [3] Jacob Eisenstein, "Introduction to Natural Language Processing", 2019, MIT Press
- [4] Carol Genetti, "How Languages Work: An Introduction to Language and Linguistics, 2019, Cambridge University Press.

CA 8423 [E2]: IMAGE PROCESSING AND PATTERN RECOGNITION

Total No. of Lectures: 48	Total Marks: 100	[L - T - P - S]
No. of Lectures/Week: 4	Credits: 4	[3 - 1 - 0 - 2]

Learning Objectives:

- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- Students will learn importance of pattern recognition in various applications.
- Students will learn how to classify patterns.

Learning Outcomes:

The students will be able to:

- Understand image formation, role human visual system plays in perception of gray and color image data.
- Apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Design image analysis techniques, image segmentation and to evaluate the Methodologies for segmentation.
- Conduct independent study and analysis of feature extraction techniques.
- Apply different de-noising models to recover original image.

- Identify different pattern recognition methods and apply them in problem areas.

Unit - I

Digital Image Processing: Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.

Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Formation Model, Sampling and Quantization, Representing Digital Images, Spatial and Gray-level Resolution, Zooming and Shrinking, Basic Relationships Between Pixels, Linear and Nonlinear Operations.

(9hrs)

Unit - II

Image Enhancement in the Spatial Domain: Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Combining Spatial Enhancement Methods.

Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Frequency-Domain Filters, Homomorphic Filtering.

Image Restoration: Image degradation/Restoration process, Noise Models, Restoration in, Periodic Noise Reduction, Degradations, Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Least Square Filtering, Geometric Mean Filter.

(10hrs)

Unit - III

Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation.

Image Feature Extraction: Image Features and Extraction–Image Features– Types of Features– Feature Extraction–SIFT, SURF and Texture–Feature Reduction Algorithms

Image Representation: Representation, Boundary Descriptors, Regional Descriptors

(10hrs)

Unit - IV

Introduction to Pattern Recognition : Elements of Image Analysis, Introduction to pattern classification Feature selection and extraction, Supervised and Unsupervised Parameter estimation Basic concepts- Structure of a typical pattern recognition system Feature vectors , Feature spaces , Pattern classification by distance functions - Minimum distance classification - Cluster algorithms

(10 hrs)

Unit - V

Pattern Classification: Pattern classification using Statistical classifiers and Bayes' classifier Classification performance measures - Risk and error probabilities. Fuzzy classification - Fuzzy

clustering - Fuzzy pattern recognition - Syntactic pattern recognition. Application of pattern recognition (9hrs)

Text Books:

- [1] Rafael C Gonzalez and Richard E. Woods: "Digital Image Processing", 4th Edition, 2018, Pearson Publication.
- [2] Sergios Theodoridis, Konstantinos Koutroumbas, "Pattern Recognition", 5th Edition, 2018, Academic Press.

Reference Books:

- [1] Scott. E. Umbaugh, "Digital Image Processing and Analysis", 3rd Edition, 2017, CRC Press
- [2] M. Sonka Milan, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", 4th Edition, 2014, Cengage Learning
- [3] Rafael C. Gonzalez, Richard Eugene Woods, "Digital Image Processing Using MATLAB", 2nd Edition, 2013. Tata McGraw Hill Ed.
- [4] Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing: A Practical Approach with Examples".
- [5] W. K. Pratt, Introduction to "Digital Image Processing", 2014, CRC Press.
- [6] Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Ed, 2012, John Wiley & sons
- [7] Christopher M. Bishop, "Pattern Recognition and Machine Learning", 2016, Springer.

CA 8423 [E3]: Bioinformatics Algorithms, Databases and Tools

Total No. of Lectures: 48	Total Marks: 100	[L - T - P - S]
No. of Lectures/Week: 4	Credits: 4	[3 - 1 - 0 - 2]

Learning Objective: The subject aims to introduce students to

- Understand fundamentals concepts in Bioinformatics
- Have an overview of the most important methods and tools used
- Appreciate the need for methods to be accurate and efficient to implement some of the algorithms
- Capable of performing simple sequence analyses using existing tools

Learning Outcome: Upon completion of the subject, students shall be able to

- Gain a knowledge of simple biology and Bioinformatics
- Gain knowledge of database and tools with respect to Genomics and Proteomics
- Understand different Biological algorithms
- Apply different algorithms for biological problems
- Usage of HMM for Profiling

Unit - I

The Origin and Evolution of Cells: The First Cell, The Evolution of Metabolism, Eukaryotic Cells, The Origin of Eukaryotes, The Development of Multicellular Organisms, **Molecules of Cells:** Carbohydrates, Lipids, Nucleic Acids, Proteins, **Heredity, Genes, and DNA:** Genes and Chromosomes, Identification of DNA as the Genetic Material, The Structure of DNA, **Protein Synthesis:** Transfer RNAs, The Ribosome, The Organization of mRNAs and the Initiation of Translation, The Process of Translation, Regulation of Translation

Introduction to Bioinformatics: What Is Bioinformatics? , Goal, Applications, Limitations, **Biological Databases:** What Is a Database?, Types of Databases, Biological Databases, Pitfalls of Biological Databases, Information Retrieval from Biological Databases **(10 hrs)**

Unit - II

Genome Information Resources- Introduction, DNA Sequence databases, Specialised genomic databases

Protein Information Resources: Introduction, Biological databases, Primary Sequence Databases, Composite Sequence Databases, Secondary Databases – Prosite, PRINTS, BLOCKS, Profiles, Pfam, Identify Composite Protein pattern databases – SCOP, CATH, PDBsum

(9 hrs)

Unit - III

Algorithms and Complexity: Biological Algorithms versus Computer Algorithms, The Change Problem, Correct versus Incorrect Algorithms, Recursive Algorithms, Iterative versus Recursive Algorithms, Fast versus Slow Algorithms, Big-O Notation, Algorithm Design Techniques, Tractable versus Intractable Problems

Exhaustive Search: Impractical Restriction Mapping Algorithms, A Practical Restriction Mapping Algorithm, The Motif Finding Problem, Search Trees, Finding Motifs **(9 hrs)**

Unit - IV

Dynamic Programming Algorithms: The Power of DNA Sequence Comparison, The Change Problem Revisited, The Manhattan Tourist Problem, Global Sequence Alignment, Local Sequence Alignment, Multiple Alignment, Gene Prediction, Statistical Approaches to Gene Prediction

Divide-and-Conquer Algorithms: Divide-and-Conquer Approach to Sorting, Space-Efficient Sequence Alignment, Block Alignment and the Four-Russians Speedup **(10 hrs)**

Unit - V

Graph Algorithms: Graphs, Graphs and Genetics, DNA Sequencing, Shortest Superstring Problem, DNA Arrays as an Alternative Sequencing Technique, Sequencing by Hybridization, SBH as a Hamiltonian Path Problem, SBH as an Eulerian Path Problem, Protein Sequencing and Identification, The Peptide Sequencing Problem

Hidden Markov Models: CG-Islands and the “Fair Bet Casino”, The Fair Bet Casino and Hidden Markov Models, Decoding Algorithm, HMM Parameter Estimation, Profile HMM Alignment

(10 hrs)

Text Books:

- [1] Geoffrey M. Cooper, “ The Cell, A Molecular Approach”, 8th Edition, Oxford University Press
- [2] Jin Xiong, “Essential Bioinformatics”, Cambridge University Press
- [3] `Teresa K Attwood and David J. Parry-smith, “Introduction to Bioinformatics”, Prentice Hall
- [4] Neil C. Jones and Pavel A. Pevzner, “An Introduction to Bioinformatics Algorithms”, The MIT Press

Reference Books:

- [1] Anna Tramantono, ““Introduction to Bioinformatics”, 3rd Edition, 2012, CRC Press
- [2] Orpitha Bosu, S K Thukral, “Bioinformatics Databases, Tools, Algorithms”, 2nd Ed, 2012, Oxford University Press
- [3] Ion Mandoiu, A Zelinkovisky, “Bioinformatics Algorithms: Techniques and Applications”, 2012, Wiley

CA 8523 [E1]: DATA WAREHOUSING AND DATA MINING

Total no of lectures: 39 **Total marks: 100** **[L – T – P – S]**

No of lectures / week: 3 **Credits: 3** **[3 – 1 – 1 – 1]**

Learning Objectives:

- To introduce the basic concepts and techniques of data mining.
- To develop the skills using recent data mining software for solving practical problems.
- To assess the strengths and weaknesses of various methods and algorithms
- Identify the key processes of data mining, data warehousing and knowledge discovery process.
- Basic principles and algorithms used in practical data mining and understand their strengths and weaknesses
- Apply data mining techniques to solve problems in other disciplines in a mathematical way.

Learning outcomes: After completing this course, students will be able to

- List the definitions, concepts and architectures of data mining
- Demonstrate the impact of business reporting, information visualization and dashboards
- Explain data mining, support vector machines and text mining.
- Define social impacts of data mining.
- Handle classification through statistical methods used in prediction.

Unit – I

Data Warehousing: Data Warehousing Components – Building a Data Warehouse – Mapping the Data Warehouse to a Multi-Processor Architecture – ETL Process – Loading and Refreshing the Warehouse Data – Metadata – OLAP – Multidimensional Data Analysis – Report and Query Tools and Applications. **(9 hrs)**

Unit – II

Data Mining: Data – Types of Data – Data Mining functionalities – Data Mining Task Primitives – Issues - Integration of Data Mining system with a Data Warehouse.

Data Preprocessing: Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation **(9 hrs)**

Unit – III

Association Rule Mining: Scalable Frequent Itemset Mining Methods – Improving efficiency – Mining various kinds of Association Rules – Association Mining to Correlation Analysis – Constraint based Association Mining. **(10 hrs)**

Unit – IV

Classification and Prediction: Issues – Classification by Decision Tree Induction – Bayesian Classification – Rule Based Classification - Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures –Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section. **(10 hrs)**

Unit – V

Cluster and Outlier Analysis: Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Constraint-Based Cluster Analysis – Outlier Analysis.

Data Mining Applications: Data mining applications - Social impacts of data mining: Ubiquitous and invisible data mining – data mining privacy and data security - Case Studies: Mining the WWW -Text mining. **(10 hrs)**

Text Books:

1. Jain Pei, Jiawei Han, Micheline Kamber, “Data Mining : Concepts and Techniques”, 3rd Ed, 2011, Elsevier
2. Alex Berson, Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, 3rd Ed, 2011, McGraw Hill
3. Witten, Frank, Hall, “Data Mining : Practical Machine Learning Tools & Techniques”, 3rd 2010, Elsevier

Reference Books:

1. Reema Theraja “Data Warehousing”, 1st Edition, 2011, Oxford University Press.
2. Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, 2nd Ed, 2012, Wiley India

3. Prabhu C.S.R., "Data Warehousing Concepts, Techniques, Products and Applications", 3rd Edition, 2011, PHI Learning Private Limited.
4. Sam Anahory, Dennis Murray, "Data Warehousing In The Real World : A Practical Guide For Building Decision Support Systems", 1st Edition, 2011, Pearson Asia
5. K.P. Soman, ShyamDiwakar, V. Ajay "Insight into Data mining Theory and Practice", 2nd Ed, 2010, PHI
6. Pang-Ning Tan, Michael Steinbach, Vipin Kumar "Introduction to Data Mining", 3rd Ed, 2011, Pearson
7. Vikram Pudi, Radhakrishna, "Data Mining", 2nd Edition, 2011, Oxford University Press.
8. Richard Roiger, Michael Getz, "Data Mining : A Practical Based Primer", 1st Ed, 2010, Pearson
9. Margaret Dunham, "Data Mining : Introductory & Advanced Topics", 1st Edition, 2011, Pearson
10. Arun K Pujari, "Data Mining Techniques", 2nd Ed, 2013, University Press
11. Peter Adrians, Rolf Zantinge, "Data Mining", 1st Edition, 2010, Pearson Education
12. Gordon S. Linoff Michael J. A. Berry, "Mastering Data Mining: The Art And Science Of Customer Relationship Management", 1st Edition, 2013, Wiley India

CA 8523 [E2] : BUSINESS INTELLIGENCE & ADVANCED DATA MINING

Total no of lectures: 39	Total marks: 100	[L - T - P - S]
No of lectures / week: 3	Credits: 3	[3 - 1 - 1 - 1]

Learning Objectives:

- To introduce the basic concepts and techniques of business intelligence.
- To develop the skills using recent data mining software for solving practical problems.
- To assess the strengths and weaknesses of various methods and algorithms
- Identify the key processes of data mining, data warehousing and knowledge discovery process.
- Basic principles and algorithms used in practical data mining and understand their strengths, weaknesses
- Apply data mining techniques to solve problems in other disciplines in a mathematical way.

Learning outcomes: After completing this course, students will be able to

- Identify the major frameworks of business intelligence (BI).
- List the definitions, concepts and architectures of data mining
- Demonstrate the impact of business reporting, information visualization and dashboards
- Explain data mining, neural networks, support vector machines, text mining, web mining, social network analysis.
- Handle classification through statistical methods used in prediction.

UNIT - I

Business Intelligence: Road Map of Business Intelligence – Architecture – Components - Cycle of Business Intelligence Analysis – Development of a BI system – Ethics and BI -

Data Warehousing: Data Warehouse: Definitions, Properties and Characteristics – Data Warehouse Development approach – Components of Data Warehouse **(9 hrs)**

UNIT – II

Modeling the Data Warehouse: Choosing the Architecture – Creating the Dimensional Model

Building Data Warehouse:Data Extraction – Transformation – Loading – Refreshing the Warehouse – Purging and Archiving the Data – Metadata: Types - Strategy – Metadata Management Tools **(9 hrs)**

UNIT – III

Classification and Prediction: Issues – Bayesian Belief Networks – Classification by Back propagation – Support Vector Machine – Classification using Frequent Patterns – Lazy Learners – Multi Class Classification – Semi Supervised Classification – Active Learning – Transfer Learning **(10 hrs)**

UNIT – IV

Advanced Pattern Mining: Roadmap to Pattern Mining – Pattern mining in Multi-Level and Multi-Dimensional Space – Mining Quantitative Association Rules – Mining Rare and Negative Patterns – Constraint Based Pattern Mining.

Cluster and Outlier Analysis: Types of Data in Cluster Analysis – Requirements - Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Probabilistic Model-Based Clustering Methods – Clustering High Dimensional Data: Biclustering Methods **(10 hrs)**

UNIT – V

Mining Sequential Patterns in Transactional Database - Graph Mining – Social Network Analysis – Text Mining – Web Mining – Data Visualization - Data Mining Applications **(10 hrs)**

Text Books:

- [1] Delen Dursun Delen, Efraim Turban, Ramesh Sharda, “Decision Support And Business Intelligence Systems”, 9th Edition, 2013, Pearson
- [2] R N Prasad, Seema Acharya, “Fundamentals of Business Analytics”, 1st Ed, 2011, Wiley India
- [3] Jain Pei, Jiawei Han, Micheline Kamber, “Data Mining : Concepts and Techniques”, 3rd Ed, 2011, Elsevier

Reference Books:

- [1] Reema Theraja “Data Warehousing”, 1st Edition, 2011, Oxford University Press.
- [2] Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, 2nd Ed, 2012, Wiley India
- [3] Alex Berson, Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, 3rd Ed, 2011, McGraw Hill
- [4] Pang-Ning Tan, Michael Steinbach, Vipin Kumar “Introduction to Data Mining”, 3rd Ed, 2011, Pearson
- [5] Witten, Frank, Hall, “Data Mining : Practical Machine Learning Tools & Techniques”, 3rd 2010, Elsevier
- [6] Vikram Pudi, Radhakrishna, “Data Mining”, 2nd Edition, 2011, Oxford University Press.
- [7] Richard Roiger, Michael Getz, “Data Mining : A Practical Based Primer”, 1st Ed, 2010, Pearson

- [8] Margaret Dunham, "Data Mining : Introductory & Advanced Topics", 1st Edition, 2011, Pearson
- [9] Peter Adrians, Rolf Zantinge, "Data Mining", 1st Edition, 2010, Pearson Education
- [10] Carlo Verellis, "Business Intelligence: Data Mining and Optimization for Decision Making", 2013, Wiley.
- [11] Effraim Turban, Ramesh Sharda, Dursun Delen, David King, "Business Intelligence : A Managerial Approach", 1st Edition, 2012, Pearson.
- [12] Mark Rittman, "Oracle Business Intelligence 11G Developers Guide", 1st Ed, 2012, McGraw Hill.
- [13] Gert H. N. Laursen, Jesper Thorlund, "Business Analytics for Managers : Taking Business Intelligence Beyond Reporting", 1st Edition, 2013, Wiley

CA 8523 [E3]: DATA SCIENCE AND ANALYTICS

Total no of lectures: 39 **Total marks: 100** **[L - T - P - S]**

No of lectures / week: 3 **Credits: 3** **[3 - 1 - 1 - 1]**

Learning Objectives: The objectives of this course are to provide with

- data sampling/cleaning in order to get an informative, manageable data set
- data storage and management in order to be able to access data.
- exploratory data analysis to generate hypotheses and intuition about the data.
- prediction based on statistical tools such as regression, classification, and clustering.
- communication of results through visualization, stories, and interpretable summaries

Learning Outcomes : After successful completion of this course, you will be able to...

- Use data management techniques to store data
- Use statistical methods and visualization to quickly explore data
- Apply statistics and computational analysis to make predictions based on data
- Implement data-intensive computations on cluster and cloud infrastructures.
- Effectively communicate the outcome of data analysis using descriptive statistics and visualizations

UNIT- I

Data Science: Data science process – roles, stages in data science project; working with data from files; working with relational databases; exploring data, managing data, cleaning and sampling for modeling and validation, introduction to NoSQL.

Data Analytics Life Cycle: Introduction to Big data Business Analytics; State of the practice in analytics role of data scientists; Key roles for successful analytic project; Main phases of life cycle - Developing core deliverables for stakeholders. **(9 hrs)**

UNIT – II

Data Mining: Introduction -Data mining task. Data Preprocessing: Descriptive Data Summarization - Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization. Data visualization

Association Rule Mining: Basic concepts – Market basket analysis Scalable Frequent Itemset Mining Methods – Improving efficiency – Mining various kinds of Association Rules – Association Mining to Correlation Analysis – Constraint based Association Mining. **(9 hrs)**

UNIT – III

Classification: Basic concepts – Decision tree induction - Bayes classification methods – Rule based classification – Support Vector Machine.

Cluster Analysis: Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods. **(10 hrs)**

UNIT – IV

Predictive Analytics: Simple linear regression: Coefficient of determination, Significance tests, Residual analysis, Confidence and Prediction intervals;

Multiple linear regression: Coefficient of determination, Interpretation of regression coefficients, Categorical variables, outliers, Regression Model Building;

Logistic and Multinomial Regression: Logistic function, Estimation of probability using logistic regression. **(10 hrs)**

UNIT – V

Hypothesis testing: Null and alternate hypotheses; Types of errors, Level of significance, Power of a test, ANOVA; Test for goodness of fit

Forecasting: Moving average, Exponential smoothing, Casual Models.

Application of predictive analytics in retail, direct marketing, health care, financial services, insurance, supply chain, etc. **(10 hrs)**

Text Books:

- [1] Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
- [2] Jain Pei, Jiawei Han, Micheline Kamber, “Data Mining : Concepts and Techniques”, 3rd Ed, 2011, Elsevier
- [3] Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, 2nd Edition, 2011, Springer Series in Statistics.
- [4] Daniel T. Larose, Chantal D. Larose “Data Mining and Predictive Analytics”, 2nd Ed, 2016, John Wiley & Sons Inc.,

Reference Books:

- [1] Ken Black, "Applied BUSINESS STATISTICS Making better business decisions", 7th Ed, 2016, John Wiley & Sons Inc.,
- [2] R N Prasad, Seema Acharya, "Fundamentals of Business Analytics", 1st Ed, 2011, Wiley India
- [3] Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", 1st Ed, 2014, Packt Publishing Ltd..
- [4] Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization", 2011, Wiley
- [5] Daniel T. Larose, "Discovering Knowledge in Data: An Introduction to Data Mining", 2011, Wiley Intl
- [6] Thomas W Miller, "Modeling Techniques in Predictive Analytics", 1st Ed, 2013, Pearson
- [7] Peter Adrians, Rolf Zantinge, "Data Mining", 1st Edition, 2010, Pearson Education
- [8] Vikram Pudi, Radhakrishna, "Data Mining", 2nd Edition, 2011, Oxford University Press.
- [9] Richard Roiger, Michael Getz, "Data Mining : A Practical Based Primer", 1st Ed, 2010, Pearson
- [10] Arun K Pujari, "Data Mining Techniques", 2nd Ed, 2013, University Press

CA 8P1 & CA 8P2: Cloud Computing and Mobile App Development Lab

CA 8P3 & CA 8P4: Advanced Computing and Data Mining Lab

CA 8623: FUNDAMENTALS OF CYBER SECURITY

Total no of lectures: 39

Total marks: 100

[L - T - P - S]

No of lectures / week: 3

Credits: 3

[2 - 1 - 0 - 0]

Learning Objectives: This course deals with the various techniques principles of risk management, the common response techniques, and the issues related to recovery of IT systems and analyze the importance of network principles, architecture, and virtualization to security operations

Learning outcomes:

- Demonstrate computer skills necessary for cybersecurity data analytics.
- Describe the principles of risk management, the common response techniques, and the issues related to recovery of IT systems.
- Analyze the importance of network principles, architecture, and virtualization to security operations.
- Perform basic security audits, testing, and monitoring of computer networks.

UNIT I

INTRODUCTION TO SECURITY TRENDS: The Computer Security Problem - Targets and Attacks - Approaches to Computer Security - Ethics - Basic Security Terminology - Security Models

(7 HRS)

UNIT II

OPERATIONAL AND ORGANIZATIONAL SECURITY: Policies, Procedures, Standards, and Guidelines - Security Awareness and Training - Interoperability Agreements - The Security Perimeter - Physical Security - Environmental Issues - Wireless - Electromagnetic Eavesdropping - People—A Security Problem - People as a Security Tool

(9 HRS)

UNIT III

CRYPTOGRAPHY: Cryptography in Practice - Historical Perspectives - Algorithms - Hashing Functions - Symmetric Encryption - Asymmetric Encryption - Quantum Cryptography - Cryptography Algorithm Use

(8 HRS)

UNIT IV

AUTHENTICATION AND REMOTE ACCESS: User, Group, and Role Management - Password Policies - Single Sign-On - Security Controls and Permissions - Preventing Data Loss or Theft - The Remote Access Process - Remote Access Methods

(8 HRS)

UNIT V

INTRUSION DETECTION SYSTEMS: History of Intrusion Detection Systems - IDS Overview - Network-Based IDSs - Host-Based IDSs- Intrusion Prevention Systems - Honeypots and Honeynets - Tools **(7 HRS)**

Text Book:

1. W.A.Coklin, G.White, Principles of Computer Security: Fourth Edition, McGraw Hill, 2016.

Reference Books:

- [1] William Stallings, Cryptography and Network Security Principles and Practices, Seventh Edition, Pearson, 2017.
- [2] Mayank Bhushan Rajkumar Singh Rathore Aatif Jamshed, Fundamentals Of Cyber Security, First Edition, BPB Publications, 2018.

III Semester

CA 9123 [E1]: FUNCTIONAL PROGRAMMING PARADIGM

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives: This subject aims to teach students how to use the features of modern typed functional programming languages (e.g. Haskell, Clojure) to design and implement libraries and DSLs. It aims to demonstrate how such techniques can improve both correctness and efficiency. The programs can be viewed as mathematical functions. This makes the language very powerful, so that we can easily construct programs that would be difficult or very large in other languages. The main objective of this subject is how to apply mathematical reasoning to programs, so as to prove that a program performs its task correctly, or to derive it by algebraic manipulation from a simpler but less efficient program for the same problem.

Course Learning Outcomes – upon successful completion of this course, the participant will be able to:

- The ability to know functional programming language (e.g. Haskell, Clojure)
- The ability of know types and functions for programming.
- Work with JSON data.
- The ability to work with I/O files.
- The ability to know Efficient file processing, regular Expressions, Filename matching.

Unit - I

INTRODUCTION TO HASKELL: Haskell environment, basic interaction, command-line editing in ghci, lists, strings and characters, first steps with types.

Types and Functions: Haskell type system, common basic types, function application, composite data types, functions over lists and tuples, function types and purity, Haskell source files, understanding evaluation, polymorphism.

Defining Types, Streamlining Functions: Defining new Data type, type synonyms, algebraic data types, pattern matching, record syntax, parameterized types, recursive types, local variables, case expression. **(10 Hrs)**

Unit - II

Functional Programming: infix functions, working with lists, think about loops, partial functions.

Working with JSON Data: representing JSON data in Haskell, anatomy of a Haskell module, generating a Haskell program and importing modules, printing JSON data, type inference, arrays and objects, module header, creating package.

Using Typeclasses: need for typeclasses, typeclass instances, built-in typeclasses. **(10 Hrs)**

Unit - III

I/O: working with files and handles- open file, closing handles, seek and tell, standard input, output and error, deleting and renaming files, temporary files, lazy I/O, Buffering.

Efficient file processing, regular Expressions, Filename matching: efficient file processing, filename matching, regular expressions, writing lazy functions. **(9 Hrs)**

Unit - IV

Introduction to Clojure: clojure way, why Lisp, functional programming, why clojure isn't especially object-oriented. Scalars, collections, functions, vars, locals, loops and blocks, quoting, interop, exceptional, namespaces.

Data types: on scalars- understanding precision, rational, use of keywords, symbolic resolution, regular expressions. **(9 Hrs)**

Unit - V

Composite data types: persistence, sequence and complexity, vectors, lists, persistent queues, persistent sets, thinking in maps. Immutability, designing a persistent, laziness. Functions in all forms, closures, recursively. **(10 Hrs)**

Text Books:

- [1] Bryan O'Sullivan, Don Stewart, and John Georzen," Real World Haskell", O'Reilly.
- [2] Michael Fogus, Chris Houser," The Joy of Clojure ", Manning Publications.

Reference Books

- [1] Michael Swaine ," Functional programming a pragpub anthology", Pragmatic Bookshelf.
- [2] Richard Bird, Philip wadler, "Introduction to functional programming", prentice hall series in computer science.
- [3] Allen B. Tucker, Robert E. Noonam, "Programming languages principles and paradigms", McGraw Hill.
- [4] Alex Miller," Programming Clojure", Pragmatic Bookshelf.
- [5] Michael Bevilacqua-Linn," Functional programming patterns in scala and clojure", Pragmatic bookshelf.
- [6] Graham Hutton, "Programming in Haskell ", Cambridge University Press.

CA 9123 [E2] : INTERNET OF THINGS ARCHITECTURE & DEVELOPMENT

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives: This subject provides a broad study of various latest internet technologies and underlying communication technologies used in the Internet of Things (IoT). The main emphasis is to combine technical concepts with a high-level understanding of IoT networks and communication media used in the IoT. The subject provides a comprehensive

understanding of the Internet of Things and explores topics such as IoT architecture, IoT communication protocols, security in IoT and IoT applications in the modern world. The subject also examines business use-cases of IoT in real-world environments such as industrial and home automation.

Course Learning Outcomes – upon successful completion of this course, the participant will be able to:

- The knowledge and understanding of the security and ethical issues of the Internet of Things.
- Conceptually identify vulnerabilities, including recent attacks, involving the Internet of Things.
- Conceptually describe countermeasures for Internet of Things devices.
- Analyse the societal impact of IoT security events; Develop critical thinking skills.
- Compare and contrast the threat environment based on industry and/or device type.

Unit - I

The IoT Networking Core : Technologies involved in IoT Development: Internet/Web and Networking Basics OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers,

Network Fundamentals: Overview and working principle of Wired Networking equipment's – Router, Switches, Overview and working principle of Wireless Networking equipment's, Access Points. **(10 Hrs)**

Unit - II

IoT Architecture: M2M – Machine to Machine, Web of Things, IoT protocols Applications: Remote Monitoring & Sensing, The Architecture The Layering concepts, IoT Communication Pattern

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. **(10 Hrs)**

Unit - III

IOT Data Link Layer and Protocols: PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer- IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

(9 Hrs)

Unit - IV

User Experience Design for the Internet of Things: UX for IoT Different, Design model for IoT.

Things the Technology of Connected devices: Types of connected device, multipurpose computers, bridging physical and digital: sensors and actuators, the challenge of powering devices, conserving battery life. **(9 Hrs)**

Unit - V

Networks the Technology of connectivity: Networking relevant to IoT UX, networking issues that cause UX challenges for IoT, the Architecture of the IoT, types of Networks, network communication patterns, internet service.

Product/Service definition and strategy: making good products, from innovation to mass market, tools versus products, what makes good product, services in IoT, business models.

(10 Hrs)

Text Books:

- [1] Zach Shelby, Carsten Bormann, "LoWPAN: The Wireless Embedded Internet", 1st Ed, 2010, Wiley
- [2] Claire Rowland, Elizabeth Goodman, Martin Charlier, " Designing connected Products UX for the consumer internet of Things", Oreilly.

Reference Books

- [1] Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, "The Internet of Things: From RFID to the Next-Generation Pervasive Networked", 1st Edition, 2011, Wiley International
- [2] Vijay Madisetti , Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Ed, 2014, TMH
- [3] Hakim Cassimally, "Designing the Internet of Things, Adrian McEwen (Author)", McGraw Hill
- [4] Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
- [5] Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatios Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press,
- [6] Peter Waher, "Learning Internet of Things", 1st Edition, 2015, PACKT publishing,
- [7] Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", 2014, Springer
- [8] Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", 1st Edition, 2016, Wiley Publications
- [9] Jean-Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet", 2nd Edition, 2014, Morgan Kuffmann
- [10] Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", 1st Edition, 2013, River Publishers

CA 9123 [E3]: AUGMENTED AND VIRTUAL REALITY

Total No. of Lectures : 48

Total Marks : 100

[L - T - P - S]

No. of Lectures / Week : 4

Credits : 4

[3 - 1 - 0 - 2]

Learning Objectives:

- Understanding the differences in AR/VR concepts and technologies.
- Have an Overview of AR/VR development approaches.
- To make students know the basic concept and framework of virtual reality.
- To teach students the principles and multidisciplinary features of virtual reality.
- To teach students the technology for multimodal user interaction and perception in VR, in particular the visual, auidial and haptic interface and behavior.

Learning Outcomes: When students have successfully completed this module they should be able to:

- Describe how VR System work.
- Describe the basic concept and framework of virtual reality.
- Interpret the principles and multidisciplinary features of virtual reality.
- A knowledge of the research literature in Augmented Reality for both compositing and interactive applications
- A Knowledge of the research ideas in Augmented Reality.

Unit - I

Introduction: Creative Coding Platforms; Open-Source Platforms; PIC - Arduino, Sketch, Raspberry Pi, Iterative coding methodology; Python Programming; Mobile phones and similar devices; Arm Devices; Basic Electronics (circuit theory, measurements, parts identification)

(9 Hrs)

Unit - II

Software and Hardware Frameworks: Software: openFrameworks as our IDE (C/C++) - “Arduino” Language (C/C++) – **Hardware:** Desktop / Laptop / Raspberry Pi; approach to a programming problem; Representing “reality” with computers; Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) ; Digital to Analog Conversion (DAC); Microcontrollers; Communication Serial& Parallel; Hardware to Hardware Communication; I2C/IIC (Inter-Integrated Circuit); SPI (Serial Peripheral Interface) – Serial UART Communication

(10 Hrs)

Unit - III

Wearable Computers and Augmented Reality: Public Policy, Theory of augmented Reality, Challenges and Future Ahead.

Wearable Computing Challenge: Networking, power and heat, mobile input, display, virtual reality, portable video viewwers, industrial wearable systems, academic/maker systems for everyday use, consumer devices, meeting the challenge.

(9Hrs)

Unit - IV

Introduction of Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality.

Multiple Models of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.

Applications in Virtual Reality: wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. **(10 Hrs)**

Unit - V

Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality. **(10 Hrs)**

Text Books:

- [1] Woodrow Barfield, "Fundamentals of Wearable Computers and Augmented Reality", 2nd, 2015, Pearson Burdea.
- [2] Paul Scherzand Simon Monk, "Practical Electronics for Inventors", Third Edition, 2016, Wiley Int.

Reference Books:

- [1] William R. Sherman, Alan B. Craig, "Understanding Virtual Reality", by Elsevier Science.
- [2] Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 2nd Edition, 2014, Morgan Kaufmann Publishers.
- [3] Alan Craig, William Sherman and Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", 1st Edition, 2009, Morgan Kaufmann.
- [4] Borko Furht, "Hanbook of Augmented Reality", Springer.
- [5] Intel Galileo and Intel Galileo "API Features and Arduino Projects for Linux Programmers", Ramon, Manoel 2014 (Open Access)
- [6] G. C. and P. Coffet. "Virtual Reality Technology", Second Edition. 2009, Wiley
- [7] Ravi Iyer, "Programming Interactivity", Second Edition, 2012, O'reilly Publishers
- [8] Josha Noble, "Programming the Raspberry Pi: Getting Started with Python ", 2E, 2016, Apress.

Unit - IV

Introduction to Node.js: Asynchronous programming, Benefits of using Node.js, Setting up the environment, Introduction to REPL and NPM and usage, Modules in Node.js, Event-driven applications using Node.js, File Uploading and Email Handling. **09 hrs**

Unit - V

Advanced Node.js: Using Express Framework, Introduction to RESTful API using Node.js, Using Node.js with MySQL to create connection, database and tables, inserting, updating and deleting records, retrieving records to display. **09 hrs**

Text books:

- [1] Caleb Dayley, Brendan Dayley, Brad Dayley, "Learning AngularJS", Edition 2nd 2017, Addison- Wesley Publishers
- [2] Basarat Syed, "Beginning Node.js", Edition 1st 2014, Wiley – Apress Publishers

Reference books:

- [1] Valeri Karpov, Diego Netto, "Professional AngularJS", Edition 1st 2015, Wiley Wrox
- [2] Pawel Kozlowski, "Mastering Web Application Development with AngularJS", Edition 1st 2013, Packt Publishing
- [3] Pedro Teixeira, "Professional Node.js: Building Javascript Based Scalable Software", Edition 1st 2012, Wiley
- [4] Ethan Brown, "Web Development with Node and Express", Edition 1st 2014, O'Reilly
- [5] Sandro Pasquali, "Mastering Node.js", Edition 1st 2013, Packt Publishing Limited
- [6] Brad Dayley, " Node.js, MongoDB, and AngularJS Web Development", Edition 2nd 2014, Addison- Wesley

CA 9223 [E2]: CONTENT MANAGEMENT WITH JOOMLA & WORDPRES

Total No. of Lectures : 48	Total Marks : 100	[L – T – P – S]
No. of Lectures / Week : 4	Credits : 4	[3 – 1 – 0 – 2]

Learning Objectives:

- Introduce learners to two most popular open-source content management systems (CMS) in use on the web today, WordPress and Joomla.
- Understand the difference between a CMS website, a static website, and websites using other server-side technologies.
- Understand the benefits of working with a server-side database and the power it brings to creating and managing websites.

Course outcomes:

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

- Create and deploy websites using CMS, including creating and editing content, adding functionality, and creating custom templates and themes.
- Understand ongoing maintenance considerations with CMS websites.

UNIT I

Introduction to Content Management Systems: Revisiting HTML Page Structure, using CSS for page layout - Introduction to CMS: Exploring CMS terminology, including open source, PHP, MySQL, server-side, client-side, static HTML website, how CMS web pages are generated.

(10 HRS)

UNIT II

Introduction to Joomla: Overview, Installing Joomla, Architecture, How Joomla works, Control Panel, Toolbars and Menus. Content creation, Content customization: images, video, audio, tags, formats, etc. Adding and displaying menus, Linking menus to articles and other features

(10 HRS)

UNIT III

Extending Joomla: Finding and adding Joomla plugins, how do Plugins Work? plugin types, examples for plugin usage, Modules in Joomla, User management and permissions. Using Templates in Joomla.

(10 HRS)

UNIT IV

Introduction to WordPress: Overview, Installing WordPress, Dashboard, Content Management using WordPress, Exploring the admin interface, WordPress Categories and Posts, Content customization: images, tags, formats, etc. WordPress themes and templates.

(10 HRS)

UNIT V

Extending WordPress: WordPress media, Using WordPress Plugins, Managing Databases in CMS, Comments and Links Management in WordPress, User management and permissions, creating a blog website using WordPress.

(10 HRS)

Text books

- [1] Brad Williams, David Damstra, Hal Stern, Professional WordPress: Design and Development, 2nd 2013, John Wiley & Sons
- [2] Jennifer Marriott, The Official Joomla! Book, 2nd 2013 Addison-Wesley Professional

Reference Books

- [1] Matthew Macdonald , WordPress: The Missing Manual, 1st 2012, O'Reilly
- [2] Matthew Macdonald , WordPress: The Missing Manual, 1st 2012, O'Reilly
- [3] Eric Tiggeler , Joomla! 3 Beginner's Guide , 2nd 2014 Packt Publishing Limited
- [4] Dan Rahmel , Advanced Joomla!, 4th 2013 Apress
- [5] Mark Dexter, Louis Landry, Joomla! Programming, 1st 2012 Addison- Wesley

CA 9223 [E3] Blockchain Technology with Ethereum

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives:

Explain distributed systems and Blockchain technology

- Explain how bitcoin works, from when a transaction is created to when it is considered part of the Blockchain
- Explain private and public keys as well as addresses and how exactly they are constructed and used
- Explain to students both fundamental and implied differences between Ethereum and Bitcoin protocol by covering historical, conceptual and architectural distinctions
- Provide a detailed covering of the most prominent smart contract platform Ethereum and expose students to its main programming language Solidity

Learning Outcomes

- Understand what and why of Blockchain
- Explore the major components of Blockchain
- Learn about Hyperledger Fabric model and its Architecture
- Learn about Hyperledger Composer and Explorer
- Learn about Bitcoin, Ethereum
- Learn about Ethereum Virtual machine, The Ethereum network. Applications development on Ethereum.

UNIT 1

Distributed systems: CAP theorem, Byzantine Generals problem, The history of blockchain electronic cash. Introduction to blockchain: Various technical definitions of blockchains, Generic elements of a blockchain Features of a blockchain Applications of blockchain technology, Tiers of blockchain technology, Types of blockchain -Public blockchains, Private blockchains, Semi-private blockchains, Sidechains, Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, Consensus in blockchain. CAP theorem and blockchain Benefits and limitations of blockchain **(10 HRS)**

UNIT II

Blockchain and full ecosystem decentralization, Smart contracts , Decentralized Organizations , Decentralized Autonomous Organizations, Decentralized Autonomous Corporations, Decentralized Autonomous Societies, Decentralized Applications ,Platforms for decentralization Cryptography and technical foundations: cryptography, confidentiality , Integrity, Authentication, Symmetric Cryptography, Asymmetric Cryptography, RSA, Discrete logarithm problem, Cryptographic primitives, Hash Functions, Elliptic curve digital signature Algorithm(ECDSA)

(10 HRS)

UNIT III

Bitcoin, Transactions : The Transaction life cycle, The transaction structure, Types of transaction, Blockchain : the structure of a block, the structure of a block header, the genesis block, the bitcoin network, Wallets. Bitcoin payments. Bitcoin Limitations: privacy and anonymity, Extended protocols on top of bitcoin, Development of altcoins, Namecoin, Litecoin, Primecoin. Zcash **(10 HRS)**

UNIT IV

Ethereum clients and releases, the Ethereum stack, Ethereum Blockchain: Currency, Forks, Gas, the consensus mechanism, the world state. Transactions, Contract creating transaction, Message call transaction.

Elements of the Ethereum blockchain : Ethereum virtual machine (EVM): Execution environment, Opcodes and their meaning, Accounts: Types of accounts, Block: Block header, The genesis block, Transaction receipts, Transaction validation and execution, the block validation mechanism. Ether, Messages, Mining, Clients and wallets, Trading and Investment, The Ethereum network. Applications developed on Ethereum. **(10 HRS)**

UNIT V

Setting up a development environment : Test Net, Setting up a Private Net, Starting up the private network. Development tools and clients: Languages, Compilers, Tools and Libraries, EthereumJS. Contract development and deployment. Introducing solidity: Types: value types, Literals, Enums, Function types, Mappings, Global variables, control structures.

Introducing Web3: POST requests, The HTML and JavaScript frontend. Development framework: Truffle **(10 HRS)**

Text Books:

[1] Imran Bashir, Mastering Blockchain, 1st edition 2017, Packt publications Ltd.

Reference Books

[1] Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, 1st edition, 2016, Princeton University Press

[2] Stallings W., Cryptography and Network security: Principles and Practice, 7/e, Pearson Education Asia, 2017.

[3] Kevin Werbach, The Blockchain and the new architecture of Trust, MIT Press, 2018.

[4] Joseph J. Bambara and Paul R. Allen, Blockchain – A practical guide to developing business, law, and technology solutions, McGraw Hill, 2018

- [5] Melanie Swan, Blockchain –Blueprint for a new economy, OReilly publishers, 2018.
 [6] Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Blockchain for Business, Pearson publishers, 2019.

CA 9323 [E1]: Computing with C# and .NET Framework

Total No. of Lectures : 48	Total Marks : 100	[L – T – P – S]
No. of Lectures / Week : 4	Credits : 4	[3 – 1 – 0 – 2]

Objectives:

- The Objective of this course is to introduce .NET Framework with C# as the programming language
- To develop applications for Windows with ease using GUI programming
- To learn the latest Universal Windows App Programming with C#
- To give an Introduction to the .NET Core Paradigm

Course outcomes: At the end of the course, students should be able to:

- Understand what is .NET Framework and how does it work
- Develop Programs using various C# concepts
- Design and develop full-fledged UWP applications using C#
- Use any DB technology appropriate with the application.
- Gain knowledge in the area of .NET Core and develop applications using .NET Core

UNIT I

.NET Framework: Architecture of .NET Framework. Working, .NET Compliant Languages - The Common Language Runtime (CLR); Common Type System (CTS); Common Language Specification (CLS); Common Intermediate Language (CIL); Types of JIT Compilers; Garbage Collection; Base Classes Framework; Assemblies and Modules.

8 Hrs

UNIT II

Introduction to C#.NET: Overview, Environment, Program Structure, Basic Syntax, Data Types, Variables, Constants, Modifiers, Statements, Operators, Decision Making, Loops, Strings, Date & Time, Arrays, Collections, Object Oriented Programming with C#.NET; Classes and Objects, Inheritance, Polymorphism, Encapsulation.

10 Hrs

UNIT III

Universal Windows App Development using C#: Overview of the IDE to develop Metro Style Apps; Windows Store apps using C# and XAML: Blank, Grid and Split App; Overview of XAML for

Design; Syntax, Features and working of XAML; Manage app life cycle and state; Navigation, layout, and views; File access and pickers using C#.

10 Hrs

UNIT IV

Data Access: The ADO.NET Object Model; Managed Providers; Working with Connected and Disconnected Architectures; Connection, Command, DataReader, DataAdapter, DataSet and Transaction objects; Using Data Controls – Code way; An Overview of LINQ; Using LINQ to SQL; Entity Framework: Entity Data Model, Querying Data, CRUD Operations in EF.

10 Hrs

UNIT V

Introduction to .NET Core: Overview, Working of .NET Core, Execution, Modularity, Project File References, Creating UWP using .NET Core, Portable Class Libraries, Using ASP.NET Core, Components, Web Pages Introduction to ASP.NET Core MVC.

10 Hrs

TEXT BOOKS:

1. Sergii Baidachnyi, “Developing Windows 10 Applications with C#”, CreateSpace Independent Publishing Platform, 2016
2. Rishabh Verma, Neha Shrivastava, “.NET Core 2.0 By Example:”, Packt Publishing; 1st edition 2018

REFERENCE BOOKS:

1. E Balagurusamy, “Programming in C#”, McGraw Hill Education; 4th edition, 2017
2. Arthur Gittleman, “Computing with C# and the .NET Framework”, Jones & Bartlett Learning, 2nd edition, 2011

CA 9323 [E2]: Web Technologies and .NET Framework

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Objective: The learning objectives are -

- To study the elements of the .NET Framework platform and its working
- To learn the features of C# using VS.NET IDE.
- Understand the architecture and main classes of ADO.NET.
- To use LINQ and Entity Framework in Applications.
- Develop Dynamic Web Applications using ASP.NET.

- To Develop ASP.NET MVC application and Introduce ASP.NET Core

Course outcomes:

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

- Understand what is .NET Framework and Develop Programs using various C# concepts
- Design and develop full-fledged Web applications using ASP.NET With C#
- Use any DB technology appropriate with the application.
- Create and Consume Web Services and Develop ASP.NET MVC applications
- Gain knowledge in the area of .NET Core and develop web applications using ASP.NET Core

UNIT - I

.NET Framework and C#: Architecture of .NET Framework. -.NET Compliant Languages - The Common Language Runtime (CLR); Common Type System (CTS); Common Language Specification (CLS); Common Intermediate Language (CIL); **C#:** Data types – Operators and Expressions - Statements – Decision Making – Loops – Arrays and Collections – Strings; Object Oriented Programming - Encapsulation, Polymorphism and Inheritance in C#.

10 hrs

UNIT - II

ASP.NET: ASP.NET Architecture; Programming with ASP.NET Web pages, Components, Master pages and User Control; ASP.NET State Management; Caching; **ASP.NET AJAX** Components of Microsoft's AJAX Support; Partial Page Update; Script Manager; Client-Side Page Lifecycle; Update Panel Control; Update Modes; Timer.

9 hrs

UNIT - III

Data Access using ADO.NET, LINQ, Entity Framework: The ADO.NET Object Model; Managed Providers; Working with Connected and Disconnected Architectures; Command, DataReader, DataAdapter, DataSet and Transaction objects; **LINQ;** Using Standard 'LINQ to' Technologies namely: LINQ to Object, LINQ to DataSet, LINQ to SQL, LINQ to XML; **Entity Framework,** Entity Data Model, Navigating the EF, Querying Data, CRUD Operations in EF.

10 hrs

UNIT - IV

Web Services: Overview; Working of a Web Service; Features; Platform Elements; Creating a Web Service using ASP.NET; Consuming a Web Service. **ASP.NET MVC:** MVC Overview; Advantages of using MVC Model; ASP.NET MVC application Structure; Creating the Model; Creating a Controller; Adding a View; Razor View Engine; Razor Syntax, Variables, Loops and Logic; Specifying a Partial View; Models, Layout; Scaffolding, Databases;

10 hrs

UNIT - V

ASP.NET Core: Overview, Environment Setup, Project Layout, Project. Json, Configuration, Middleware, Exceptions, Static Files, Setup MVC, MVC Design Pattern, Routing, Attribute Routes, Action Results, Views, Setup Entity Framework **9 hrs**

TEXT BOOKS:

- [1] Mary Delamater, Anne Boehm, "Murachs ASP.NET 4.6 Web Programming with C#", Shroff Publishers & Distributors Pvt Ltd, 6th edition, 2016
- [2] James Chambers, David Paquette, Simon Timms, "ASP.NET Core Application Development", PHI Learning Private Limited, 2017

REFERENCE BOOKS:

- [1] E Balagurusamy, "Programming in C#", McGraw Hill Education; 4th edition, 2017
- [2] Imar Spaanjaars, "Beginning ASP.NET 4: in C# and VB", Wrox, 2010

CA 9323 [E3]: Cross Platform Development using .NET Core

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Learning Objectives: The learning objectives are -

- To study the .NET Framework platform and the features of C# language.
- To understand the latest version of .NET Core
- Develop .NET Core applications with Data Access
- To Develop Web Applications using ASP.NET Core with Razor View Engine
- To Develop and Implement ASP.NET MVC Core Web Applications with Entity Framework

Course outcomes:

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

- Understand what is .NET Framework and Develop Programs using various C# concepts
- Design and develop full-fledged applications using .NET Core
- Use DB technologies like Entity Framework and LINQ with .NET Core
- Create and Web Applications using ASP.NET Core
- Gain knowledge in the area of ASP.NET Core and develop web applications using ASP.NET MVC Core and Razor View Engine

UNIT I

.NET Framework and C#: Architecture of .NET Framework. -.NET Compliant Languages - The Common Language Runtime (CLR); Common Type System (CTS); Common Language Specification (CLS); Common Intermediate Language (CIL); C#: Data types – Operators and Expressions - Statements – Decision Making – Loops – Arrays and Collections – Strings; Object Oriented Programming - Encapsulation, Polymorphism and Inheritance in C#. **8 Hrs**

UNIT II

Introduction to .NET Core: Overview, Environment, Controlling Flow and Converting Types, Writing, Debugging and testing functions. Object Oriented Programming Implementing Interfaces and Inheriting Classes, Understanding and Packaging .NET Types. **10 Hrs**

UNIT III

Advanced Concepts .NET Core: Working with Files, Streams and Serialization in .NET Core. Protecting Data and Applications, Working with Databases using Entity Framework Core. Querying and Manipulating Data using LINQ. Improving performance and Scalability using Multitasking. **10 Hrs**

UNIT IV

ASP.NET Core: Building Websites using ASP.NET Core: Understanding ASP.NET Core, Classic ASP.NET vs ASP.NET Core, Testing and Securing the Website. Enabling Razor Pages, Defining a Razor Page. Using shared layouts with Razor pages. Using Entity Framework Core with ASP.NET Core **10 Hrs**

UNIT V

Introduction to ASP.NET Core MVC Framework: Set up MVC, Difference Between AddMvc and AddMvcCore, Dependency Injection, Model, Controllers, Views in ASP.NET Core MVC, ViewData, ViewModel, ViewBag, Strongly Typed View in ASP.NET Core MVC, Routing, Custom Routing & Attribute Routing, Layout View, Sections in Layout Page, ViewStart, ViewImports, Use Bootstrap in ASP.NET Core MVC, Tag Helpers, Navigation Menus. **10 Hrs**

TEXT BOOKS:

- [1] Mark J. Price, "C# 8.0 and .NET Core 3.0 - Modern Cross-Platform Development", Packt Publishing Limited; 4th Revised edition 2019.
- [2] James Chambers, David Paquette, Simon Timms, "ASP.NET Core Application Development", PHI Learning Private Limited, 2017

REFERENCE BOOKS:

- [1] Gabriel Baptista, Francesco Abbruzzese, "Hands-On Software Architecture with C# 8 and .NET Core 3", Packt Publishing Limited 2019

[2] Ian Griffiths, "Programming C# 8.0: Build Cloud, Web, and Desktop Applications", O'Reilly Media; 1st edition 2020

CA 9423 [E1]: Cognitive Computing and Artificial Intelligence

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Course Objectives:

- To Apply a given AI technique to a given concrete problem
- To learn at scale, reason with purpose and interact with humans naturally with cognitive computing.
- To understand uncertainty and Problem solving techniques.
- To understand various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
- To understand various learning techniques and agent technology.

Course Outcomes:

- Describe Cognitive computing and AI based techniques and models
- Apply and assess Cognitive computing and AI based applications in various areas
- To Design intelligent agents for problem solving, reasoning, planning, decision making, and learning.
- To specifically design with performance constraints when needed and design variants of existing algorithms
- Apply AI technique on current applications. - Problem solving, knowledge representation, reasoning, and learning.

Unit - I

Cognitive Science: Cognitive view, Fundamental concepts, Computers in Cognitive science, Applied Cognitive science, Interdisciplinary nature of Cognitive science

Cognitive Psychology: The Nature of Cognitive Psychology, The Notion of Cognitive Architecture, Propositional and Schematic representation, Cognitive processes, Working memory and Attention, Mental Images, Automatic and Controlled processes, The Acquisition of Skill Approach, The Connectionist approach to cognitive architecture

(10 Hrs)

Unit -II

Cognitive Psychology-Further Explorations: Concepts and Categories, Memory, Reasoning, Problem Solving

Neuroscience: Brain and Cognition: Introduction o the study of the nervous system, Organization of the central nervous system, Neural Representation, Neuropsychology, Computational Neuroscience

(9 Hrs)

Unit - III

Artificial Intelligence: The AI Problems, The Underlying assumption, AI Technique, The Level of the model, Criteria for success, some general references, Problems, problem spaces, and search: Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs, Additional Problems.

Intelligent Agents: Agents and Environments, The nature of environments, The structure of agents. **(9 Hrs)**

Unit - IV

Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search, Problem reduction, Constraint satisfaction, Mean-ends analysis.

Knowledge representation issues: Representations and mappings, Approaches to knowledge representation, Issues in knowledge representation, The frame problem.

Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction.

Logical Agents: Knowledge -based agents, the Wumpus world, Logic-Propositional logic, Propositional theorem proving, Effective propositional model checking, Agents based on propositional logic. **(10 Hrs)**

Unit - V

Symbolic Reasoning Under Uncertainty: Introduction to nonmonotonic reasoning, Logic for nonmonotonic reasoning, Implementation Issues, Augmenting a problem-solver,

Implementation: Depth-first search, Implementation: Breadth-first search.

Statistical Reasoning: Probability and Bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic.

Quantifying Uncertainty: Acting under uncertainty, Basic probability notation, Inference using full joint distributions, Independence, Bayes' rule and its use, The Wumpus world revisited.

(10 Hrs)

Text Books :

- [1] Neil A Stillings, Steven E. Weisler, Christopher H Chase, Mark H Feistein, Jay L Garfield and Edwina L Rissland, "Cognitive Science", Second Edition, MIT Press
- [2] Elaine Rich, Kevin Knight, Shivashankar B Nair:, "Artificial Intelligence", 3rd edition. 2013, Mc Graw Hill
- [3] Stuart Russel, Peter Norvig, "Artificial Intelligence A Modern Approach", 3rd edition 2013 Pearson.

Reference Books :

- [1] E. Charniak, *et.al.*, "Introduction to Artificial Intelligence", 2nd Ed, 2014, Pearson Education.
- [2] P. H. Winston, "Artificial Intelligence", 1st Edition, 2010, Pearson India
- [3] Rich and K. Knight, "Artificial Intelligence", 1st Edition, 2013, Pearson Education.
- [4] Hurwitz, Kaufman, and Bowles, "Cognitive Computing and Big Data Analytics", Wiley, Indianapolis, 2005.

Fuzzy Systems Implementations: Implementation Issues, Fuzzy Rule System Implementation, Evolving Fuzzy Rule Systems **(9 Hrs)**

Unit - III

Computational Intelligence Implementations– Implementation Issues, Fuzzy Evolutionary Fuzzy Rule System Implementation, Choosing the Best Tools, Applying Computational Intelligence to Data Mining

Performance Metrics: General Issues, Percent Correct, Average Sum-squared Error; Analysis and Explanation

Analysis and Explanation: Sensitivity Analysis, Hinton Diagrams, Computational Intelligence Tools for Explanation Facilities **(9 Hrs)**

Unit - IV

Introduction: Machine Learning Foundations, Overview, Applications, Types of Machine Learning, Basic Concepts in Machine Learning, Examples of Machine Learning, Applications.

Supervised Learning: Probably Approximately Correct (PAC) Learning, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm.

Bayesian Decision Theory: Introduction, Classification, Discriminant Functions, Bayesian Networks, Association Rules.

Dimensionality Reduction: Introduction, Subset Selection, Principal Components Analysis, Linear Discriminant Analysis.

Clustering: Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Hierarchical Clustering, Choosing the Number of Clusters.

(10 Hrs)

Unit - V

Decision Trees: Introduction, Univariate Trees, Pruning, Rule Extraction from Trees, Multivariate Trees.

Linear Discrimination: Introduction, Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Gradient Descent, Logistic Discrimination, Support Vector Machines.

Hidden Markov Models: Introduction, Discrete Markov Processes, Three Basic Problems of HMMs, Evaluation Problem, Learning Model Parameters, Model Selection in HMM.

Assessing and Comparing Classification Algorithms: Introduction, Cross-Validation and Resampling Methods, Measuring Error, Assessing a Classification Algorithm's Performance, Comparing Two Classification Algorithms, Comparing Multiple Classification Algorithms: Analysis of Variance. **(10 Hrs)**

Text Books :

- [1] Russel Eberhart, Yuhui Shi, "Computational Intelligence Concepts to Implementation", 2nd Edition, 2010, Elsevier Publications
- [2] Ethem Alpaydin, "Introduction to Machine Learning", 1st 2004, MIT press

Reference Books :

- [1] Christopher Bishop, "Pattern Recognition and Machine Learning", 1st 2006, Springer.
- [2] Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1st 2012, MIT press
- [3] Tom Mitchell, "Machine Learning", 1997, McGraw-Hill.
- [4] .N Sivanandam, S.N Deepa, "Principles of Soft Computing", 3rd Edition, 2015, Wiley.
- [5] F. Hayes Roth et.al., "Building Expert Systems", 1st Edition, 2009, Pearson Education.
- [6] Anderson J.A., "An Introduction to Neural Networks", 3rd Ed, 2014, Pearson Asia

CA 9423 [E3]: Deep Learning and Neural Networks

Total No. of Lectures : 48	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 4	Credits : 4	[3 - 1 - 0 - 2]

Objectives:

- To understand the concepts of machine learning.
- To appreciate supervised and unsupervised learning and their applications.
- To understand the theoretical and practical aspects of Probabilistic Graphical Models.
- To appreciate the concepts and algorithm of reinforcement learning.

Course outcomes:

- To implement a neural network for an application of your choice using an available tool.
- To implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results.
- To use a tool to implement typical clustering algorithms for different types of applications.
- To design and implement an NN for a sequence model type of application
- To identify applications suitable for different types of deep learning with suitable justification.

Unit - I

Artificial Neural Network: An Introduction: Fundamental Concept, Evolution of Neural Networks, Basic Modes of Artificial Neural Network, Important Terminologies of ANNs, McCulloch-Pitts Neuron, Linear Separability, Hebb Network

Supervised Learning Network: Introduction, Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons, Back-Propagation Network, Radial Basis Function Network

Unsupervised Learning Networks: Introduction, Fixed Weight Competitive Nets, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter propagation Networks, Adaptive Resonance Theory Network **(10 Hrs)**

Unit - II

Associative memory networks: Introduction, Training Algorithms for Pattern Association, Autoassociative Memory Network, Heteroassociative Memory Network, Bidirectional

Associative Memory (BAM), Continuous BAM, Hopfield Networks, Iterative Autoassociative Memory Networks, Temporal Associative Memory Network

Special Networks: Introduction, Simulated Annealing Network, Boltzmann Machine, Probabilistic Neural Net, Cellular Neural Network

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Introduction, Classical Sets (Crisp Sets), Fuzzy Sets **(9 Hrs)**

Unit - III

Classical Relations and Fuzzy Relations: Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relations, Tolerance and Equivalence Relations, Noninteractive Fuzzy Sets

Membership Functions: Introduction, Features, Fuzzification, Methods of Membership Value Assignments

Defuzzification: Introduction, Defuzzification Methods

Fuzzy Arithmetic and Fuzzy Measures: Introduction, Fuzzy Arithmetic, Extension Principle, Fuzzy Measures, Measures of Fuzziness, Fuzzy Integrals

Fuzzy Decision Making: Introduction, Individual Decision Making, Multiperson Decision Making, Multiobjective Decision Making, Multiattribute Decision Making, Fuzzy Bayesian Decision Making **(10 Hrs)**

Unit - IV

Introduction: Historical trends in Deep learning, Deep learning: Overview of Methods.

Applied Math for Machine Learning: Linear Algebra, Probability and Information Theory, Numerical Computation.

Deep Networks: Deep Feedforward Networks – Feed Forward networks, Gradient Based learning, Backpropagation; Regularization- Overview, Parameter Penalties, Data Augmentation, Multi Task learning, Bagging, Dropout; Optimization for Training Deep Models – Optimization vs training, Basic Algorithms, Adaptive learning Rates; Convolution Networks – The Convolution operation and CNNs, Convolution Networks, Pooling; Sequence Modeling: Recurrent and recursive Nets – Sequence Modeling, Unfolding Graphs, Recurrent Neural networks, Bidirectional RNNs, Deep Recurrent Networks. **(10 Hrs)**

Unit - V

Deep Learning research: Linear Factor Models- PCA and factor Analysis, ICA; Autoencoders – Stochastic Encoders and Decoders, Denoising Autoencoders, Applications; Representation Learning- Greedy Layer wise Unsupervised Pretraining, Transfer Learning and Domain Adaptation, Semi-supervised Distinguishing of causal factors, Distributed Representation; Structured Probabilistic Models for Deep Learning – Using Graphs to describe model structure, Sampling from Graphical models; Monte Carlo Methods – Markov Chain Monte Carlo Methods, Gibbs Sampling, Deep generative Models – Boltzmann Machines, Deep Belief Networks, Directive Generative nets. **(9 hrs)**

Text books:

[1] S.N Sivanandam, S.N Deepa, “ Principles of Soft Computing”, 3rd Edition, 2015, Wiley.

[2] Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", 1st 2016 MIT press

Reference books :

- [1] Haykin S., "Neural Networks-A Comprehensive Foundations", 3rd Ed, 2012, Pearson
- [2] Kishan Mehrotra, Chilukuri K. Mohan, Sanjay Ranka: "Elements of Artificial Neural Networks", 2nd Edition, 2014, Penram International Publishing
- [3] Simon O Haykin, "Neural Networks and Learning Machines", 3rd 2008, Prentice Hall
- [4] Michael Nielson, "Neural Networks and Deep learning", 2nd 2015, Determination Press

CA 9523 [E1]: BIG DATA ANALYTICS with MAP REDUCE AND HADOOP

Total No. of Lectures : 39	Total Marks : 100	[L - T - P - S]
No. of Lectures / Week : 3	Credits : 3	[2 - 1 - 0 - 2]

Learning Objectives: The course aims to cover Big Data Fundamentals, including the characteristics of Big Data, the sources Big Data (such as social media, sensor data, geospatial data etc), as well as the challenges imposed around information management, data analytics, privacy and security, as well as platforms and architectures. Emphasis will be given on non-relational databases by examining techniques for storing and processing large volumes of structured and unstructured data, streaming data as well as complex analytics on them. Data warehouses will be also presented as a solution to handling big data and business intelligence applications.

Learning Outcomes : Upon Completion of the course, the students will be able to

- Identify and distinguish big data analytics applications
- Describe big data analytics tools
- Explain big data analytics techniques
- Present cases involving big data analytics in solving practical problems
- Conduct big data analytics using system tools
- Suggest appropriate solutions to big data analytics problems

UNIT- I

Introduction to big data: Data, Characteristics of data and Types of digital data:, Sources of data, Working with unstructured data, Evolution and Definition of big data, Characteristics and Need of big data, Challenges of big data.

Big data analytics: Overview of business intelligence, Data science and Analytics, Meaning and Characteristics of big data analytics, Need of big data analytics, Classification of analytics, Challenges to big data analytics, Importance of big data analytics, Basic terminologies in big data environment.

(10 Hrs)

UNIT II

NoSQL Data Management : Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models; relationships, graph databases, schemaless databases, materialized views, distribution models, sharding; master-slave replication; peer-peer replication; sharding and replication; consistency; relaxing consistency; version stamps; Case studies using MongoDB.

(10 Hrs)

UNIT -III

Introduction to Hadoop: Introducing Hadoop, need of Hadoop, limitations of RDBMS, RDBMS versus Hadoop, Distributed Computing Challenges, History of Hadoop , Hadoop Overview, Use Case of Hadoop, Hadoop Distributors, HDFS (Hadoop Distributed File System) , Processing Data with Hadoop, Managing Resources and Applications with Hadoop YARN (Yet another Resource Negotiator), Interacting with Hadoop Ecosystem .

(10 Hrs)

UNIT -IV

Introduction to MAPREDUCE Programming: Introduction , Mapper, Reducer, Combiner, Partitioner , Searching, Sorting , Compression, Real time applications using MapReduce, Data serialization and Working with common serialization formats, Big data serialization formats.

(9 Hrs)

UNIT -V

Introduction to Hive: Introduction to Hive, Hive Architecture , Hive Data Types, Hive File Format, Hive Query Language (HQL), User-Defined Function (UDF) in Hive.

Introduction to Pig: Introduction to Pig, The Anatomy of Pig , Pig on Hadoop , Pig Philosophy , Use Case for Pig: ETL Processing , Pig Latin Overview , Data Types in Pig , Running Pig , Execution Modes of Pig, HDFS Commands, Relational Operators, Piggy Bank , Word Count Example using Pig , Pig at Yahoo!, Pig versus Hive

(9 Hrs)

Text Books:

- [1] Seema Acharya, Subhashini Chellappan “Big Data and Analytics”, 1st Edition, 2015, Wiley International
- [2] S. Mohanthy, Madhu Jagadish, Harsh Srivatsa, “Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics”, 1st Edition, 2015, Wiley Apress

Reference Books:

- [1] Jey Liebowitz, “Big Data and Business Analytics”, 1st Edition, 2014, CRC Press
- [2] Tom White, “Hadoop – Definitive Guide”, 1st Edition, 2015, O’Reilly Publishers

Spark – REPL & RDDs: Dig deeper into Apache Spark, Apache Spark installation, Introduction to RDDs, Using the Spark shell, Actions and Transformations, Caching, Loading and saving data.

Special RDD Operations: Types of RDDs, Aggregations, Partitioning and shuffling, Broadcast variables, Accumulators.

Spark SQL: Introducing Spark Session, Understanding Spark SQL concepts, Using Spark SQL in streaming applications; Spark SQL and DataFrames, DataFrame API and SQL API, Aggregations, Joins.

Spark SQL for Processing Structured and Unstructured Data: data sources in Spark applications, Spark with relational databases, Spark with MongoDB (NoSQL database), Spark with JSON data, Spark with Avro files, Spark with Parquet files, Defining and using custom data sources in Spark **(10 hrs)**

Unit- III

Spark SQL for Data Exploration: Exploratory Data Analysis (EDA), Spark SQL for basic data analysis, Visualizing data with Apache Zeppelin, Sampling data with Spark SQL APIs, Spark SQL for creating pivot tables

Spark SQL for Data Munging: Data munging, Exploring data munging techniques, Munging textual data, Munging time series data, Dealing with variable length records, Preparing data for machine learning

Spark Streaming: Spark Streaming, Discretized streams, Stateful /stateless transformations Check pointing, Interoperability with streaming platforms (Apache Kafka), Structured streaming.

Graphx: A brief introduction to graph theory, GraphX, VertexRDD and EdgeRDD, Graph operators, Pregel API, PageRank; Exploring graphs using GraphFrames, Analyzing JSON input modeled as a graph

Processing graphs containing multiple types of relationships, Understanding GraphFrame internals **(10 hrs)**

Unit- IV

Spark MLLIB & ML: Introduction to machine learning, Spark machine learning APIs, Feature extraction and transformation, Creating a simple pipeline, Unsupervised machine learning, Binary and multiclass classification

Bayes and Nave Bayes: Multinomial classification, Bayesian inference, Naive Bayes, The decision trees

Clustering Data with MLLIB: Unsupervised learning, Clustering techniques, Centroid-based clustering (CC), Hierarchical clustering (HC), Distribution-based clustering (DC), Determining number of clusters, A comparative analysis between clustering algorithms, Submitting Spark job for cluster analysis.

Text Analytics using Spark ML : Understanding text analytics, Transformers and Estimators, Tokenization, StopWordsRemover, NGrams, TF-IDF, Word2Vec, CountVectorizer, Topic modeling using LDA, Implementing text classification. **(9 hrs)**

Unit- V

Spark Tuning: Monitoring Spark jobs, Spark configuration, Common mistakes in Spark app development, Optimization techniques;

Deploying Spark on a Cluster – Spark architecture in a cluster, Deploying the Spark application on a cluster

Testing and Debugging in Spark: Testing in a distributed environment, Testing Spark applications, Debugging Spark applications.

PySparrk & SparkR: Introduction to PySpark, Installation and configuration, Introducing SparkR, the SparkR architecture, SparkR DataFrames, SparkR for EDA and data munging tasks, SparkR for computing summary statistics, SparkR for data visualization, SparkR for machine learning **(9 hrs)**

Text Books:

- [1] Md. Rezaul Karim, Sridhar Alla, “Scala and Spark for Big Data Analytics - Harness the power of Scala to program Spark and analyze tonnes of data in the blink of an eye”, 1st Ed, 2017, PACKT
- [2] Romeo Kienzler, “Mastering Apache Spark 2.x”, 2nd Edition, 2016, PACKT Publishers

Reference Books:

- [1] Ilya Ganelin, Ema Orhian, Kai Sasaki, Brennon York, “Spark: Big Data Cluster Computing in Production”, 1st Edition, 2016, Wiley
- [2] Rishi Yadav, “Apache Spark 2.x Cookbook”, 2nd Edition, 2016, PACKT Publishers
- [3] Dean Wampler, Alex Payne, “Programming Scala, Scalability = Functional Programming + Objects”, 2nd Edition, 2016, O’Reilly Publishers
- [4] Jason Swartz, “Learning Scala Practical Functional Programming for the JVM”, 2016, O’Reilly
- [5] Guller, Mohammed, “Big Data Analytics with Spark A Practitioner's Guide to Using Spark for Large Scale Data Analysis”, 2nd Edition, 2016, Apress
- [6] Luu, Hien, “Beginning Apache Spark 2 With Resilient Distributed Datasets, Spark SQL, Structured Streaming and Spark Machine Learning library”, 2nd Ed, 2016, Apress Edition
- [7] Nabi, Zubair, “Pro Spark Streaming The Zen of Real-Time Analytics Using Apache Spark”, 2nd Edition, 2017, Apress Edition.
- [8] Matei Zaharia, Holden Karau, Andy Konwinski, Patrick Wendell, “Learning Spark Lightning-Fast Big Data Analysis”, 2nd Edition, 2017, O’Reilly Publishers

Using Dashboards to get Results: Enriching data with mashups, Page trails, Guided analytics with Tableau, Sharing results in a meeting, Notes and annotations, Using external data to enrich your dashboard. **(10 hrs)**

UNIT - II

Putting the Dash into Dashboards: Choosing the visualization, Using parameters in dashboards, Using custom geocoding in Tableau, Profiting from Big Data to rev your visualization, Filtering data for focus

Creating choices in dashboards using conditional logic

Making Dashboards Relevant: Adding an infographic to your Tableau dashboard, String manipulation in dashboards, Correcting data exports from Tableau to Excel, Blending data, Optimizing tips for efficient, fast visualization

Visual Best Practices: Coloring the numbers, Dueling with dual axes, three dimensional data, pie charts or not? Sizing to make a data story.

Connecting to Data Sources: Connecting to text files- to Excel files - to Access databases - to a SQL Server; Pasting from a clipboard; Connecting to other databases, Connecting to Windows Azure Marketplace, dimensions and measures, Changing data types, Applying filters, Merging multiple data sources. **(10 hrs)**

UNIT - III

Creating Univariate Charts: Creating tables, bar graphs, pie charts, sorting the graphs, creating histograms, line charts, Using the Show Me toolbar, stacked bar graphs, box plots, Showing aggregate measures.

Creating Bivariate Charts: Creating tables, Creating scatter plots, Swapping rows and columns, Adding trend lines, Selecting color palettes, Using dates.

Creating Multivariate Charts: Creating facets, area charts, bullet graphs, dual axes charts, Gantt charts, heat maps

Creating Maps: Setting geographic roles, Placing marks on a map, Overlaying demographic data, Creating choropleth maps, Using polygon shapes, Customizing maps. **(10 hrs)**

UNIT - IV

Calculating User Defined Fields : Using predefined functions, Calculating percentages, Applying the If-Then logic, Applying logical functions, Showing totals, percentage of totals, Discretizing data, Manipulating text, Aggregating data.

Advanced Features: Viewing data, Changing the mark size, Using the presentation mode, Adding annotations, Excluding data on the fly, Customizing mark shapes, Adding drop-down

selectors, Adding search box selectors, Adding slider selectors, Creating dashboards, Creating animated visualizations, Creating parameters

Tableau Public: Tableau Public overview, Telling story with Tableau Public, Installing Tableau Public

Opening files and creating profile, Discover, Explore; Tableau Public user interface, Using the Marks card, The Show Me tool; Connecting Data - Public data, Tables and databases, data sources that Tableau Public connects to, The databases, tables, dimensions, facts, field formats and conventions, Connecting to the data in Tableau Public. **(09 hrs)**

UNIT - V

Calculations: Creating calculated fields, Types of calculations -number functions, date functions, Type conversions, string functions, aggregate functions, logic functions, Blending data sources; Creating quick table calculations, Changing over time, Compute using Manually editing table calculations, Ranking The level of detail calculations

Dashboard Design and Style: Dashboard design process, Best practices for dashboard design, Creating a dashboard, dashboard tab interface, Setting the size of dashboard elements, Adding and using Filters, Filtering across Data sources with parameters, Actions, URL actions.

(9 hrs)

Text Books:

- [1] David Baldwin, "Mastering Tableau - Master the intricacies of Tableau to create effective data visualizations", 1st Ed, 2017, PACKT
- [2] Acharya, Seema, Chellappan, Subhashini, "Pro Tableau A Step-by-Step Guide", 2017, Apress
- [3] Joshua N. Milligan, "Learning Tableau 10", 2nd Edition, 2016, PACKT Publishers

Reference Books:

- [1] Jen Stirrup et al., "Tableau: Creating Interactive Data Visualizations", 2nd Ed, 2016, PACKT
- [2] Joshua N. Milligan, Donabel Santos, "Tableau 10 Bootcamp", 1st Edition, 2015, PACKT
- [3] Ryan Sleeper, "Practical Tableau -100 Tips, Tutorials, and Strategies from a Tableau Zen Master", 2nd Edition, 2016, O'Reilly Publishers
- [4] Ben Jones, "Communicating Data with Tableau - Designing, Developing, and Delivering Data Visualizations", 1st Edition, 2015, O'Reilly Publishers
- [5] Jen Stirrup, Ruben Oliva Ramos, "Advanced Analytics with R and Tableau", 2nd Edition, 2017, PACKT Publishers

- [6] Joshua N. Milligan, "Learning Tableau", 1st Edition, 2016, PACKT
- [7] Ashutosh Nandeshwar, "Tableau Data Visualization Cookbook", 2nd Edition, 2016, PACKT
- [8] Chandraish Sinha, "Tableau 10 for Beginners : Step by Step Guide to Developing Visualizations in Tableau 10", 1st Edition, 2015, Create Space Publishers
- [9] Khan, Arshad, "Jumpstart Tableau A Step-By-Step Guide to Better Data Visualization", 1st Edition, 2016, Apress International

CA 9P1 & CA 9P2: Web Application Development & .NET Lab

CA 9P3 & CA 9P4: Machine Learning & Big Data Lab

CA 9623: BUSINESS CONSULTANCY PROJECT

Total Marks	: 100	Final Viva	: 100	[L - T - P - S]
Internal Assessment	: 50	Credits	: 3	[0 - 2 - 4 - 4]

Learning Objectives : The purpose of a thesis is to enable the student to develop deeper knowledge, understanding, capabilities and attitudes in the context of the programme of study. The thesis offers the opportunity to delve more deeply into and synthesise knowledge acquired in previous studies. A thesis for a Domain Knowledge should place emphasis on the technical/scientific/artistic aspects of the subject matter.

Graduates are prepared to serve as project leaders and team members who add value through innovation, customer focus, prudence, and professional responsibility, consistent with the objectives of the projects in which they are involved and the organizations they support.

Learning Outcomes for a thesis are based on the objectives for MCA has Specific learning outcomes: for the student to demonstrate:

- Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.

- Concepts to address specific management needs at the individual, team, division and/or organizational level
- Practical applications of project management to formulate strategies allowing organizations to achieve strategic goals
- A perspective of leadership effectiveness in organizations
- Team-building skills required to support successful performance
- Critical-thinking and analytical decision-making capabilities to investigate complex business problems to propose project-based solutions
- Skills to manage creative teams and project processes effectively and efficiently

GUIDELINES FOR REPORT WRITING

1. Title Page

First page of report

Try to find a title that clearly describes the work you have done and be as precise as possible [Capital 'Cambria – 16 font size].

Mention your name, name of the department (i.e. Department of Computer Applications), name of the university (SJIT, St Joseph's University),

place and month and year of submission of the report [all those above will be centre alignment, font size 14, and your name, previous degree (14 font size, italics) will be font size 16] [Check Annexure – I]

Second Page

There should be a Forwarding Certificate page of standard format signed by the supervisor (Internal, and external if any), Head of the department and Dean of the School with date and seal. [Check Annexure – II]

Third Page

There should be a Certificate of Approval page of standard format signed by the Committee members of the viva-voce. [Check Annexure – III]

Fourth Page

Declaration by the student
(Check Annexure – IV)

General Introduction

- The Report should be prepared in A-4 (21x29.7 cm, or 8.5x11 inch) size sheet.
- Please remember that only distinct black print on clean white paper will be reproduced early, and margin widths and spacing must be rigidly observed.
- As the report will also be kept in CD format, color illustrations or figures are acceptable.
- Gray scale material may be used if necessary.
- The Final Report will be hard bind format in maroon rexin materials.
- Students need to submit (One copy for Internal Supervisor, One copy for external Supervisor (if any), One copy for Departmental Library, One copy for main library, One copy for student)
- 4 or 5 copies of the report (hard binding) along with pdf version of complete thesis in CD.
- Manuscripts should be typed with 1.5 spacing except for headlines.
- The font type should be Times New Roman or Cambria (shown here), as close as possible.
- Laser Printed manuscripts on A4 (or 8.5x11 inch) Sheets with 12-point letters, you may prepare your manuscript directly.
- Standard character spacing and a line spacing of 13-point will result as you see in this sheet.
- The side margins of 30 mm each. The top margin should be 30 mm for the title page only and 22 mm on all subsequent pages. The bottom margin should be 29mm.

Description of Major Headings

1. This sheet is type set in accordance with the style to be followed for the headings.
2. Major headings are in upper and lower case letters printed bold without underlining.
3. They should appear with left-hand justified in the sheet.
4. In order to save space, a blankline should be placed only before major headings and subheadings.

Subheadings

- Sub-subheadings are to be in lower case with an initial capital without underlining.
- They should start on a separate line at the left hand margin beginning with Parenthesized letters in alphabetical or numerical order.
- Equations are to be numbered consecutively throughout the text.
- The equation number should be placed in parentheses and flush with the right-hand margin of the column.
- Leave a blank line before and after equations.

- The font sizes are demonstrated: Usages - 10 points; For subscript and footnotes - 12 points For body text, sub headings - 14 points Main headings.
- The graphs should be scaled.
- The quantities represented by the abscissa and coordinate should be written briefly in words with corresponding units clearly stated.

2. Abstract

- On a separate page, (shown in this guidelines), summarize the main points of the report.
- Persons getting interested in the report after reading the title should be able to judge from the abstract whether the report is really interesting for them.
- So, briefly formulate the problem that has been investigated, (i) objectives and their rationale in brief, (ii) methodology adopted in brief, (iii) high points of the findings including recommendation.
- The abstract should not occupy more than one page (about 400 to 500 words). This page should precede the content page.

3. Table of Contents (TOC)

- Should list only those items that follow it appearing in the following order
 - List of tables (1.1, 1.2, 1.3., 2.1, 2.2, .. etc.)
 - List of figures (1.1, 1.2, 1.3., 2.1, 2.2, .. etc.)
 - Nomenclature: necessary whenever the number of symbols exceeds 0.
- This is in order of English (i.e., Roman) letters (Uppercase followed by lowercase), Symbols in Greek letters, subscripts and superscripts used, Special Symbols, followed by acronyms (i.e., Abbreviations) if any; everything in alphabetical order.
- All entries in nomenclature should have appropriate units in SI system.
 - The chapters (1, 2, ... N, followed by the name of the chapter),
 - Sections within chapters (e.g. 1.1, 2.4, etc. + name)
 - Subsections within sections (e.g. 1.1.1 + name)
 - Appendices (I, II, III, IV, .. etc. + name), if any - References

The page numbers where they start

- Do not include the abstract and the table of contents itself in the table of contents.
- Every page of the report other than the title page and abstract should be numbered

- Pages of Table of Contents, Nomenclature, List of Tables and List of Figures should be numbered with lower case Roman numerals (i, ii, iii, iv, ...etc.).
- From the first page of the first chapter onwards, all the pages should be numbered using Hindu-Arabic numerals (1, 2, 3, ... etc.).

4. The Chapters

- The number of chapters you need and their contents strongly depend on the topic selected and the subject matter to be presented.
- Roughly the following chapters may be included.
- However, it is your own report and you have to structure it according to the flow of overall logic and organization.
- Each chapter, section, subsection, etc. should have a title.
- An identical entry should exist in the TOC.
- Each chapter is numbered using Hindu-Arabic numerals:
- 1, 2, 3, ... Sections within a chapter are numbered using a two level scheme, (chapter no).(section no); for example, sections in chapter 3 are numbered 3.1, 3.2, 3.3, ... Subsections within a section are numbered using a three-level scheme, (chapter no).(section no).(subsection no); for example, subsections in chapter 3, section 2 are numbered 3.2.1, 3.2.2, 3.2.3, ...
- General Structure of the Dissertation Initial Pages (As mentioned above)
Chapter 1: Introduction
Chapter 2: Review of literature
Chapter 3: Methodology (or Materials and Methods)
Chapter 4: Theoretical Consideration or Model development (Optional)
Chapter 4 or 5: Results and Discussion
Chapter 5: Conclusions List of Reference (as per standard style: Ref Annexure V)
Appendices
List of Publications

Introduction

In this chapter you formulate the problem that you want to address, the initial goals you had, etc. without going into details. Here you also describe the structure of the rest of your report, indicating which chapter will address which issue.

Review of literature

The discussion on the literature may be organized under a separate chapter & titled suitably.

Summarize the literature that you have read. Rather than literally copying the texts that you have

e read, you should present your own interpretation of the theory. This will help you in developing your own thinking discipline and technical language.

Theory Oriented Chapters

The basic theory necessary to formulate the subject matter may be presented under a separate chapter & titled suitably.

Practice Oriented Chapters (experiment design)

Depending on the work that you have done, it might be important to write about the system specifications, practical details, system behavior and characteristics and cross links of the selected topic.

Conclusions This is one of the most important chapters and should be carefully written. Here you evaluate your study, states which of the initial goals were reached and which not, mention the strong and weak points of your work, etc. You may point out the issues recommended for future research.

5. Equations

Each equation should be numbered using a two-level scheme, (chapter no).(eq no).

While typing, the equation numbers should be flush right.

(Use MS Word Equation editor or LaTeX) This number (e.g. 2.4, with 2 as chapter number and 4 as equation number) should be used (as Eqn. 2.4)

Whenever the equation is referred in the text. The equations should be clearly written.

Symbols used in the equations should be explained immediately after the equation

when they are referred first as well as in the nomenclature. SI units must be used throughout the report. Example: $a = b + c$ (3.14)

6. Acronyms

Avoid acronyms (short forms) in the report except the following standard ones. Equation(s): Eq(s), Figure(s): Fig(s). The words 'Table' and 'Chapter' are not shortened. If any other acronyms have to be used, list them separately at the beginning (after nomenclature). Mention the acronym in the brackets following its full form, whenever it occurs first. The first word in a sentence is never a short form.

7. Tables and figures

Tables and figures should be numbered and captioned. Each table or figure should be numbered using a two-level scheme, (chapter no). (Table no) or (chapter no). (figure no).

This number (e.g. Table 4.8, or Fig. 3.7) should be used whenever the equation is referred in the text. Each table as well as figure should have a title. An identical entry should exist in List of Tables or List of Figures respectively. Title of a table is given at the top of the table following its number. Title of a figure is given at the bottom of the figure following its number. Tables and figures should be on separate pages immediately following the page where they are referred first.

Photocopied tables should not be included.

Photocopied figures should be avoided as far as possible and if included they should be large enough and clear. If taken from any reference, the reference should be cited within the text as well as at the caption of the figure or table.

1. Bibliography style as per the University Standards

2. The Appendices

Appendices are useful for those things that you consider important, but that do not fit in the main presentation of your work.

There could be several reasons for using appendices: the material is too long and has too many details

(e.g. the specifications of instruments or equipment), you have formulated a theorem, the proof of which is too long for the main text, you want to include a user manual for the software that you have come across (strongly recommended!), you want to present the schematics of a hardware design, experimental set-up, survey proforma etc.

Appendices tend to occupy many pages. Think carefully on what you want to include.

Appendices follow chapters, and are numbered using Roman numerals (Appendix I, Appendix II, Appendix III, etc.) in this format.

SEMINAR AND TECHNICAL COMMUNICATION - II

Introduction

Graduates of final year IT program are supposed to design and implement projects through knowledge and skills acquired in previous semesters. Students should identify complex engineering problems and find effective, efficient and innovative ways of solving them through their projects.

In a technical seminar, students should aim to review literature in a focused way for identifying a complex problem to be attempted in their final year project. Seminar should make the student attain skills like

- a. gathering of literature in specific area in a focused manner
- b. effectively summarizing the literature to find state-of-the-art in proposed area
- c. identifying scope for future work
- d. presenting (arguing) the case for the intended work to be done as project
- e. reporting literature review and proposed work in scientific way using good English.

Course Objectives :

- To perform focused study of published or unpublished research literature relevant to a specific topic.
- To study, interpret and summarize literature scientifically.
- To build independent thinking on complex problems.
- To build collaborative work practices
- To communicate scientific information to a larger audience.
- To use presentation standards and guidelines effectively.
- To be ethical in presenting purpose, sources, conduct and use of the literature reviewed.
- To define future work or problem statement for projects.

Course Outcomes :

- Gather, organize, summarize and interpret literature with the purpose of formulating a proposal.
- Write a technical report summarizing state-of-the-art on an identified topic.
- Present the study using graphics and multimedia techniques.
- Define intended future work based on the technical review.

GUIDELINES FOR PROJECT BASED SEMINAR (PBS)

3. A group of 3-4 students shall identify problem(s) in Computer Engineering / Information Technology referring to recent trends and developments in consultation with institute guide.
4. The group must review sufficient literature (books, journal articles, conference papers, magazines, web resources etc.) in relevant area in parts (allocated to each student) decided by the SIG guide.
5. Research articles could be referred from IEEE, ACM, Science direct, Springer, Elsevier, IETE,CSI or from freely available digital libraries like Digital Library of India (dli.ernet.in), National Science Digital Library, JRD Tata Memorial Library, citeseerx.ist.psu.edu,

getcited.org, arizona.openrepository.com, Open J-Gate, Research Gate, worldwidescience.org etc.

6. The group shall present the study as individual seminars in 20 – 25 minutes concluding with the solution to problem identified as their project statement.
7. Each student shall submit two copies of the seminar report in a prescribed format duly signed by the guide and Head of the department.
8. Internal guide shall define a project statement based on the study by student group.
9. Broad contents of review report (20-25 pages) shall be
 - i. Introduction of specific topic
 - ii. Motivation, purpose and scope of review
 - iii. Related work with citations
 - iv. Discussion (your own reflections and analysis)
 - v. Conclusions
 - vi. Project definition. (Short version of RUP's vision document if possible).
 - vii. Bibliography

EVALUATION SCHEME (for add on certification)

- a) A panel of staff members from the institute will assess the seminar internally during the presentation
- b) Attendance for all seminars for all students is compulsory.
- c) Criteria for evaluation
 - i. Relevance of topic - 05 Marks
 - ii. Relevance + depth of literature reviewed - 10 Marks
 - iii. Seminar report (Technical Content) - 10 Marks
 - iv. Seminar report (Language) - 05 Marks
 - v. Presentation Slides - 05 Marks
 - vi. Communication Skills - 05 Marks
 - vii. Question and Answers - 10 Marks

Reference Books

1. Gersen and Gersen, "Technical Writing: Process and Product" 6th Ed, 2012, Pearson Education Asia.
2. Rutherford, "Basic Communication Skills for Technology", 3rd Ed, 2009, Pearson Education Asia.
3. Lesikar, "Lesikar's Basic Business Communication", 2011; McGraw Hill Publishers

IV SEMESTER

CA 9723 : INDUSTRY INTERNSHIP / PROJECT WORK

Total Marks	: 500	External	: 300	[L - T - P - S]
Internal Assessment	: 200	Credits	: 15	[0 - 2 - 0 - 10]

Learning Objectives:

To provide students with an opportunity to gain work experience that will enhance and complement their academic learning. The course requirements are designed to provide a structure that will enable students to make connections between what they learn in the classroom and on the job, to further develop analytical and interpersonal skills, and to practice business writing skills.

Course Requirements

1. The Internship / Project work / Dissertation for credit requires students to spend the majority of their time in technical, analytical, or administrative work that will contribute to their learning as outlined in the course objectives.
2. Work of a clerical nature must be limited to a maximum of 15 percent of the time spent on the job.
3. Prior to beginning an internship for credit, students must receive an internship orientation at the Training and Placement Cell of SJIIT..
4. A meeting with the faculty advisor / Guide to cover the ground rules and requirements.
5. Submission of the Final Report within seven days of the completion of the internship

The body of the Final Report will cover the following:

- **Job description:** Describe in detail your internship position duties and responsibilities. Discuss what duties were performed on a daily basis, periodic (e.g., weekly) basis, and one-time special projects.
- **Knowledge gained:** Describe the knowledge gained or enhanced as a result of your internship experience. Relate this knowledge to what you learned in specific courses at AIMIT. Did your courses prepare you to handle the responsibilities of your position?
- **Skills learned:** Describe the skills that you learned or sharpened on the job. Discuss any skills that you learned as part of a course at SJIIT that were useful on the job. Consider a skill as the ability to do something like problem solving, analyze a problem, work in a groups, etc.
- **Attitudes/values:** Describe the attitudes or values that you found to be important for success in your job. Think of attitudes as a way of thinking or behavior, e.g., stubborn, patient, confrontational, etc. Consider values as the things you regard as important in life, e.g., dependability, integrity, hard work, etc.

- **Learning outcomes:** Identify the outcomes or results from the knowledge, skills and attitudes or values that you have described above. For example, what can you do for an organization today that you could not have done, or could not have done as well, before your internship

Guidelines to prepare the Project Document / Dissertation

The following format guidelines are intended to help you prepare your master's thesis or dissertation and should be used in conjunction with the specific style adopted by your IT program. It is your responsibility to conform to the following format requirements and ensure that your manuscript's presentation is of the highest quality. Because requirements may change over time, students should not use existing library or departmental copies of manuscripts as examples of proper format.

Format

All pages of your manuscript must be in 'Letter Size', 8 ½ X 11 inch, format.

Reproduction Quality

The copies of your manuscript must be clean, unshaded, and free of spots and smudges. Faint, streaked, or uneven copies are unacceptable.

Margins

The left margin of each page must be 1 1/2 inches, and the top, right, and bottom margins 1 inch.

Placement of Page Numbers

There are only two ways to paginate your manuscript; upper right hand corner and bottom center. If your page numbers are at the bottom, leave two blank line spaces between the last line of text and the line on which the page number is placed. Whether they are at the top or the bottom, page numbers should appear just outside the 1-inch margins (.5 to .8 inches from the top or bottom edge of the page. Whichever method of pagination is selected, it must be followed consistently. Use lower-case Roman numerals for the front matter (which is all pages before the body of research), create section break and continue (beginning again with page "1") with Arabic numerals for the remainder of the manuscript, including the text, illustrations, appendices and references.

Type and Font

Your manuscript should be double-spaced (one and a half spaces can be used if approved by the chair of your committee) and single-sided. References may be single-spaced with a double space between each reference. Indented quotations may also be single-spaced. Use a professional quality font (e.g., Arial, Times Roman, Courier or Helvetica). Font size for your text should be 12 point; headings may be up to 14 point. Fonts for tables, figures, and appendices may range from 8 to 12 point.

Style

The style of your thesis or dissertation may follow any one of many standard style guides, as preferred by your graduate unit, or the style considered standard in your particular discipline. You should consult your advisor for preferences or additional requirements your department may have. In any case, your manuscript must be internally consistent.

Format Guidelines

Thesis or dissertation manuscripts are generally divided into three sections – the Front Matter, the Body of Research, and the Reference Matter.

For a visual reference to format the Front Matter, utilize the Example of Completed Front Matter link at the Approval Template page. A Thesis Example and a Dissertation Example will help you format the Front Matter for pagination and the placement of the proper order of the front matter pages which can be generated at the "MS Word Templates" page.

Approval (Signature) Page

The Approval Page is the first page of the Front Matter and the manuscript. Count this as page "i". Type the names of the committee members on the lines provided at the center of the page.

Title Page

The Title page contains the title of your manuscript, your name, your previous degrees (including your majors, institutions and years centered on the page). Count the title page as page "ii". The degree you will be receiving at SJU, and the month and year of your graduation should be listed toward the bottom of the page (check with Graduate Studies for the graduation date). When listing the degree to be awarded, please refer to the Master's Degree List included with these guidelines. Do not use abbreviations.

Dedication Page

This is an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The dedication itself may be single or double-spaced.

Acknowledgement Page

This is also an optional page. If you use one, number it in appropriate sequence with a lower-case Roman numeral. The title must be in capital letters, centered just below the top margin of the page. The acknowledgment itself may be single or double-spaced.

Abstract Page

On the Abstract page first list the title of your manuscript, your name, all degrees you have already earned (in chronological order), and the degree to be awarded. These lines should be centered on the page, beginning just below the top margin. Then double-space, and on the following line, center the word ABSTRACT. Double-space again before beginning the text of your

abstract. Use paragraph indentation as appropriate. The text itself should be either one and a half spaces or double-spaced.

Number the Abstract Page in appropriate sequence with a lower-case Roman numeral.

Table of Contents

The Table of Contents page is counted and numbered with a lower-case Roman numeral. If you have used a List of Figures (Optional) and/or a List of Tables (Optional) , they must be included in your Table of Contents. Tab leaders should be used between the heading levels and the page numbers. (DO NOT simply type dots across the page--the spacing will not work out. Instead, set a dot leader tab. If you have multiple appendices, they must each be listed (see section on Appendices).

List of Figures

Placed on separate page after the Table of Contents. This page is counted and numbered with a lower-case Roman numeral. It may be single or double-spaced. Tab leaders should be used between the title of the figures and page the numbers. This page should be listed at the beginning of the Table of Contents.

List of Tables

Placed on separate after the Table of Contents. This page is counted and numbered with a lower-case Roman numeral. It may be single or double-spaced. Tab leaders should be used between the title of the tables and the page numbers. This page should be listed after the List of Figures at the beginning of the Table of Contents.

Preface Page

This page is counted and numbered with a lower-case Roman numeral.

The Text

Beginning with the first page of the text (begin again with page "1"), pages are numbered with sequential Arabic numerals through the end of your manuscript. Each chapter/major division of the text must start on a new page. Each of these lead pages should be counted and numbered.

Figures

Figures may include diagrams, charts, drawings, schematics, photographs, etc. Each of the two required copies of your manuscript must contain its own original figures, with the exception of photographs, in which case both may be high-quality copies either in color or black and white. Figures should be inserted as near as reasonably possible to the text to which they relate. They should be numbered consecutively with Arabic numerals as part of the continuing text.

Figures and their captions must appear on the same page, within the required margins. If captions are more than one line long, they may be single-spaced. They should be placed on paper of the same size and weight as the rest of the manuscript. Colored materials are acceptable, but

since color does not reproduce on microfilm, an alternate key should be provided if it will be needed for interpretation of the figure in black and white.

Oversized figures may be presented in one of two ways: A horizontal figure that is too wide to fit on a regular manuscript page may be mounted on another piece of paper at the left hand margin, and folded like a fan. The folds must be within the right hand margin.

A figure that is both too long and too wide may be folded and inserted into a 6 ½ x 9 " envelope that is mounted on another sheet of paper.

Tables

Tables that are a half-page or shorter in size may be placed at the top or the bottom of the page, or in the center, with text above and below. Tables may also be placed alone on the page immediately following the page that refers to them. The placement of tables should be consistent throughout the manuscript. Tables continuing for more than one page should be labeled [e.g., Table 1 (cont.)], and oversized tables should be treated in the same way as oversized figures.

Reference matter

It may include notes to the text, appendices, a glossary, a list of references, and an index. The appendices and the list of references are the two most commonly used categories, and are discussed in detail below.

Appendices

The appendix (or a series of appendices) usually follows the main text, and contains material that is useful for a detailed review of the study, but is not essential to an understanding of the text. For example, an appendix is the appropriate section in which to place material such as raw data, the results of individual laboratory analyses, or sample forms. This may be useful supporting data even though it is not specifically utilized in the text. Note, however, that some reference should be made in the text to the fact that these materials appear in the appendix. The pages of the appendices are numbered in sequence with those of the text. Although it is preferable, you do not have to meet margin requirements for the material in your appendix, except for the left-hand margin.

After the last page of text, include a list of Appendices on a separate page. Individual appendices should start on a separate page and should be clearly marked.

The List of Appendices should also be included in the Table of Contents. To list appendices in your Table of Contents, use "Appendices" as your major heading. On the next line, indent five spaces, and begin listing each appendix with its title (for example, "Appendix A. Survey Data") and page number.

List of References

No manuscript is complete without a full listing of the necessary bibliographic information about the sources upon which the study is based. In most cases, only those sources actually cited in the

study are listed. This section will be called "List of References", "References Cited", or simply "References", and all pages are counted and numbered. The list is most often arranged alphabetically, although it may follow some other logical plan. It will follow the appendices.

Problems encountered:

Front Matter

Formatting on front material is very detailed. Make sure that formatting matches examples. Make sure that pages are numbered correctly.

Margins

Margins for the entire manuscript must be:

left - 1.5 inches; top, right, bottom - 1 inch

Exceptions: Top, right and bottom margins may vary in the Appendix pages, but the left margin must be 1.5 inches throughout the ENTIRE manuscript. Page numbers in the Appendices must also appear consistently as in the rest of the manuscript.

Landscape-oriented figures and tables

Margin requirements must be met, and page numbers must be placed consistently as in the rest of the manuscript.

Table of Contents/Headings & Subheadings within manuscripts

Your Table of Contents will be checked against the body of your manuscript.

Page numbers must be correct.

All headings/sub-headings that appear at the same level should have the same appearance in the body of the manuscript and be distinguished from other heading-levels by appearance or numbering.

All headings and subheadings (as many levels as you include in the Table of Contents) should appear in the Table of Contents. If you have some third-level headings in the Table of Contents, then ALL third-level subheadings should appear in the Table of Contents. The major section headings (usually Chapter headings) should each begin on a new page. Other levels should not be started on a new page.

Forms

Your manuscript must be accompanied by ALL the appropriate completed forms or it will not be accepted.

Please Note: The problems listed above are among the most common, but manuscripts can be returned for other problems as well.
