Savitribai Phule Pune University, Pune

Faculty of Commerce and Management

Master of Computer Application (MCA)

Programme Curriculum

(Pattern 2024)

(With Effect from Academic Year 2024-25)

Revised 2-year, 4 Semester Full time Programme Choice Based Credit System (CBCS) and Grading System Outcome Based Education Pattern Aligned with National Education Policy (NEP) 2020

MCA 1st year effective from A.Y. 2024 – 25

MCA 2nd year effective from A.Y. 2025 - 26

Preamble:

1. The name of the programme shall be Master of Computer Application (M.C.A)
2. The revised MCA Curriculum 2024 builds on the implementation of the Choice Based Credit System (CBCS). The curriculum takes the MCA programme to the next level in terms of implementing National Education Policy (NEP) and Outcome Based Education (OBE) along with the CBCS and Grading System.
3. The Institutes should assist in placements for M.C.A. students by interacting with Industries. Institute's placement cell should focus on identifying industrial expectations and institutional preparation for meeting industrial needs.
4. Industry and academia should identify possible areas of collaboration and work together to cater to the rapidly changing scenario.
5. During each semester students can attempt to complete various certifications for better opportunities in the industry.

Introduction:

1. Definition: Outcome Based Education:

1.1 Outcome Based Education (OBE) Approach: Outcomes are about performance, and this implies:

1.1.1 There must be a performer – the student (learner), not only the teacher

1.1.2 There must be something performable (thus demonstrable or assessable) to perform

1.1.3 The focus is on the performance, not the activity or task to be performed

1.2 Programme Educational Objectives (PEOs): Programme educational objectives are broad statements that describe the career and professional accomplishments that the programme is preparing graduates to achieve. Programme Educational Objectives are a set of broad future focused learner's performance outcomes that explicitly identify what learners will be able to do with what they have learned, and what they will be like after they leave institution and are living full and productive lives. Thus, PEOs are what the programme is preparing graduates for in their career and professional life (to attain within a few years after graduation).

1.3 Programme Outcomes (POs): Programme Outcomes are a set of narrow statements that describes what students (learners) of the programme are expected to know and be able to perform or attain by the time of graduation.

1.4 Course Outcomes (COs): Course Outcomes are narrower statements that describe what students are expected to know and be able to do at the end of each course. These relate to the skills, knowledge, and behavior that students acquire in their matriculation through the course.

1.5 Learning Outcomes: A learning outcome is what a student CAN DO because of a learning experience. It describes a specific task that he/she can perform at a given level of competence under a certain situation. The three broad types of learning outcomes are: a) Disciplinary knowledge and skills b) Generic skills c) Attitudes and values

1.6 Teaching and Learning Activities (TLAs): The set of pedagogical tools and techniques or the teaching and learning activities that aim to help students to attain the intended learning outcomes and engage them in these learning activities through the teaching process.

1.7 Assessment and Evaluation: Assessment is one or more processes, carried out by the institution, that identify, collect, and prepare data to evaluate the achievement of programme educational objectives and programme outcomes. Evaluation is one or more processes, done by the evaluation team, for interpreting the data and evidence accumulated through assessment

practices evaluation determines the extent to which programme educational objectives or programme outcomes are being achieved, and results in decisions and actions to improve the programme.

2. MCA Programme Focus:

The basic objective of the Master of Computer Application (MCA) is to provide a steady stream of necessary knowledge, skills and foundation for acquiring a wide range of rewarding careers into rapidly expanding world of Information Technology

2.1 Programme Educational Objectives: PEOs are defined by institution. Following are the guidelines for defining PEOs

2.1.1 PEOs should be assessable and realistic within the context of the committed resources.

2.1.2 The PEOs should be consistent with the mission of the institution.

2.1.3 All the stakeholders should participate in the process of framing PEOs.

2.1.4 The number of PEOs should be manageable.

2.1.5 It should be based on the needs of the stakeholders.

2.1.6 It should be achievable by the programme.

2.1.7 It should be specific to the programme and not too broad.

2.1.8 It should not be too narrow and similar to the POs.

2.2 MCA Programme Outcomes (POs):

Learners are expected to know and be able to		
PO1	**Computing Knowledge**	Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
PO2	**Problem Analysis**	Identify, formulate, research literature, and solve complex Computing problems reaching substantiated conclusions using fundamental principles of Mathematics, Computing sciences, and relevant domain disciplines.
PO3	**Design & Development**	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO4	**Research & Development**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5	**Prompt Tool Usage**	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO6	**Ethical Practices**	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO7	**Life Long Learning**	Recognize the need, and have the ability, to engage in independent learning for continual development as a Computing professional.
PO8	**Professional Skills**	Demonstrate knowledge and understanding of computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO9	**Communication Skills**	Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
PO10	**Societal Contribution**	Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
PO11	**Teamwork & Leadership**	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
PO12	**Innovation & Sustainability**	Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

3. Admission Details:

3.1 Eligibility for Admission: The eligibility criteria for admission for the MCA course will be as decided by the All India Council of Technical Education (AICTE), New Delhi and Directorate of Technical Education (DTE), Government of Maharashtra. It will publish on their respective websites time to time.

3.2 Reservation of Seat: The percentage of seat reserved for candidates belonging to backward classes only from Maharashtra State in all the Government Aided, Un-aided Institutions/Colleges and University Departments is as per the norms given by Government of Maharashtra, time to time.

3.3 Selection Basis: The selection would be done as per the guidelines given by the Director of Technical Education, Maharashtra State, time to time.

***Bridge course:** Bridge course for Non- IT/ CS students shall be conducted by the Institute.

4. Lecture-Practical-Project

A course shall have either or all the three components, i.e. a course may have only lecture component, or only practical/project component or a combination of any two/three components.

The MCA programme is a combination of:

a. Three-Credit Courses (75 Marks each)
b. One-Credit Courses (25 Marks each)
c. Six- Credit Courses (100 Marks)
d. Three-Credit MOOC courses (50 marks each)
e. Three-Credit Practical courses and Mini Project (50 marks each)

f. Twelve Credit FP/OJT (Internal 150 marks & External 300 marks).

The curriculum of MCA is providing freedom to choose subjects based on their interests, regardless of their academic stream. This shift encourages disciplinary learning, enabling students to explore diverse fields and broaden their knowledge horizons. The choice based subjects start from the first semester and provide flexible options throughout the semesters.

4.1 Lecture(L): Classroom sessions delivered by faculty in an interactive mode. It should be conducted as per the scheme of lectures indicated in respective course.

4.2 Practical/Project(P): Practical / Project Work consisting of Hands-on experience /Field Studies / Case studies that equip students to acquire the much-required skill component. Besides separate Practical/Project course, three course in each semester include few practical assignment and it will be evaluated under internal evaluation

4.3 A Mini project is an assignment that the student needs to complete at the end of every semester in first year, in order to strengthen the understanding of fundamentals through effective application of the courses learnt.

4.4 The Field Project (FP)/On Job Training(OJT): To be conducted in the FINAL Semester and evaluated at the end of the semester. The detail guidelines have been in the respective course structure.

5. Elective Courses (EC):

Institute has to offer six elective courses with 3 credits from Semester I to Semester III. The motive behind keeping an elective course is to make students aware of current/upcoming trends in Information Technology and other domains.

6. MOOCs Certification:

Each course (Where ever applicable) includes suggested certification which help learners to enrich themselves as per industry demands and requirements.

MOOCs provide opportunities for students to delve deeper into specific topics or explore emerging areas. MOOC platforms offer a wide range of courses across various disciplines within computer applications. Students can access courses on advanced programming languages, artificial intelligence, data science, machine learning, cybersecurity, cloud computing, and many more. This diversity allows students to tailor their learning experience based on their interests and career goals.

7. Research Project

Research project within an MCA course is integral components designed to impart advanced skills and knowledge essential for addressing complex challenges in computing. Research project involve rigorous investigation, experimentation and application of theoretical concepts acquired during the program.

Students are encouraged to explore diverse areas such as software engineering, data science, cybersecurity, and artificial intelligence, fostering expertise that aligns with industry demands. Engaging in research not only enhances academic understanding but also cultivates practical skills in problem-solving, critical analysis, and project management.

Students are encouraged to publish their research work in reputed journals/conferences.

8. Soft Skill Assessment: The soft skill course comprised of one credit with total duration of 15 hours per semester focusing on different skills viz. interpersonal, communication, professional, writing etc.

9. Evaluation and Assessment:

Concurrent Evaluation, a continuous assessment system integral to semester-based courses, spans the duration of each course and is conducted by the course faculty. The assessment aims to provide timely feedback on the teaching-learning process. As part of this system, students undergo continuous evaluation by the institute to ensure progressive student learning.

Faculty promptly share assessment outcomes with students, guiding them toward improvement. Each institute has the autonomy to design evaluation components that offer a balanced assessment across Knowledge, Skills & Attitude (KSA) dimensions, using various assessment tools. The institute determines the type, method, and frequency of concurrent evaluation for each course, maintaining detailed records of all assessments. The curriculum spans two years and four semesters, totaling 95 credits.

Semester	Credit Points	UE	IE
Semester I	26	300	300
Semester II	26	300	300
Semester III	25	250	300
Semester IV	18	300	250
Total	**95**	**1150**	**1150**
			2300

The final total assessment of the candidate is made in terms of an internal (concurrent) evaluation and an external (university) examination for each course.

Examination: Examinations shall be conducted at the end of the semester i.e. during November and in April/May. However supplementary examinations will also be held in November and April/May.

Marks/Grade/Grade Point:

A grade is assigned to each head based on marks obtained by a student in evaluation of the course. These grades, their equivalent grade points are given in the following table.

Sr. No.	% of Max. Marks	Grade Point	Grade Letter
1	90 ≤ Marks ≤ 100	10	O (Outstanding)
2	75 ≤ Marks ≤ 89	9	A+ (Excellent)
3	60 ≤ Marks ≤ 74	8	A (Very Good)
4	55 ≤ Marks ≤ 59	7	B+ (Good)
5	50 ≤ Marks ≤ 54	6	B (Above Average)
6	45 ≤ Marks ≤ 49	5	C (Average)
7	40 ≤Marks ≤ 44	4	D (Pass)
8	Marks < 40	0	F (Fail)
9	Nil	0	Ab(Absent)
10	--	0	FX (Detained, Repeat the Course)
11	--	0	IC (Incomplete Course-Absent for Exam but continue for the course
12	--	0	AC(Audit Course Completed)
13	--	--	CAN (Audit Course not Completed)

Suggested components for Concurrent Evaluation (CE) are:

1. Class Test
2. Open Book Test
3. Group Discussion
4. Scrap Book
5. Role Play / Story Telling
6. Learning Diary
7. In-depth Viva
8. Quiz
9. Certification

10. Written Home Assignment 11. Small Group Project & Internal Viva-Voce
12. Literature Review / Book Review
13. Case Study / Situation Analysis – (Group Activity or Individual Activity)
14. Field Visit / Study tour and report of the same
15. Individual Term Paper / Thematic Presentation
16. Industry Analysis – (Group Activity or Individual Activity)
17. Model Development / Simulation Exercises – (Group Activity or Individual Activity)

Institute can decide the type, method and frequency of Concurrent Evaluation for each course and execute accordingly. Detailed record of the Concurrent Evaluation shall be maintained by the Institute. The same shall be made available to the University, on demand.

10. Choice based Credit System (CBCS) and Grading:

The detail document about Choice based Credit System for PG Programme is available on university website. The Grading methodology is also available on university website. University reserves rights to revise CBCS and grading system time to time.

11. Medium of Instruction: The medium of Instruction will be English.

12. Clarification of Syllabus:

It may be necessary to clarify certain points regarding the course. The BOS should meet to study and clarify any difficulties from the Institutes, as and when required.

13. Revision of Syllabus: As the computer technology is changing very fast, revision of the syllabus should be considered every 2 years.

14. Attendance: The student must meet the requirement of 75% attendance per semester per course for grant of the term. The Director shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled. Since the emphasis is on continuous learning and concurrent evaluation, it is expected that the students study all-round the semester. Therefore, there shall not be any preparatory leave before the University examinations.

15. ATKT Rules: The ATKT rules mention in CBCS handbook (available on university website) is application to MCA Programme.

16. Maximum Duration for completion of the Programme:

The candidates shall complete the MCA Programme WITHIN 4 YEARS from the date of admission, by earning the requisite credits. The student will be finally declared as failed if she/he does not pass in all credits within a total period of four years. After that, such students will have to seek fresh admission as per the admission rules prevailing at that time.

17. Exit option: The students can exit the Programme after one year of MCA, but he has to take additional 4 Credits of on- job Training. To get PG Diploma after Three Year UG Degree, he should earn total 52+ 4= 56 Credits.

Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG program

The institute may conduct bridge courses for the respective students at the discretion of Director/ Head of the institutions.

18. Scaling Down of CE/INT Scores: The marks obtained by the student for the CE/INT ***shall be scaled down***, to the required extent, if percentage of the marks of CE/INT exceeds the percentage of marks scored in the End Semester University Examination by 25% for the respective course.

19. Structure of the Programme and detail syllabus of each course:

MCA Semester I					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Python Programming	PPR**501**MJ	3	50	25
2	Data Structure and Algorithms	DSA**502**MJ	3	50	25
3	Advanced DBMS	ADB**503**MJ	3	50	25
4	Business Statistics	BST**504**MJ	3	50	25
5	Software Engineering and Project Management	SEP**505**MJ	3	50	25
6	**Elective- I (Select any one from following)**		3	50	25
	Fundamentals of Cloud Computing	FCC**510**MJ			
	Web Development	WDE**511**MJ			
	Fundamental of Data Science	FDS**512**MJ			
	Introduction to Cyber Security	ICE**513**MJ			
***Practical**					
7	Practical based on Python and DS	PBP**506**MJP	3	-	50
8	Mini Project	MP**541**MP	3	-	50
Soft Skills and IKS					
9	Soft Skills – I	SSI**507**MJ	1	-	25
10	IKS	IKS**508**MJ	1	-	25
		Semester Total	**26**	**300**	**300**

MCA Semester II					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Java Programming	JPR**551**MJ	3	50	25
2	Optimization Techniques	OTE**552**MJ	3	50	25
3	Software Testing and Quality Assurance	STQ**553**MJ	3	50	25
4	Research Methodology	RMW**554**MJ	3	50	25
5	**Elective- II (Select any one from following)**		3	50	25
	Cloud Computing Management and Security	CCM**560**MJ			
	JavaScript	JS**561**MJ			
	Machine Learning Techniques	MLT**562**MJ			
	Essentials of Cyber Security	ECS**563**MJ			
6	**Elective- III (Select any one from following)**		3	50	25
	Essentials of Cloud Computing and Security	ECS**564**MJ			
	Advance Web Development	AWD**565**MJ			
	Power BI	PBI**566**MJ			
	Essentials of Information Security	EIS**567**MJ			
***Practical**					
7	Practical based on Java	PBJ**555**MJP	3	-	50
8	Mini Project	MP**581**MP	3	-	50
Soft Skills and IKS					
9	Soft Skills – II	SSK**556**MJ	1	-	25
10	IKS	IKS**557**MJ	1	-	25
		Semester Total	**26**	**300**	**300**

MCA Semester III					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Organizational Behaviour	OBE**601**MJ	3	50	25
2	Design and Analysis of Algorithm	DAA**602**MJ	3	50	25
3	**Elective- IV (Select any one from following)**		3	50	25
	Cloud API's and Services	CAS**610**MJ			
	Mobile Application Development	MAD**611**MJ			
	Tableau	TAB**612**MJ			
	End -Point Security	EPS**613**MJ			
4	**Elective- V (Select any one from following)**		3	50	25
	Cloud Migration and Management	CMM**614**MJ			
	MERN Stack Development	MSD**615**MJ			
	Deep Learning	DEL**616**MJ			
	Ethical Hacking	EH**617**MJ			
5	**Elective- VI (Select any one from following)**		3	50	25
	Enterprise Resource Planning (ERP)	ERP**618**MJ			
	E-Commerce	EC**619**MJ			
	Social media Marketing	SMM**620**MJ			
	Innovation and Entrepreneurship Development	IED**621**MJ			
***Practical**					
6	Practical based on Electives IV and V	PBE**603**MJP	3	-	50
7	Research Project	RP**641**RP	6	-	100
Soft Skills					
8	Soft Skills- III	SSK**604**MJ	1		25
		Semester Total	**25**	**250**	**300**

MCA Semester IV					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Internship/Project Work (FP/OJT)	IPW**681**FP	12	300	150
2	MOOC- I	MOO**682**MJ	3	-	50
3	MOOC- II	MOO**683**MJ	3	-	50
		Semester Total	**18**	**300**	**250**

Semester	Credit Points	UE	IE
Semester I	26	300	300
Semester II	26	300	300
Semester III	25	250	300
Semester IV	18	300	250
Total	**95**	**1150**	**1150**
		Total Marks	**2300**

Semester I

PPR501MJ: Python Programming

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory Sessions: Total 45 Hours		**Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Object oriented Concepts.

Course Objectives:

- To understand and use the basics of python.
- To understand advanced concepts of python and be able to apply it for solving complex problems.
- To understand the development of real-world applications using OOP concepts in python.
- To understand basic database concepts in python.
- To understand web application development using python and Django framework.

Course Outcomes: On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	To learn and apply basic constructs of python such as data, operations, conditions, loops, data types.
CO2	Apply	To understand advance concepts of python and apply it for solving the complex problems.
CO3	Apply	To develop Python programs that incorporate OOPS concept, regular expressions and multithreading for complex problem-solving and performance enhancement.
CO4	Apply	To implement various types of database operations in MongoDB.
CO5	Apply	To develop comprehensive web applications using Django Framework.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Fundamentals of Python** 1.1 Introduction 1.2 Keywords, Identifiers, Literals, Operators 1.3 Data Types- Number, Strings, Lists, Tuples, Dictionaries, Sets 1.4 Understanding Python blocks 1.5 Control flow- if, else, elif 1.6 Loops- while, for, continue, break 1.7 Loop manipulation using pass, continue, break and else 1.8 For loop using ranges, string, list and dictionaries 1.9 Programming using Python conditional and loops block	15	9

	1.10 Comprehensions on List, Tuple, Dictionaries		
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Functions, Modules & Packages, Exceptional Handling** 2.1. Function Basics-Scope, nested function, non-local statements 2.2. Built-in functions 2.3. Types of functions, Anonymous Function: lambda 2.4. Decorators and Generators 2.5. Modules: Module basic usage, Creating, importing modules. 2.6. Importing functions and variables from different modules. 2.7. Python built-in modules - math, random, datetime, etc. 2.8. Package: import basics 2.9. Python namespace packages 2.10. User defined modules and packages 2.11. Exception Handling 2.11.1 Avoiding code break using exception handling 2.11.2 Safeguarding file operation using exception handling 2.11.3 Handling multiple and user defined exception 2.11.4 Handling and helping developer with error code 2.11.5 Programming using Exception handling.	20	9
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Python Object Oriented Programming** 3.1 Concept of class, object and instances, method call, Real time use of class in live projects 3.2 Constructor, class attributes and destructors 3.3 Inheritance, super class, method overriding 3.4 Overloading operators 3.5 Static and Class methods 3.6 Delegation and containership 3.7 Python Regular Expression 3.7.1 Pattern matching and searching using regex in python 3.7.2 Real time parsing of data using regex 3.7.3 Applications of Regex-Password, email, URL validation 3.8 Multithreading 3.8.1 Understanding threads 3.8.2 Synchronizing the threads 3.8.3 Programming using multithreading	25	9
*Mapping of Course Outcomes for Unit 3: CO3			

4	**Python database interaction using MongoDB** 4.1. Introduction to NoSQL database 4.2. Types of NoSQL 4.2.1 Document Based: MongoDB 4.2.2 Key-Value Database – Couchbase 4.2.3 Wide-column Databases: Cassandra 4.2.4 Graph/node Databases: Neo4j 4.3. SQL Vs NoSQL 4.4. Introduction to MongoDB with python 4.5. Installing MongoDB on Windows 4.6. Exploring Collections and Documents 4.7. Performing CRUD Operations 4.8. Commit, Rollback and Cursor operation 4.9. Handling errors.	20	9
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Web Development using Django** 5.1 Introduction to Web Development and Django 5.2 Django Project Structure and Django Models 5.3 Django Views and Django Templates 5.4 Django URLs and Django Forms 5.5 Django Authentication and Advanced Django Features 5.6 Django Rest Framework (DRF) and Testing in Django 5.7 Deployment and Performance Optimization 5.8 Building a real-world Django application with Django Channels for WebSockets	20	9
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books:

- Introduction to Python Programming, By Gowrishankar S,
- Introduction to Python Programming by UDAYAN DAS, SAINT MARY'S COLLEGE OF CALIFORNIA AUBREY LAWSON, WILEY
- Python Crash Course: A Hands-On, Project-Based Introduction to Programming

Reference Books:

- Learning Python 5th ed. by Mark Lutz
- Python: The Complete Reference by Martin C. Brown
- Python Data Analytics: With Pandas, NumPy, and Matplotlib 2nd ed. Edition by Fabio Nelli
- Core Python Programming by Wesley J. Chun Publisher: Prentice Hall
- Python Programming: A modular approach by Taneja Sheetal, Kumar Naveen
- Beginner's Guide to Python Programming: Learn Python 3 Fundamentals, Plotting and

Tkinter GUI Development Easily by Serhan Yamacli

- Programming Python, O'reilly, by Mark Lutz
- Learning Python, O'reilly, Mark Lutz
- Head First Python, O'reilly, By Paul Barry

Recommended Learning Material:

Online Courses:

- Coursera: "Python for Everybody" by the University of Michigan
- Udemy: "Complete Python Bootcamp: Go from zero to hero in Python 3" by Jose Portilla
- edX: "Introduction to Python Programming" by Microsoft

Official Documentation:

- Python Official Documentation: https://docs.python.org/3/
- Django Official Documentation: https://docs.djangoproject.com/en/stable/
- MongoDB Documentation: https://docs.mongodb.com/

Recommended Certification:

- Programming, Data Structures and Algorithms Using Python https://swayam.gov.in/nd1_noc19_cs40/preview
- Data Analytics with Python https://swayam.gov.in/nd1_noc20_cs46/preview

DSA502MJ: Data Structure and Algorithms		
Teaching Scheme: **Theory Session**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :**75 Marks

Prerequisites:

Programming Knowledge, Mathematical Foundations, Understanding of Algorithms.

Course Objectives:

- To acquire the knowledge fundamentals of various data structure and algorithms.
- To choose the appropriate data structure for a specified application.
- To formulate the problems using appropriate Linear and non-linear data structures such as Array, linked lists, stacks, queues, hash tables, trees, heaps and graphs.
- To understand and analyze various Searching, Sorting, Hashing and Heap technique to solve the problems.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Implement linear data structures and its various real time applications
CO2	Apply	Demonstrate linked list data structure and its types
CO3	Apply	Demonstrate dynamic linear data structures like stack, queue and analyze their various applications.
CO4	Apply	Implement techniques of Non-Linear data structures like Tree and Graph
CO5	Apply	Demonstrate and compare various approaches of Searching, Sorting, Hashing and Heaps.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Arrays/List:** 1.1 Introduction & Definition of an Array 1.2 Memory Allocation & Indexing 1.3 Operations on 1-D & 2D Arrays/Lists 1.4 Arrays and Their Applications 1.5 Sparse Matrices 1.6 String manipulation using arrays	15	4
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Linked Lists:** 2.1 Introduction 2.2 Definition of a Linked List 2.3 Memory Allocation in a Linked List 2.4 Types of Linked Lists 2.4.1 Singly Linked List	20	7

	2.4.2 Operations on a Singly Linked List 2.4.3 Circular Linked Lists 2.4.4 Operations on a Circular Linked List 2.4.5 Doubly Linked List 2.4.6 Operations on a Doubly Linked List		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Stacks and Queues** 3.1 Introduction and Definition of a Stack 3.2 Implementation of a Stack 3.2.1 Implementation of Stacks Using Arrays 3.2.2 Implementation of Stacks Using Linked Lists 3.3 Applications of Stacks: 3.3.1 Conversion of an expression (Infix, Prefix, Postfix) 3.3.2 Evaluation of Expression 3.3.3 String Reversal 3.4 Introduction and Definition of a Queue 3.5 Implementation of a Queue 3.5.1 Implementation of Queues Using Arrays 3.5.2 Implementation of Queues Using Linked Lists 3.6 Applications of Queues	20	10
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Tree & Graph** 4.1 Tree Definition, representation 4.2 Binary Search Tree and its operations 4.2.1 Tree Traversal 4.2.2 Insertion 4.2.3 Deletion 4.2.4 Search 4.3 AVL Tree and its operations 4.3.1 Insertion 4.3.2 Deletion 4.3.3 Rotations 4.4 Directed and Undirected Graph 4.5 Graph Representations 4.5.1 Adjacency Matrix 4.5.2 Adjacency List 4.6 Graph Traversals 4.6.1 BFS 4.6.2 DFS	25	16
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Searching and Sorting** 5.1 Linear Search or Sequential Search 5.2 Binary Search	20	8

	5.3 Interpolation Search 5.4 Introduction to Sorting 5.5.1 Merge Sort 5.5.2 Quick Sort 5.5.3 Bubble Sort 5.5 Heap 5.5.1 Min heap and Max heap 5.6 Hashing 5.6.1 Hash Table 5.6.2 Hash Functions		
*Mapping of Course Outcomes for Unit 5: CO5			

Note: Course should be taught in python programming language.

Learning Resources

Text Books

- Jean Paul Tremblay, Paul G. Sorensons, “An Introduction to Data Structures with Application”, McGraw Hall Publication (INDIAN edition)
- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser “Data Structures and Algorithms in Python”, Wiley
- Dheeraj Malhotra, Neha Malhotra, “Data Structures and Program Design using Python”, Mercury Learning and Information

Reference Books

- Lipschutz Schaum’s, “Data Structure”, Outline Series, MH
- D. Samanta, “Classical Data Structure”, PHI,
- Practical Approach to Data Structures by Hanuman Thappa.
- Horowitz/Sahani, Fundamental of Algorithm. PHI, Galgotia.
- Magnifying Data Structures, Arpita Gopal, PHI Publications

Recommended Learning Material

Online Courses:

- Coursera: Data Structures and Algorithms Specialization by UCSan Deigo
- Coursera: Python Data Structures by the University of Michigan
- Udemy: "The Complete Data Structure & Algorithms in Python”
- edX: " GTx: Data Structures & Algorithms I: ArrayLists, LinkedLists, Stacks and Queues”

Tutorials and Guides:

- https://www.freecodecamp.org/news/learn-data-structures-and-algorithms/
- https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/
- https://www.programiz.com/dsa

Recommended Certification

- Programming, Data Structures and Algorithms Using Python https://swayam.gov.in/nd1_noc19_cs40/preview
- https://www.coursera.org/specializations/data-structures-algorithms
- https://www.coursera.org/learn/python-data

ADB503MJ: Advanced DBMS		
Teaching Scheme: **Theory Session**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal(TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: File Structure

Course Objectives:

- To understand the fundamental concepts and applications of Database Management Systems.
- To understand the relational database design principles.
- To get familiar with Data Collection and Design techniques.
- To acquire the skillset to use flexible databases for real world applications.
- To design Database Management Systems for projects.
- To relate different DB languages like MySQL, Noe4J, Risk, MongoDB.

Course Outcomes: On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Demonstrating the concept of fundamentals of relational database systems include: data models, database & DDBS architectures, and ER features.
CO2	Understand	Understand the concepts of transaction concurrency control, Query Processing and Security aspects
CO3	Apply	Apply SQL & NoSQL development tools on different types of Schemas.
CO4	Apply	Demonstrate database design and Computation techniques for parallel and distributed database Technology.
CO5	Apply	Implement Real Time applications using Database tools.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Database Design and SQL Query Processing** 1.1 Introduction to Database, Data Models and Architecture of DBMS (Views of data: Schemas and Instances, Data Independence) 1.2 Data Modelling using ER Diagram: Representation of Entities, Attributes, Relationships and their Types, Cardinality, Generalization, Specialization, Aggregation. 1.3 Relational Data Model: Structure of Relational Database Model, Referential Integrity Constraints & its types, Codd's rules	20	10

	1.4 Database Design using E-R, E-R to Relational Tables Conversion, Database design using Normalization – Normal forms - 1NF, 2NF, 3NF - Case Studies 1.5 Introduction to SQL Query Processing (DDL, DML, Aggregate Functions and Joins)		
*Mapping of Course Outcomes for Unit 1: CO1 & CO3			
2	**Transaction and Concurrency Control** 2.1. Concept of Transaction and Transaction processing, ACID properties, Transaction States 2.2 Concurrency control, Problems in concurrency Control 2.3 Scheduling of Transactions, Serializability and Testing of Serializability 2.4 Concurrency Control Protocols: Lock-Based Protocol and Time Stamp-based ordering protocols 2.5 Deadlock in DBMS , Deadlock Handling Methods,	20	8
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Database Recovery and Security Techniques** 3.1 Failure Classification 3.2 Storage Structure 3.3 Recovery and Atomicity 3.4 Log-Based Recovery (Deferred Database Modification, Immediate Database Modification) 3.5 Check Points, Shadow Paging 3.6 Introduction to Database backup, factors of database backups, Types of backups, steps to create database backup plan, Recovery from catastrophic failures 3.7 Database Security in DBMS, Importance of Database Security, Security Threats, Challenges in Database Security 3.8 Discretionary access control based on grant & revoking Privilege 3.9 Mandatory access control and role-based access control for Multilevel security 3.10 Encryption- its types & Public & Private key Infrastructures	20	10
*Mapping of Course Outcomes for Unit 3: CO2			
4	**Parallel and Distributed Database** 4.1 Parallel Database System: Parallel Database Architectures; Parallel query processing and optimization; Load balancing; database clusters 4.2 Introduction to Distributed DBMS & Architecture, Characteristics	20	9

	4.3 Distributed Data Processing, Promises of DDBMSs, Problem Areas. 4.4 Distributed data storage (Fragmentation, Replication & Transparency) 4.5 Query Processing: Objectives, Query decomposition; Localization of distributed data 4.6 Transaction Management & Concurrency Control in DDBMS, Commit Protocols (2-PC, 3-PC)		
*Mapping of Course Outcomes for Unit 4: CO4			
5	**NOSQL database for Business Applications** 5.1 Introduction to NOSQL Database: Overview, History of NoSQL Databases, The Definition of the Four Types of NoSQL Databases. 5.2 Processing of NOSQL Column-Oriented NoSQL Databases using MongoDB, NoSQL Key/Value databases using MongoDB 5.3 Introduction to MongoDB Database, JSON and JSON Structure, NoSQL Key/Value databases, Graph NoSQL Databases using Neo4J, NoSQL database development tools and programming languages, Future Trends in NoSQL Databases. 5.4 Introduction to FireBase	20	8
*Mapping of Course Outcomes for Unit 5: CO3, CO5			

Learning Resources

Text Books

- Raghurama Krishnan, Johannes Gehrke, Database Management Systems, 3rd edition, Tata McGraw Hill, New Delhi, India
- Introduction to database systems C.J. Date, Pearson.
- Principles of Database Management James Martin, PHI
- Elmasri Navate, Fundamentals of Database Systems, Pearson Education, India.
- Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.
- Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991..
- Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Reference Books

- Database Management Systems by Raghu Ramakrishnan and Johannes Gehrke Third Edition
- Database System Concepts by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan Seventh Edition

- Peter Rob, Carlos Coronel (2009), Database Systems Design, Implementation and Management, 7th edition
- Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN13: 978-9332557338)
- Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
- Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694)
- Meier & Kaufmann. SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, 1st ed. Springer, 2019
- Bradshaw & Chodorow. MongoDB: The Definitive Guide: Powerful and Scalable Data Storage, 3rd ed. O'Reilly, 2019
- Pivert. NoSQL Data Models: Trends and Challenges, 1st ed. Wiley, 2018
- Sullivan. NoSQL for Mere Mortals, 1st ed. Addison-Wesley Professional, 2015
- A Dive Deep into Types of Databases -https://www.blazeclan.com/blog/dive-deep-types-nosql-databases
- Geethmi Nimantha Dissanayake - A Study on Real-Time Database Technology and Its Applications.
- Adity Gupta, Swati Tyagi, Nupur Panwar, Shelly Sachdeva Jaypee Institute of Information Technology, India -NoSQL Databases:Critical Analysis and Comparison.
- Firebase Realtime Database -https://firebase.google.com/docs/database
- Database system practical approach to design, implementation & management by Connoly & Begg

Recommended Learning Material

- https://www.geeksforgeeks.org/sql-concepts-and-queries/
- https://www.udemy.com
- https://www.w3schools.com/sql/
- https://www.codecademy.com/article/sql-commands
- https://www.w3schools.com/sql/sql_intro.asp
- https://www.javatpoint.com/sql-tutorial
- https://www.geeksforgeeks.org/introduction-to-nosql/
- https://www.edx.org/learn/nosql
- http://libguides.regis.edu/tutorials.
- https://www.mongodb.com/resources/basics/databases/nosql-explained
- https://www.oracle.com/in/database/nosql/what-is-nosql/
- https://www.javatpoint.com/nosql-databases
- https://www.mysql.com/products/cluster/nosql.html
- https://firebaseopensource.com/
- https://nptel.ac.in/courses/106/105/106105175/ 2.
- https://onlinecourses.nptel.ac.in/noc21_cs04/ 3.

- https://nptel.ac.in/courses/106/106/106106093/
- https://www.coursera.org/courses?query=database%20management

Recommended Certification

- The Complete Database Design & Modeling Beginners Tutorial
- Oracle Database SQL Certification
- SQL for Data Science
- Introduction to SQL
- MySQL Certification
- Complete SQL Bootcamp
- Oracle Certified Professional, MySQL 5.7 Database Administrator Certification
- IBM Associate Certified DBA - Db2 12 for z/OS Fundamentals
- DataCamp's SQL Certification
- Free MongoDB Course
- Neo4j Certified Professional
- MongoDB Certified Developer Associate

BST504MJ: Business Statistics		
Teaching Scheme: **Theory Session:** Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal(TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Basic Mathematics

Course Objectives:

- To understand the importance of data-driven business decisions.
- To learn the basics of business decision analysis.
- To summarize business data numerically and graphically.
- Learn the basics of beginning predictive business modelling.
- To understand the importance of business sampling methods, and be able to describe different business sampling methods.
- To understand the process associated with statistical decisions, defining and formulating problems, analysing the data, and using the results in decision-making.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the role and importance of statistics in business decision-making.
CO2	Apply	Apply measures of central tendency and dispersion to summarize data.
CO3	Understand	Understand basic probability concepts and rules.
CO4	Apply	Apply correlation and regression techniques to analyze relationships between variables
CO5	Apply	Apply time series analysis techniques to forecast business trends.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to Business Statistics** 1.1 Definition and Scope of Business Statistics Definition of Statistics, Importance, Scope and Applications of Statistics, Characteristics of Statistics, Functions of Statistics, Limitations of Statistics, Importance of Statistics in modern business environment. 1.2 Need of Data, Organisation of data, Data Classification & Types of Data : Qualitative and Quantitative 1.3 Data Collection Methods and representation of data, Principles of Measurement, Source of Data 1.4 Scales of Measurement: Nominal, Ordinal, Interval, Ratio	20	7

	1.5 Descriptive vs. Inferential Statistics		
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Descriptive Statistics** 2.1 Introduction, Objectives of statistical average, Requisites of a Good Average, Statistical Averages - Arithmetic mean - 2.2 Measures of Central Tendency: Properties of arithmetic mean - Merits and demerits of arithmetic mean ,Median - Merits and demerits of median , Mode - Merits and demerits of mode , Geometric Mean , Harmonic Mean 2.3 Measures of Dispersion: Dispersion – Range - Quartile - Percentile, deviations, Mean deviation ,Standard Deviation -Properties of standard deviation, Coefficient of Variance 2.4 Skewness and Kurtosis 2.5 Exploratory Data Analysis	20	10
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Probability and Probability Distributions** 3.1 Basic of Permutation and Combinatorics, Probability Concepts: Events, Sample Space, Rules of Probability 3.2 Random variable Expected values, Conditional Probability and Bayes' Theorem 3.3 Discrete Probability Distributions: Binomial, Poisson distribution 3.4 Continuous Probability Distributions: Normal	20	8
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Correlation and Regression Analysis** 4.1 Introduction of Correlation 4.2 Types of Correlation - Measures of Correlation - Scatter diagram - Karl Pearson’s correlation coefficient- 4.3 Properties of Karl Pearson’s correlation coefficient - Spearman’s Rank Correlation Coefficient 4.4 Regression - Regression analysis - Regression lines - Regression coefficient, 4.5 Multiple Regression Analysis, Reliability of Estimates 4.6 Model Diagnostics and Validation Application of Multiple Regressions	20	10
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Time Series Analysis** 5.1 Time Series Analysis -Introduction, Time Series Analysis, Utility of the Time Series, Components of Time Series - Long term trend or secular trend - Seasonal variations - Cyclic variations - Random variations	20	10

	5.2 Methods of Measuring Trend - Free hand or graphic method - Semi-average method - Method of moving averages - Method of least squares, 5.3 Mathematical Models for Time Series - Additive model - multiplicative model, Editing of Time Series, Measurement of Seasonal Variation - Seasonal average method - Seasonal variation through moving averages - Chain or link relative method - Ratio to trend method		

*Mapping of Course Outcomes for Unit 5: CO5

Learning Resources

Text Books

- Business Statistics by J.K. Sharma
- Statistics for Management by Richard I. Levin, David S. Rubin, Masood H. Siddiqui, and Sanjay Rastogi
- Fundamentals of Statistics by S.C. Gupta
- Business Statistics by S.P. Gupta and M.P. Gupta
- Quantitative Techniques for Management by N.D. Vohra

Reference Books

- Statistics for Business and Economics by P. N. Arora, S. Arora, and S. Arora
- Quantitative Techniques for Decision Making by Anand Sharma
- Mathematical Statistics by J.N. Kapur and H.C. Saxena
- Business Statistics and Analytics by P. Mariappan
- Introduction to the Theory of Statistics by A.M. Mood, F.A. Graybill, and D.C. Boes

Recommended Learning Material

Online Courses:

- Coursera: "Business Statistics and Analysis Specialization by Rice University
- edX: "Statistics and Data Science" MicroMasters Program by MIT
- Khan Academy: "Statistics and Probability"
- Udacity: "Introduction to Descriptive Statistics" and "Introduction to Inferential Statistics"
- LinkedIn Learning: "Business Statistics Fundamentals"

Software Tools

- Microsoft Excel
- R and RStudio
- IBM SPSS Statistics
- Tableau
- Python (with libraries such as Pandas, NumPy, and Matplotlib)

Recommended Certification

- Certified Business Analysis Professional (CBAP)
- Microsoft Certified: Data Analyst Associate
- SAS Certified Statistical Business Analyst
- Certified Analytics Professional (CAP)
- IBM Data Science Professional Certificate
- Google Data Analytics Professional Certificate
- Certified Six Sigma Green Belt
- Tableau Desktop Specialist
- Coursera Specializations in Business Statistics
- edX MicroMasters in Data, Economics, and Development Policy

SEP505MJ : Software Engineering and Project Management		
Teaching Scheme: **Theory Sessions:** Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Basic software engineering concepts

Course Objectives:

- To understand fundamental principles and concepts of software engineering.
- To learn requirement analysis and system design principles.
- To study the process of Software Project Management for effective project planning.
- To acquire knowledge of Agile Project Management Framework.
- To apply Agile tools for software development.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Apply concepts, principles of software engineering to develop comprehensive Software Requirement Specification.
CO2	Apply	Use software engineering analysis and design modelling technique to represent systems.
CO3	Apply	Illustrate Software Project Management models for effective plan, manage and enhance projects.
CO4	Apply	Implement Agile methodologies to enhance project adaptability and responsiveness to changing requirements.
CO5	Apply	Employ Agile tools effectively to manage, navigate and facilitate collaboration and streamline project workflows in software development.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Overview of Software Engineering** 1.1. Overview of Software Engineering 1.2. SDLC models 1.3. Requirement Engineering 1.3.1. Types of Requirements: -Functional and Non-functional 1.3.2. Four Phases of Requirement Engineering 1.4. Software requirement Specification (SRS) 1.4.1. Structure and contents of SRS 1.4.2. IEEE SRS Format Case studies : based on SRS	15	6
*Mapping of Course Outcomes for Unit 1: CO1			
2	**System Analysis and Modeling** 2.1. Use case diagrams	20	8

	2.2. Class Diagram 2.3. Activity Diagram 2.4. Interaction Diagram 2.5. Package, component and deployment Diagrams Case studies based on diagrams		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Fundamentals of Project Management** 3.1. Overview of project Management 3.2. Project management life cycle-IEEE Life Cycle 3.3. Quality Metrics 3.4. Risk Management Process 3.5. Linear Software Project Cost Estimation 3.5.1. COCOMO-I (ProblemStatement) 3.5.2 Function Point Analysis (Problem Statement) 3.5.3. The SEI Capability Maturity Model CMM 3.5.4. Software Configuration management Case studies/Numerical Problems based on Risk management , COCOMO-I and FPA	25	12
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Agile Project Management Framework** 4.1. Introduction and Definition Agile, Agile Project Life Cycle 4.2. Agile Manifesto: History of Agile and Agile Principles 4.3. Team and roles of an Agile Team: Scrum Master Product Owner, Development Team 4.4. Key Agile Concepts: 4.5. User stories, Story points 4.6. Techniques for estimating Story Points 4.7. Product Backlog 4.8. Sprint Backlog, 4.9. Product Vision and Product Roadmap 4.10. Sprint Velocity 4.11. Swim lanes 4.12. Minimum Viable Product (MVP) 4.13. Version and Release 4.14. Agile Project Management v/s Traditional Project Management 4.15. Agile Reports: Daily Reports, Sprint Burn down Chart and Reports User Stories Scenarios and writing user stories	30	14
*Mapping of Course Outcomes for Unit 4: CO3, CO4			

5	**Implementation with Agile Tools** 5.1. MS Project Tool 5.2. Agile Tools: Open Source 5.3. Hands on GitHub 5.4. Create Project using Kanban 5.5. Project Repositories 5.6. Continuous Integration 5.7. Project Backlog 5.8 Team Management	10	5

*Mapping of Course Outcomes for Unit 5:CO4, CO5

Learning Resources

Text Books

- Software Engineering by Roger Pressman (6th edition)
- Object-Oriented Software Engineering: A Use Case Driven Approach by Ivan Jacobson
- Software Engineering by Sommerville, Pearson,8th Ed
- Agile Software Engineering with visual studio by Sam Guckenheimer, Neno Loje.
- Coaching Agile Teams: A Comparison for ScrumMasters, Agile Coaches, and Project Managers in Transition, Lyssa Adkins
- Agile Project Management: Creating Innovative Products (2nd Edition) by Jim Highsmith, Addison-Wesley Professional

Reference Books

- Object Oriented Modeling and Design with UML by James Rumbaugh, MichaelBlaha
- Software Engineering by Chandramouli Subramanian, Saikat Dutt
- Object Oriented Systems Analysis and Design using UML by Simon Bennett
- The Unified Modeling Language user guide by Grady Booch, James Rumbaugh,Ivar Jacobson Mark C. Layton, Steven J. Ostermiller
- Agile Estimating and Planning by Mike Cohn Robert C Martin Series
- Introduction to Software Project Management by Adolfo Villafiorita, CRC Press
- Agile Project Management for Dummies by Mark C. Layton
- Agile Project Management with Kanban By Eric Brechner

Recommended Learning Material

- https://www.mooc-list.com/course/object-oriented-design-coursera
- https://nptel.ac.in/courses/106101061/
- https://www.agilealliance.org
- http://www.pmi.org
- https://github.com/topics/kanban
- https://www.opensourcescrum.com/
- https://www.scrum.org/resources
- https://www.atlassian.com/agile

Recommended Certification

- Project Management Professional (PMP)
- PMI-ACP(Agile Certified Practitioner)

- Certified Associate in Project Management (CAPM)
- Certified Project Director
- Certified Project Management Practitioner (CPMP)
- Certified Project Manager (CPM)
- Certified ScrumMaster (CSM)
- Professional in Project Management (PPM)
- Project Management in IT Security (PMITS)
- Certified Agile Project Manager (IAPM)

FCC510MJ: Fundamentals of Cloud Computing		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Networking Fundamentals, Database Basics

Course Objectives:

- To introduce the fundamentals of cloud computing, Dockers and Containers.
- To give Insights into Cloud Service Models and Deployment Models.
- To provide knowledge on virtualization technologies.
- To know about Cloud Architecture and SOA.
- To impart the knowledge on different Cloud Platforms.

Course Outcomes: On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Describe the concepts of Cloud Computing, Dockers and Container.
CO2	Understand	Explore the various Cloud Service Models and Deployment Models.
CO3	Apply	Implement concepts, hypervisors, virtual machines, VMware, Microsoft Hyper-V, and Open-Source Virtualization Manager.
CO4	Understand	Describe the Cloud Architecture and relate Cloud to SOA along with SLA management, cloud bursting strategies.
CO5	Analyze	Compare different Cloud Platforms – AWS, GCP, IBM Cloud.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to Cloud Computing** 1.1 Introduction to Cloud Computing 1.2 Cloud Computing vs. Cluster Computing vs. Grid Computing 1.3 Characteristics, Pros and Cons of Cloud 1.4 Introduction to Dockers 1.5 Introduction to Container	15%	6
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Cloud Service Models and Deployment Models** 2.1 Cloud Service Models - IAAS, PAAS, SAAS & its Comparison 2.2 Cloud Deployment Models-Public, Private, Hybrid, Community 2.3 XAAS- Anything as a Service – Storage as a service, Network as a Service, Database as a Service	20	9

	2.4 Cloud Storage Types: Block, File, Object Storage		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Virtualization** 3.1. Introduction to Virtualization concept & Hypervisors 3.2. Pros and Cons of Virtualization 3.3. Machine Image, Virtual Machine (VM) 3.4. Xen: Para virtualization, VMware: Full Virtualization 3.5. Microsoft Hyper-V 3.6. Open-Source Virtualization Manager	25	12
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Cloud Architecture** 4.1 Web Services: SOAP and REST 4.2. Relating SOA and Cloud Computing. 4.3. Service Level Agreement (SLA), Billing, Pricing, and Support 4.4. Cloud Computing Architecture 4.5. Multi Cloud Environment 4.6. Edge Computing Concepts 4.7. Cloud Bursting	25	12
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Fundamentals of Cloud Platforms** 5.1. Commercial cloud computing Infrastructures. 5.2. Amazon Web Services (AWS) 5.3. Google Cloud Platform (GCP) 5.4. Microsoft Azure (M. Azure) 5.5. Sales Force 5.6. IBM Cloud	15	6
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- Cloud Computing Concepts, Technology & Architecture by Thomas Erl,
- Zaigham Mahmood, and Ricardo Puttin
- Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola,
- S. Thamarai Selvi - McGraw Hill Education (India) Private Limited,
- Cloud Computing Web –Based Applications that change the way you
- work and Collaborate Online by Michael Miller, Pearson
- Cloud Computing for Dummies by Judith Hurwitz, Robin Bloor, Marcia
- Kaufman, FernHalper

Reference Books:

- Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,
- Cloud Computing: Automating the Virtualized Data Center

- Cloud Computing by Dr. Kumar Saurabh ,Wiley–India
- Cloud computing: A practical approach by Anthony T. Velte, Tata
- McGraw-Hill

Recommended Learning Material

- http://www.cloudcomputingpatterns.org/
- http://whatiscloud.com
- www.w3schools.com

Recommended Certification:

- Amazon Web Services (AWS)
- Google Cloud Platform (GCP)
- Microsoft Azure (M.Azure)
- Sales Force
- IBM Cloud

WDE511MJ: Web Development		
Teaching Scheme: **Theory**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Student must have hands-on working knowledge of HTML and CSS

Course Objectives:

- To impart the design, development and implementation of Dynamic Web Pages.
- To implement the Latest properties of CSS3
- To design and implement dynamic websites with a good sense of designing and latest technical aspects.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Design appropriate user interfaces by implementing new features of HTML5
CO2	Apply	Design user interfaces and implement CSS3 features
CO3	Apply	Demonstrate the concept of responsive web design and its importance
CO4	Apply	Build Dynamic web pages using server-side PHP programming
CO5	Apply	Develop and deploy web application

Unit No.	Contents	Weightage in %	No of Sessions
1	**HTML5** 1.1 Introduction to Web Technology, 1.2 The architecture of Web server, client 1.3 Introduction to Git 1.4 HTML 5 - Audio Video Tag 1.5 Semantic Elements 1.6 Canvas and SVG 1.7 Introduction to API 1.8 Translate, scale, drag drop	10	4
*Mapping of Course Outcomes for Unit 1: CO1			
2	**CSS3** 2.1 Architecture of CSS 2.2 Introduction of SCSS, CSS Modules 2.3 CSS Framework – Bootstrap (Introduction) 2.4 Selectors and Pseudo Classes 2.5 Fonts and Text Effects 2.6 Colors, Background Images, and Masks,	15	7

	2.7 Transition		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Responsive web form design** 3.1 Introduction to Responsive Web Design 3.1.1 Overview of responsive web design principles and its significance 3.2 Introduction to media queries and viewport meta tag 3.2.1Responsive web design with devices (desktop, mobile, tablet) 3.3 Flexible Images and Media 3.3.1Techniques for responsive images: 3.3.2 srcset, sizes attributes, and picture element 3.3.3 Implementing responsive video and other media 3.3.4 Optimizing multimedia content for performance and accessibility 3.4 Web Forms: Creating and handling user input forms for data collection 3.5 Responsive Typography 3.5.1 Principles of typography in web design 3.5.2 Implementing fluid typography with CSS techniques 3.5.3 Using web fonts and icon fonts for responsive design 3.5.4 Fluid layout techniques. 3.5.5 Testing on multiple devices and screen sizes.	20	9
*Mapping of Course Outcomes for Unit 3: CO3			
4	**PHP framework (CodeIgniter 4+)** 4.1 How to Download & Install CodeIgniter + Composer Folder, 4.2 File & Directory Structure 4.3 MVC Framework 4.4 Controllers, 4.5 Views 4.6 Routing Routes 4.7 Form 4.8 How to Upload Images 4.9 File handling 4.10 Sending Email 4.11 Cookie and Session 4.12 Restful and Restless API integration	25	11
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Database connectivity and Deployment** 5.1Introduction MySQL,	30	14

	CRUD operation with MySQL 5.2 Query builder 5.3 Deployment 5.4 Hosting (AWS/Hostinger/Google Cloud)		
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- Complete reference HTML, TMH
- HTML5 & CSS3, Castro Elizabeth 7th Edition
- Beginning PHP, Apache, MySQL web development

Reference Books

- Introducing HTML5 - Bruce Lawson, Remy Sharp
- Complete Ref. PHP

Recommended Learning Material

- Introduction to HTML5 – University of Michigan https://www.coursera.org/learn/html
- Introduction to Web Development – University of California https://www.coursera.org/learn/web-development
- HTML, CSS and JavaScript for Web Developers – Johns Hopkins University https://www.coursera.org/learn/html-css-javascript-for-web-developers
- Web Design for Everybody: Basics of Web Development & Coding Specialization – University of Michigan https://www.coursera.org/specializations/web-design
- Introduction to CSS3 – University of Michigan https://www.coursera.org/learn/introcss
- Building Web Applications in PHP – University of Michigan https://www.coursera.org/learn/web-applications-php
- Building Database Applications in PHP – University of Michigan https://www.coursera.org/learn/database-applications-php
- Web Applications for Everybody Specialization https://www.coursera.org/specializations/web-applications
- How to deploy Web Application on AWS https://www.cloudways.com/blog/host-php-on-aws-cloud/

Recommended Certification

- Microsoft HTML5 and CSS3 (https://www.microsoft.com/en-us/learning/exam-70-480.aspx
- Certification available on Coursera and Udemy

FDS512MJ: Fundamental of Data Science		
Teaching Scheme: **Theory Session**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Statistics, Python

Course Objectives:

- To Understand the evolution and significance of data science and Outline the stages involved in a typical data science project lifecycle.
- To implement data processing techniques using Python Libraries.
- To understand the concept of Computational Mathematics for Data Science
- To perform exploratory data analysis (EDA), and apply data transformation techniques.
- To implement Data visualization concepts and libraries.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the core concepts, techniques and methodologies used in data science
CO2	Apply	Apply Computational Mathematics concepts to solve data-related problems effectively.
CO3	Apply	Apply the principles of data collection, cleaning, and pre-processing.
CO4	Apply	Perform exploratory data analysis using Numpy and Pandas to derive insights from datasets.
CO5	Apply	Apply the strategies for visualizing the data.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to Data Science** 1.1 Introduction 1.1.1 Evolution of Data Science 1.1.2 Data Science Roles 1.1.3 Stages in a Data Science Project 1.1.4 Applications of Data Science in various fields 1.2 Tools and Techniques in Data Science - Introduction - Python & R 1.2 Data Processing 1.2.1 Data Processing Overview 1.2.2 Data Collection & Data Cleaning 1.2.3 Data Integration and Transformation 1.2.4 Data Reduction 1.2.5 Data Discretization. 1.3 Impact of Data Science	20	9

	1.4 Data Analytics Life Cycle 1.5 Ethical Consideration		
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Computational Mathematics for Data Science** 2.1 Linear Algebra: Vectors and Vector Spaces, Matrices: Operations, Types, and Properties, Systems of Linear Equations (Gaussian Elimination, Matrix Inversion) 2.2 Numerical Methods: Numerical Solutions of Equations: Bisection Method, Newton-Raphson Method, Numerical Linear Algebra: LU Decomposition, QR Decomposition, Interpolation.	20	9
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Data Processing** 3.1 Data Processing 3.1.1 Identifying Data Sources 3.1.2 Stages of data processing methods 3.2 Data collection 3.2.1 Data Cleaning and Pre-processing 3.2.2 Data Integration 3.2.3 Data Storage 3.2.4 Data Security and Privacy 3.2.5 Data processing models 3.2.6 Application of data processing 3.3 Data Wrangling Process 3.3.1 Data Inspection 3.3.2 Handling Missing Data 3.3.3 Dealing with Outliers 3.3.4 Data Transformation 3.3.5 Normalization and Scaling 3.3.6 Data Formatting 3.3.7 Data Validation 3.4 Challenges in data processing and future trends	20	9
*Mapping of Course Outcomes for Unit 3:CO3			
4	**Data Analysis using Numpy and Pandas** 4.1 Introduction to Numpy Array: Creating NumPy array, understanding ndarray object, Numpy datatypes, Indexing and Slicing, Operations on Arrays Concatenating Arrays, Reshaping Arrays, Splitting Arrays, Numpy random module, Statistical Operations on Arrays, Loading Arrays from Files, Saving numpy arrays to files	20	9

	4.2 Introduction to Pandas Data structure in pandas: Series, Data Frame Importing and Exporting Data between CSV Files and DataFrames 4.3 Exploratory Data Analysis (EDA) EDA fundamentals, Significance of EDA, selection and slicing, Data transformation techniques-merging database, reshaping and pivoting. Descriptive Statistics, Data Aggregations, sorting a Data Frame, GROUP BY Functions, Altering the Index, Other Data Frame Operations.		
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Data Visualization** 5.1 Introduction to Visualization tools Overview of Data Visualization, Plot Types and libraries. 5.2 Matplotlib Introduction to Matplotlib, Basic Plotting with Matplotlib, Line Plots, area plots, histograms, bar charts, pie charts, box plots, and scatter plots, Customizing plots with labels, titles, colors, and styles, 5.3 Seaborne Introduction, Installation of seaborne library, Categories of plot in Seaborn, Customizing plots	20	9
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books:

- Statistics and Data Science (Paperback, Dr. Swapnaja, Dr. Minakshi, Dr. Mukul, Dr. Santosh, Dr. Ravikant Z)
- Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett
- Python for Data Analysis" by Wes McKinney

Reference Books:

- "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Python" by Wes McKinney

- "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurélien Géron
- "Data Science from Scratch: First Principles with Python" by Joel Grus
- "Introduction to Linear Algebra" by Gilbert Strang
- "Numerical Methods for Engineers" by Steven C. Chapra and Raymond P. Canale

Recommended Learning Material:

- Kaggle - https://www.kaggle.com/
- Towards Data - Science - https://towardsdatascience.com/
- Real Python https://realpython.com/
- GitHub: Awesome Data Science https://github.com/bulutyazilim/awesome-datascience

Recommended Certification:

- Data Science Micro Master’s Program on edX
- IBM Data Science Professional Certificate on Coursera
- Become a Data Analyst on LinkedIn Learning

ICE513MJ: Introduction to Cyber Security		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Understanding of networking concepts (like IP addresses), and familiarity with operating systems.

Course Objectives:

- To understand the basics of cybercrime and security concepts.
- To recognize different types of cyber threats, techniques.
- To learn the various thefts and preventions.
- To categorize cyber laws, the necessity for information security, and various standard.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understanding the knowledge of cybercrimes, cyber security and cyber-attacks, vulnerabilities, techniques
CO2	Apply	Illustrate the security aspects of social media, network platforms and ethical aspects associated with use of social media
CO3	Apply	Articulate the importance of personal data theft, financial frauds and identify data privacy and security
CO4	Apply	Apply existing legal framework and laws on cyber security.
CO5	Understand	Understand the need of information security, standards and polices

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to cyber security** 1.1 Introduction of Cyber Crime and cyber-Space 1.2 History and evolution of cyber crime 1.3 Traditional Problems Associated with Computer Crime 1.4 Computer Security, 1.5 Threats, Harm, Vulnerabilities, 1.6 Cyber Security fundamentals 1.7 Types of Cybercrime 1.8 Hacking & Ethical Hacking 1.9 Cyber bullying and Cyber stalking 1.10 Impact of Cyber bullying and cyberstalking	20	7
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Cyber Crime Techniques** 2.1 Digital footprint	20	10

	2.2 Social media and Social engineering tactics 2.3 Exploiting vulnerabilities in software and hardware 2.4 Use of botnets and distributed denial-of-service (DDoS) attacks 2.5 Advanced Persistent Threats (APTs) 2.6 Web attack: Browser Attacks, Web Attacks Targeting Users 2.7 Obtaining User or Website Data, Email Attacks. 2.8 Network Vulnerabilities: Overview of vulnerability scanning with any tool like nmap. 2.9 Impact of emerging technologies like AI and IoT on cyber crime 3.0 The dark web and cyber crime Case Study based on Importance of cyber hygiene		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Identity Theft and Financial Fraud** 3.1 Identity Theft 3.1.1 Personal information theft 3.1.2 Medical identity theft 3.1.3 Criminal identity theft 3.1.4 Synthetic identity theft 3.2 Techniques of Identity Theft 3.2.1 Phishing and social engineering 3.2.2 Malware and key loggers 3.2.3 Data breaches and leaks 3.2.4 Skimming and cloning 3.3 Financial Frauds 3.3.1 Credit card fraud 3.3.2 Insurance fraud 3.3.3 Investment and securities fraud 3.3.4 Online banking fraud 3.3.5 Account takeover 3.3.6 False invoicing and billing schemes 3.3.7 Impact of Identity Theft and Financial Fraud Case studies based on cybercrime identity theft/financial fraud.	20	10
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Cyber Law and Investigation** 4.1 Cyber Law 4.2 IT Act 2000 4.3 National and international laws on cyber crime 4.4 Ethical considerations in cyber security 4.5 Privacy issues and data protection laws	20	10

	4.6 Laws and Ethics in Information Security, 4.7 Codes of Ethics, 4.8 The legal perspectives- Indian perspective, Global perspective 4.9 Legal provisions against hacking, fraud, and other cyber crimes 4.10 Intellectual property rights (IPR) and digital content 4.11 Copyright, trademark, and patent laws in the digital environment 4.12 Legal issues in software piracy and online content distribution		
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Information Security Policy and Standards:** 5.1 Information Security 5.2 Security principles-Types of Information security policies- Administrative and Technical 5.3 Framework - A structure and framework of compressive security policy, policy infrastructure, policy design life cycle and design processes, PDCA model, 5.4 Security policy standards and practices – BS7799, ISO/IEC 17799, ISO 27001. Auditing tools such as ISO 27001 ISMS TOOL KIT, NGS AUDITOR, Windows password auditor, ISO IES 27002 2005 IS AUDIT TOOL	20	8
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

Cyber Crime and Cyber Terrorism Investigator's Handbook" by Babak Akhgar, Andrew Staniforth, and Francesca Bosco

"Computer Forensics and Cyber Crime: An Introduction" by Marjie T. Britz

"The Basics of Cyber Safety: Computer and Mobile Device Safety Made Easy" by John Sammons and Michael Cross

- Information security policies, procedures and standards by Thomas Pettier
- Information security policies- Thomas R.Peltier, Peltier R. Peltier
- "Principles of Information Security" by Michael E. Whitman and Herbert J. Mattord
- "Cybersecurity for Beginners" by Raef Meeuwisse
- "Cyber Law and IPR in the Age of Information Technology" by Dr. V.K. Ahuja

Reference Books

- "Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short
- "Introduction to Cyber Security: Stay Safe Online" by Simplilearn

- "Cyberlaw: The Law of the Internet and Information Technology" by Brian Craig
- Cyber Law: Indian and International Perspectives" by Dr. Karnika Seth
- Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management" by Thomas R. Peltier
- "Stealing Your Life: The Ultimate Identity Theft Prevention Plan" by Frank W. Abagnale
- "Cyber Laws and IT Protection" by Dr. S. R. Srinivasan

Recommended Learning Material

- www.unodc.org
- www.studocu.com
- cod.pressbooks.pub
- clearias.com/cybercrime
- www.kaspersky.com

Recommended Certification

- Certified Ethical Hacker (CEH)
- Certified Information Systems Security Professional (CISSP)
- Certified Information Security Manager (CISM)
- Certified Information Systems Auditor (CISA)
- Certified Information Privacy Professional (CIPP)
- Certified Information Security Manager (CISM)

PBP506MJP: Practical based on Python and DS		
Teaching Scheme: **Practical Sessions**:45 Sessions (Each session of 2 Hrs)	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 50 Marks **Total :50 Marks**

Prerequisites - Mathematics foundation, Programming Skills, Knowledge of Algorithms

Course Objectives:

- To implement fundamental programming and OOPs concepts using Python
- To explore MongoDB and implement CRUD Operation using python
- To gain a knowledge of web application development using python framework.
- To enhance problem solving skills by implementing data algorithms
- To implement various searching and sorting algorithms

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Demonstrate Basics of Python and OOPs concepts.
CO2	Apply	Demonstrate CRUD Operation using MongoDB.
CO3	Apply	Design and Develop web application using DJango.
CO4	Apply	Implement Linear data structure like stack, queue and Linked list and demonstrate various searching and sorting techniques
CO5	Apply	Implement various operation of non-Linear data structure like Tree and Graph

Learning Resources

References

- https://www.python.org/
- https://www.djangoproject.com/
- https://www.mongodb.com/try/download/community
- https://docs.python.org/3/tutorial/datastructures.html

MPR541MRP - Mini Project		
Teaching Scheme: **Sessions**: 45 Hours.	**Credit: 03**	**Examination Scheme:** **Internal(PJ)**: 50 Marks **Total :50 Marks**

Prerequisites - Knowledge of Software Requirement Specification, technology, tools and techniques.

Course Objectives:

- Enhance programming skills, software development methodologies and proficiency in relevant technologies/tools
- Gain experience in project planning, requirement analysis, design, implementation, testing, and documentation
- Enhance problem solving capability through implementation
- Improve presentation skills by effectively communicating project goals, methodologies, results and conclusions to peers, faculty, and potentially external stakeholders
- Foster teamwork and collaborative skills through group-based project work, including division of tasks, coordination, and communication
- Encourage creative thinking and innovation in designing solutions that meet specified requirements and constraints

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Apply knowledge of software engineering principles and methodologies in designing and implementing the project
CO2	Apply	Demonstrate the ability to develop a functioning software application or solution that meets specified requirements and objectives
CO3	Apply	Design comprehensive documentation that includes project requirements, design specifications, implementation details, testing strategies, and user manuals

Indian Knowledge system (IKS)		
Teaching Scheme: **Theory Sessions:** Total 15 Hours	**Credit: 01**	**Examination Scheme:** **Internal(TH)**: 25 Marks **Total :25 Marks**

Prerequisites: Information of Indian Culture, History, Traditions and knowledge system.

Course Objectives:

- To understand and explore the ancient Indian texts and scriptures that encompass knowledge in various fields.
- To explore the ethical and moral perspectives within Indian philosophical and spiritual traditions
- To encourage interdisciplinary learning by integrating insights from Indian knowledge systems into various academic disciplines.
- To compare Indian knowledge systems with other global knowledge traditions.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand about Indianan philosophy, Culture, knowledge in different domains.
CO2	Understand	Explore the ethical and moral perspectives within Indian philosophical and spiritual traditions.
CO3	Apply	Understand Indian knowledge system and apply in current area and applications.
CO4	Understand	Understand the basics of Indian ethics and values
CO5	Understand	Explore the Indian traditions and their application in modern contexts.

Sr. No.	List of Subjects
1	Basics of Indian Knowledge System
2	Indian Languages in Education
3	Community Enhancement
4	Indian Philosophy and Indian Ethics
5	Vedic Mathematics/ Ancient Indian Mathematics
6	Indian Philosophy and Artificial Intelligence (AI)
7	E-Learning and Traditional Knowledge
8	Digital Humanities and Cultural Heritage
9	Indian Scriptures and Epics
10	Traditional Indian Sciences
11	Indian Mathematics and Astronomy
12	Application of IKS in Modern Contexts

13	Ethics in Professional Practice
14	Traditional Sciences
15	Ethics, Morality, and Social Systems
16	Value- based Leadership
17	Life Skills development
18	Indian Intellectual Heritage
19	Indian Knowledge System in Science
20	Indian Knowledge System in Architecture, Town Planning and Governance

Learning Resources

Text Books

- Linguistic Culture and Language Policy - edited by R.P. Das.
- Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.
- Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi
- Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.
- Introduction to Indian Knowledge System: Concepts and Applications, Mahadevan, B., Bhat, Vinayak Rajat, Nagendra Pavana R.N., PHI Learning Pvt. Ltd
- Traditional Knowledge System In India, Amit Jha

Recommended Learning Material

- www.sanskrit.nic.in
- onlinecourses.swayam2.ac.in
- https://ignca.gov.in/
- nptel.ac.in/courses/101104065

Recommended Certification:

- Indian Knowledge System(IKS): Humanities and Social Sciences
- Introduction to Ancient Indian Technology

Note : relevant certificate from any discipline.

Semester II

JPR551MJ: Java Programming

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory Sessions: Total 45 Hours		**Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Learner should know programming structures like decision flows, loops, variables, and function etc.

Course Objectives:

- To familiarize students with the concepts of OOPs.
- To enable the students to understand the core principles of the Java Language and use AWT tools to produce well designed, effective applications.
- Students will be able to develop server-side applications with database handling using servlets, JSP, JDBC

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Apply the concept of Object-Oriented Programming to map and solve simple real world problem
CO2	Apply	To design and develop robust, efficient, multithreaded and scalable Java applications using the collection framework, multithreading, and exception handling.
CO3	Apply	To develop Web application for solving real life problem using Servlet
CO4	Apply	To develop Web application for solving real life problem using JSP, JDBC
CO5	Apply	To develop robust web applications using Spring MVC

Unit No.	Contents	Weightage in %	No of Sessions
1	**Basics of Java** 1.1 Class and objects 1.2 Abstraction, polymorphism inheritance, and encapsulation, 1.3 Abstract Class, Interface 1.4 Garbage Collector 1.5 Lambda expression	25	10
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Advanced Java Concepts** 2.1 Introduction to Collection Framework 2.1.1 Arraylist, Vector, Set, Map, Hashing 2.2 Multithreading	20	9

	2.2.1 Thread Life-Cycle 2.2.2 Thread Priorities 2.2.3 Synchronizing Threads 2.2.4 Inter Communication of Threads 2.3 Exception Handling 2.3.1 Types of Exception 2.3.2 Keywords 2.3.3 User defined exception		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Servlets** 3.1 Fundamentals of Java Servlet programming 3.2 A simple java Servlet 3.3 Servlet life cycle 3.4 Developing and Deploying Servlets 3.5 Working with cookies	20	9
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Java Server Pages** 4.1 JSP Overview-Installation- 4.2 JSP Tags-Components of a JSP page 4.3 Expressions Script lets-Directives, JSP object, 4.4 JDBC connectivity	20	9
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Spring MVC** 5.1 Overview of the Spring Framework 5.2 Spring MVC Annotation 5.3Spring MVC Architecture 5.4 Spring MVC Flow, 5.5 Spring Form Handling 5.2 Spring Core and Spring Boot Dependency injection and inversion of control (IoC)	15	8
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- Java Complete Reference Schildt Herbert, TMH.
- Java Fundamentals (SIE), Schildt Herbert, TMH
- The Complete Reference JSP, Phil Hanna, TMH
- JDBC, Servlet and JSP, Black Book, Santosh Kumar K. Dremtech publication

Reference Books

- Head First Servlets and JSP, 2nd Edition by Bert Bates, Bryan Basham, Kathy Sierra
- OCJP Oracle Certified Programmer for Java Study Guide by Kathy Sierra and Bert Bates.

- A Programmer's Guide to Java OCJP Certification (A Comprehensive Primer) by Khalid A. Mughal and Rolf W. Rasmussen.
- Java Server Programming Java Ee&(J2EE 1.7), Black Book, Wiley publications

Recommended Learning Material

- https://docs.oracle.com/en/java/javase/index.html
- www.nptelvideos.com
- https://www.geeksforgeeks.org/courses/search?query=java

Recommended Certification

- Oracle Certified Associate Java Programmer OCA
- Oracle Certified Professional Java Programmer OCP

OTE552MJ : Optimization Techniques		
Teaching Scheme: **Theory Session: Total** 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Basic mathematical knowledge is essential.

Course Objectives:

- To understand the role and principles of optimization techniques in business world.
- To understand the process of problem statement formulation of the business scenario.
- To understand the implementation of various decision-making techniques in the process of decision making.
- To gain the techniques and skills on how to use optimization techniques to support the decision making in business world.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Understand and formulate linear programming models to solve optimization problems in various business contexts.
CO2	Apply	Apply sequential models to make informed decisions in dynamic and uncertain environments.
CO3	Apply	Utilize Markov chains and simulation techniques to model and solve complex inventory management problems.
CO4	Apply	Apply PERT/CPM techniques to plan, schedule, and control projects effectively, including managing replacement decisions.
CO5	Apply	Apply decision-making processes and strategic interactions using decision theory and game theory frameworks.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Linear Programming** 1.1. Various definitions, statements of basic theorems and properties, Advantages and Limitations 1.2. Application areas of Linear programming 1.3. Linear Programming – Concept 1.4. Simplex Method and Problems (No Graphical Solutions) 1.5 Transportation Problem (NWCM, LCM, VAM) optimize the problem using MODI Method	20	12
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Sequential model, Queuing Theory and related Problems** 2.1 Processing n jobs through 1 machine, 2 machines and 3 machines	20	05

	Queuing Theory 2.2 Characteristics of Queuing Models, Transient and Steady states of the System 2.3 Model – I [(M/M/1) : (FCFS / ∞ /∞)] Miscellaneous Problems based on above		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Markov Chains, Simulation Techniques & Inventory Theory** **Markov Chains, Simulation Techniques** 3.1 Markov chains: Applications related to technical functional areas, 3.2 Steady state Probabilities and its implications, 3.3 Decision making based on the inferences *Miscellaneous Problems based on above	20	08
*Mapping of Course Outcomes for Unit 3: CO3			
4	**PERT CPM** 4.1 Basic differences between PERT and CPM. 4.2 Network diagram 4.3 Time estimates (Forward Pass Computation, Backward Pass Computation), Critical Path 4.4 Probability of meeting scheduled date of completion, 4.5 Calculation on CPM network. Various floats for activities Event Slack 4.6 Calculation on PERT network. Miscellaneous Problems based on above	20	10
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Decision Theory & Game Theory** **Decision Theory** 5.1 Introduction and Steps of Decision-Making Process 5.2 Types of Decision-Making Environments 5.3 Decision-Making Under Uncertainty 5.4 Decision-Making Under Risk **Game Theory** 5.5 Introduction, n X m zero sum game with dominance 5.6 Solution using Algebraic, Arithmetic and Matrix strategy	20	10
*Mapping of Course Outcomes for Unit 5: CO5			
Learning Resources			
Recommended Books: **Text Books:** • Operations Research by Pannerselvam • Operations Research Theory and Application by J. K. Sharma –Mac-MillanPublication			

- Statistical and Quantative Methods – Mr. Ranjit Chitale

Reference Books:

- Statistical Methods – S.P.Gupta, Sultan Chand, New Delhi
- Operation Research by V. k. Kapoor
- Operations Research by Kanti Swaroop, P. K. Gupta and Man Mohan
- Introduction to Operations Research by Hiller & Lieberman, Tata Mc GrawHill
- Operations Research by H. A. Taha
- Operation Research by Hira & Gupta
- What is Game Theory?, David K. Levine, Economics, UCLA

Research Software:

- MS Excel Solver
- TORA
- Python and / or R programming

Websites:

- www.orsi.in
- www.atozoperationalresearch.com

Recommended Certifications*:*

- Data science with R programing
- Certification in Tableau

STQ553MJ: Software Testing and Quality Assurance		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Basic concepts software development

Course Objectives:

- To understand the principles of software development emphasizing processes and activities of quality assurance
- To study fundamental concepts in software testing, including software testing objectives, process, strategies, and methods.
- To understand test design techniques based on functionality and structure of software
- To understand test planning, monitoring, and control process
- To gain the techniques and skills on how to use software testing tools to support software testing activities

Course Outcomes: On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the role of software quality assurance in contributing to the efficient delivery of software solutions.
CO2	Understand	Understand specific software tests with well-defined objectives and targets.
CO3	Apply	Apply the software testing techniques in commercial environments.
CO4	Analyze	Construct test strategies and plans for software testing.
CO5	Apply	Demonstrate the usage of software testing tools for test effectiveness, efficiency, and coverage.

Unit No.	Content	Weightage in %	No of Sessions
1	**Software Quality Assurance Fundamentals** 1.1. Definition of Quality, Quality Assurance, Quality Control, Difference between QA and QC, SoftwareQuality Assurance Challenges 1.2. Software Quality Assurance, SQA Planning &Standards (ISO 9000) 1.3. SQA Activities 1.4. Building Blocks of SQA 1.5. Software Quality factors 1.6. Software Reliability & Reliability Measurement Factors: ROCOF, MTTF, MTTR, MTBF, POFOD, Availability	20	8

*Mapping of Course Outcomes for Unit 1: CO1

2	**Software Testing Fundamentals** 2.1. Definition & Objectives of Testing 2.2. Role of testing and its effect on quality 2.3. Causes of software failure: Definition of -Error, Bug,Fault, Defect and Failure, 2.4. Economics of Testing 2.5. Seven Testing Principles 2.6. Software Testing Life cycle 2.7. Validation & Verification Concepts - V Model and WModel 2.8. Agile Testing- Test Driven Software Development 2.9. Levels of Testing- 2.9.1. Unit (Component) Testing 2.9.2. Integration Testing 2.9.3. System Testing 2.9.4. User Acceptance Testing (UAT) 2.10. Test Types 2.10.1. Functional testing (Black-box) 2.10.2. Non-functional testing (Testing of software product characteristics) 2.10.3. Structural testing (White-box) 2.10.4. Testing related to changes – Confirmation (Re-testing) and Regression Testing 2.11. Non-Functional Testing Types – 2.11.1. Performance (Load & Stress) 2.11.2. Usability 2.11.3. Maintainability 2.11.4. Portability 2.11.5. Security 2.11.6. Localization & Internationalization 2.12. Concept of Smoke testing and Sanity Testing	20	10
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Static & Dynamic Testing** 3.1. Static Techniques – Review 3.1.1. Review Process (Informal & Formal) 3.1.2. Technical or Peer Review 3.1.3. Walkthrough 3.1.4. Inspection 3.2. Static Techniques – Static Analysis 3.2.1. Static Analysis by Tools (Automated Static Analysis) 3.3. Test Design Techniques: Black Box Testing 3.3.1. Equivalence Partitioning	20	9

	3.3.2. Boundary Value Analysis 3.3.3. Decision Table Testing 3.3.4. State Transition Testing 3.4. Test Design Techniques -White Box Testing Techniques (coverage based and fault-based) 3.4.1. Statement coverage 3.4.2. Branch & Decision coverage 3.4.3. Path coverage 3.4.4. McCabe's Cyclomatic Complexity Metric (Computation of Cyclomatic Complexity to be covered) 3.4.5. Data Flow based Testing 3.4.6. Mutation Testing 3.5. Test Design Techniques -Experience based techniques 3.5.1. Error Guessing 3.5.2. Exploratory Testing		
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Test Management** 4.1. Test Organization- Roles & Skills of Tester, Test Lead, Test Manager 4.2. Test Planning- Test Plan as per IEEE 829 STANDARDTEST PLAN TEMPLATE 4.3. Test Process Monitoring & Control 4.3.1. Test Monitoring through -Test Log (IEEE 829: TEST LOG TEMPLATE) and Defect Density 4.3.2. Reporting Test Status (IEEE 829: TEST SUMMARY REPORT TEMPLATE) 4.3.3 Test Control 4.4. Test Scenario, Test Suite, Test Cases (bothPositive & Negative Test Cases, as per IEEE 829: TEST CASE SPECIFICATION TEMPLATE) 4.5. Configuration Management-ConfigurationManagement support for Testing 4.6. Risk and Testing- Project Risk & Product Risk 4.7. Incident/ Defect Management 4.7.1. Defect Life Cycle 4.7.2. Defect/ Incident Report (IEEE 829: TEST INCIDENT REPORT TEMPLATE) Case Study on Test Plan for applications and Case study onTest Cases for different features within applications	25	11
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Tool Support for Testing** 5.1. Types of Test tools –CAST (only type &	15	7

	theirpurpose & Benefits and Risks should be covered) 5.2. Introduction of a tool into an organization 5.3. Testing tools 5.3.1. Selenium -WebDriver and Test NG 5.3.2. JMeter 5.3.3. Postman 5.3.4. ETL Testing Tool 5.4. JIRA (Project Management)		

*Mapping of Course Outcomes for Unit 5: CO5

Learning Resources

Text Books:

- Foundations of Software Testing by Rex black, Erik Van Veenendaal, Dorothy Graham
- (2020)-Cengage Learning: London UK, 5th Edition
- Software Engineering by Sommerville-Pearson,8thEdition
- Daniel Galin, “Software Quality Assurance: From Theory to Implementation”, Pearson
- Addison-Wesley, 2012. 2.
- Effective Methods for Software Testing by William Perry- Wiley Pub, 3rd Edition.

Reference Books:

- Roger S. Pressman, “Software Engineering-A Practitioner’s Approach”, McGraw Hill
- pub.2010
- Software Testing in Real World Edward Kit- Pearson Pub
- Software Testing Techniques by Boris Beizer-DreamTech Pub,2nd Edition
- Software Testing by Ron Patton, TechMedia Pub.
- Introducing Software by Testing Louise Tamres
- Fundamentals of Software Engineering –Rajib Mall, 3rd Edition
- Allen Gilles “Software quality: Theory and management”, International Thomson,
- Computer press 1997.
- Software Testing Principles Techniques and Tools by Milind. G. Limaye- Tata McGraw Hill Pub.
- Stephen H. Kan, “Metrics and models in software quality Engineering”, Addison – Wesley 2003.

Recommended Learning Material:

- www.istqb.org
- https://www.seleniumhq.org/
- https://www.softwaretestingmaterial.com/selenium-tutorial/
- https://www.toolsqa.com/selenium-tutorial/
- www.guru99.com/software-testing.html
- www.guru99.com/selenium-tutorial.html
- www.guru99.com/mobile-testing.html
- www.professionalqa.com

- www.resources.sei.cmu.edu/library
- www.iist.org

Recommended Certifications:

- CAST (Certified Associate in Software Testing)
- CSQA (Certified Software Quality Analyst Certification)
- (ISTQB) International Software Testing Qualifications Board Certification
- (CQE) Certified Quality Engineer
- (CMST) Certified Manager of Software Testing

RMW554MJ: Research Methodology		
Teaching Scheme: **Theory Session: Total** 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Fundamental knowledge of Statistics

Course Objectives:

- Understand fundamental research concepts and principles.
- Develop skills to design and conduct research studies.
- Learn to conduct thorough literature reviews and evaluate existing research.
- Gain knowledge of various research designs and methodologies.
- Acquire data collection and analysis skills using appropriate tools.
- Understand and apply ethical considerations in research.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the basic concepts, purposes, and significance of research methodology in academic and professional contexts.
CO2	Apply	Apply various research designs and their appropriateness for different types of research questions and objectives
CO3	Apply	Apply suitable data collection and sampling methods to gather reliable and valid data for research studies.
CO4	Apply	Use appropriate statistical tools and techniques to demonstrate research data and interpret the results effectively.
CO5	Apply	Apply skills in writing clear, coherent, and well-structured research reports that effectively communicate research findings.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to Research Methodology** 1.1 Definition and Importance, Importance in academic and professional contexts 1.2 Objectives of Research-Exploration, Description, Explanation, Prediction, Application 1.3 Types of Research-Basic vs. applied research, Qualitative vs. quantitative research, Cross-sectional vs. longitudinal research 1.4 Research Process and Steps, Identifying the problem, Literature review, Research questions 1.5 Research in Computer Applications-Unique aspects of research in computer science, Common research methods in computer applications.	20	7

*Mapping of Course Outcomes for Unit 1: CO1

2	**Research Design** 2.1 Definition and Purpose, Importance of a well-structured design 2.2 Types of Research Designs: Exploratory design, Descriptive design, Experimental design, Quasi-experimental design 2.3 Components of Research Design: Objectives Hypotheses, Variables, Methods of data collection, Sampling design 2.4 Validity and Reliability: Internal validity, External validity, Construct validity, Reliability and consistency.	20	10
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Data Collection and Sampling Methods** 3.1 Data Collection Methods: Primary Data Collection 3.2 Sampling Techniques: Principles of Sampling (Population vs. sample, Sampling frame), Probability Sampling Methods, Non-probability Sampling Methods, Determining Sample Size, Factors affecting sample size, Sample size calculations.	20	8
*Mapping of Course Outcomes for Unit3: CO3			
4	**Data Analysis** 4.1 Inferential Statistics: Hypothesis testing, Confidence intervals, Chi-square test, t-test, Analysis of variance (ANOVA) 4.2 Qualitative Data Analysis: Coding and Categorizing Data.	20	10
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Report Writing** 5.1 Structure of a Research Report/Thesis Title Page, Abstract, Introduction, Literature Review, Methodology, Results, Discussion and Conclusion, References, Citation styles 5.2 Writing Style and Clarity-Academic writing standards, Avoiding plagiarism, Ensuring clarity and coherence, Visual Presentation of Data, Creating effective tables, Designing clear charts and graphs, Preparing for Oral Presentations, Structuring a presentation, Structuring a presentation, Use of visual aids, Effective communication skills, Ethics in Research.	20	10
*Mapping of Course Outcomes for Unit 5: CO5			
Learning Resources			

Text Books:

- Research Methodology: Methods and Techniques" by C.R. Kothari and Gaurav Garg
- Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar
- Business Research Methods" by Donald R. Cooper and Pamela S. Schindler
- Research Methodology and Scientific Writing" by C. George Thomas
- Research Methodology: Concepts and Cases" by Deepak Chawla and Neena Sondhi

Reference Books:

- Research Methods for Business: A Skill Building Approach" by Uma Sekaran and Roger Bougie
- Qualitative Research Methods for the Social Sciences" by Bruce L. Berg and Howard Lune
- Statistics for Management" by Richard I. Levin, David S. Rubin, Masood H. Siddiqui, and Sanjay Rastogi
- Case Study Research: Design and Methods" by Robert K. Yin
- The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

Recommended Learning Material

Online Courses

- Coursera: "Research Methods" by University of London
- A comprehensive course covering the fundamentals of research methods.
- edX: "Introduction to Research Methods" by University of London
- Focuses on essential research methods and techniques.
- Udemy: "Research Methods and Statistics: An Introduction"
- Provides an introduction to research methods and basic statistical concepts.
- Khan Academy: "Statistics and Probability"
- Offers free tutorials on statistical methods relevant to research.
- MIT OpenCourseWare: "Research Methods in Management"
- A free course providing an overview of research methods in management.

Software Tools

- SPSS (Statistical Package for the Social Sciences)
- R and RStudio
- Microsoft Excel
- Software Tools-SPSS, R, Python (Pandas, NumPy)

Recommended Certification

- Research Methodology, Link: https://nptel.ac.in/courses/109/105/109105115/
- Qualitative Research Methods and Research Writing, Instructor: Prof. Aradhna Malik, IIT Kharagpur, Link: https://nptel.ac.in/courses/109/105/109105115/
- Introduction to Research, Link: https://nptel.ac.in/courses/121/106/121106007/
- Research Writing, Instructor: Prof. A. Arunachalam, IIT Kharagpur, Link: https://nptel.ac.in/courses/109/105/109105115/
- Advanced Statistical Methods in Data Science, Instructor: Prof. Shalabh, IIT Kanpur Link: https://nptel.ac.in/courses/111/104/111104071/

CCM560MJ: Cloud Computing Management and Security		
Teaching Scheme: **Theory Session**: 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total: 75 Marks**

Prerequisites: Foundational knowledge of cloud computing concepts understanding of networking fundamentals and basic cybersecurity principles.

Course Objectives:

- To introduce the fundamentals of Cloud Management & Security.
- To give Insights into Cloud Database and File Systems.
- To provide knowledge on Security Concepts in AWS.
- To know about Cloud Backup and Disaster Recovery.
- To impart the knowledge on different Cloud Compute Services.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand and describe the fundamentals of Cloud Management, Security Concepts, Quality services.
CO2	Understand	Understand and explain the concept of Cloud Database and File System with Cloud Database Services.
CO3	Apply	Demonstrate Security Concepts in AWS and security services.
CO4	Understand	Recognize the Cloud Backup and Disaster Recovery strategies.
CO5	Apply	Use and understand the various Cloud Compute Services.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Cloud Management & Security** 1.1 Data Migration in Cloud. 1.2 Cloud Migration Strategies and Process (Six R for Cloud Migration). 1.3 Cloud Security Fundamentals. 1.4 Cloud Computing Security Challenges. 1.5 Privacy and Security in the Cloud. 1.6 Quality of Services in Cloud Computing (QoS). 1.7 Identity Management and Access control.	15	6
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Fundamentals of Cloud Database and File System:** 2.1 Core concepts of data warehousing. 2.2 Primary components and architectures of data warehousing. 2.3 Cloud Native file system.	25	12

	2.4 Model for High Performance Processing of Large datasets. 2.5 Storage types. 2.6 General Purpose Cloud Storages. 2.7 Cloud Database Services and their comparison 2.7.1 Amazon Aurora, Amazon DynamoDB and Amazon Neptune.		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Security Concepts in AWS**: 3.1 Basic security concepts: Encryption, Hash Function, VPN etc. 3.2 IAM (Identity and Access Management). 3.3 Network security and Cloud Computing. 3.4 AWS security services overview. 3.5 Managing access with AWS IAM. 3.6 Case Study on Cloud Security.	20	9
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Backup and Disaster Recovery**: 4.1 Backup strategies for AWS databases 4.2 Automated backups and snapshots 4.3 Disaster recovery planning and execution 4.4 Best practices for ensuring data durability and availability 4.5 Real-world case studies on AWS database security breaches	20	9
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Cloud Compute Services Overview**: 5.1 Amazon EC2 (Virtual servers in the cloud) 5.2 Amazon EC2 Auto Scaling (Scale compute capacity to meet demand) 5.3 Amazon LightSail (Launch and manage virtual private servers) 5.4 AWS Elastic Beanstalk (Run and manage web apps) 5.5 AWS Lambda (Run code without thinking about servers). 5.6 Case Study on Cloud Services.	20	9
*Mapping of Course Outcomes for Unit 5: CO5			
Learning Resources			
Text Books: • Practical Cloud Security: A Guide for Secure Design and Deployment, by Chris Dotson • Real-Time Database Systems: Fundamentals, Architectures and Applications • (Springer Briefs in Computer Science), by Pedro Mejia Alvarez, Ricardo J. Zavaleta Vazquez			

- An Introduction to Cloud Databases by Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati
- Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Zaigham Mahmood, and Ricardo Puttini
- AWS Penetration Testing: Beginners guide to hacking AWS with tools such as Kali Linux, Metasploit, and Nmap by Jonathan Helmus
- Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud by Mark Wilkins

Reference Books:

- Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather, Subra Kumaraswamy, and Shahed Latif
- Data Warehousing Fundamentals for IT Professionals" by Paulraj Ponniah
- AWS Security Best Practices on AWS: Securing Your AWS Cloud" by Albert Anthony
- Planning Cloud-Based Disaster Recovery for Digital Assets: The Innovative Librarian Guide by Robin M. Hastings
- Amazon Web Services in Action" by Andreas Wittig and Michael Wittig
- Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud, by Mark Wilkins

Recommended Learning Material

Web Reference:

- http://www.cloudcomputingpatterns.org/
- http://whatiscloud.com
- www.w3schools.com

Recommended Certification:

- AWS Educate
- Google Cloud Training
- Microsoft Azure (M. Azure)
- Certification courses offered by NPTEL, Swayam etc.

JS561MJ: JavaScript		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Students should know least one programming language and should be familiar with concepts like Classes, Objects, Inheritance, and an intermediate knowledge on HTML.

Course Objectives:

- Develop familiarity with the JavaScript language.
- Learn to use OOPs and patterns.
- Understand concepts commonly used in dynamic language programming, such as introspection, higher-order functions, and closures.
- Become adept at implementing client-side interfaces through the use of the DOM, and AJAX.
- Become familiar with common libraries, tools and framework that are used in web application development.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Utilize Basic JavaScript concepts for writing simple Java script program.
CO2	Apply	Design and develop simple application using build-in objects and browser object Model
CO3	Apply	Implement the concepts of OOPs , event handling and Asynchronous JavaScript for developing simple real life problem solving web application
CO4	Create	Create interactive web page of application for problem solving
CO5	Apply	Demonstrate server-side and client-side aspects of web applications using Node.js and React.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Basic JavaScript** 1.1 Introduction of Java Script 1.2 Comments, Keywords, Data Types, Variables, Operators, Control Statement and Iterative statements 1.3 Functions, Array 1.4 Java Script Architecture 1.5 Framework and Libraries	15	7

*Mapping of Course Outcomes for Unit 1: CO1

2	**Client-Side Scripting** 2.1 Java Script Objects – Object, Date, String, Array, Math, Number, Boolean, 2.2 Event handling-Mouse, Keyboard, Form, Window 2.3 BOM –Object Form Validations, Regular Expressions	15	7
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Advanced JavaScript Techniques** 3.1 Introduction to Objects and Classes, 3.2 Creating and Using JavaScript Classes, Object Prototypes, Inheritance Patterns, Encapsulation Techniques, Polymorphism and Code Reusability 3.3 Asynchronous JavaScript- Callbacks, Promises, and Async/Await Managing Asynchronous Data Flow Working with Timers and Intervals Handling HTTP Requests with Fetch API 3.4 Introduction to WebSockets 3.5 Event Handlers and Callback Functions	20	9
*Mapping of Course Outcomes for Unit 3: CO3			
4	**DOM –Document Object and its Methods,** 4.1 JSON - Iterators and generators Working with Iterators, Working with Generators 4.2 Document Object Model, Document structure, selecting document elements and query selectors, moving thorough DOM tree, 4.3 HTML elements and attributes, Creating, changing and deleting nodes.	20	9
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Framework and Libraries** 5.1 Introduction of Node.js 5.2 Getting up React environment, Create React App 5.3 Hello World, Components, JSX 5.4 Functional vs class components, Props 5.5 State, Lifecycle methods 5.6 Hooks – useState, useEffect, useContext 5.7 Event handling 5.8 Forms – controlled components, submission, validation 5.9 Conditional rendering – if, ternary, && 5.10 Lists and keys, Importance of keys 5.11 Styling – CSS, CSS Modules, CSS-in-JS 5.12 React Router – setup, routes, parameters 5.13 Async/await, Promises, Fetch API	30	13

	5.14 Error handling, debugging, optimization		
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- JavaScript Demystified Keogh,Jim McGraw Hill
- Beginning Java Script Wilton,Paul Wily india
- JavaScript: The Definitive Guide by David Flanagan

Reference Books

- Learning Advanced Javascript by John Resig
- JavaScript: The Good Parts by Douglas Crockford

Recommended Learning Material

- https://developer.mozilla.org/en-US/docs/Web/JavaScript
- https://www.freecodecamp.org
- www.nptelvideos.com

Recommended Certification

- Exam 98-382: Introduction to Programming Using JavaScript by Microsoft
- Certified JavaScript Developer by javascriptinstitute
- JSE – Certified Entry-Level JavaScript Programmer by OpenEDG
- JSA – Certified Associate JavaScript Programmer by OpenEDG
- JSP-A – Certified Professional JavaScript Programmer, specialization: Front-End Web Development OpenEDG

MLT562MJ: Machine Learning Techniques		
Teaching Scheme: **Theory Session**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Data Processing, EDA, Statistics, Python

Course Objectives:

- To Understand the Concept of Machine Learning
- To Gain knowledge on Supervised and unsupervised Learning techniques.
- To evaluation of learning algorithms and model selection
- To Explore Knowledge of Semi-Supervised and reinforcement learning
- To Analyze case studies to understand successful implementations and challenges faced in practical scenarios.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Describe the workflow of a machine learning project, including data pre-processing, model training, evaluation, and deployment.
CO2	Apply	Apply the various algorithms of supervised and learning
CO3	Apply	Apply the various algorithms of unsupervised learning
CO4	Apply	Apply the fundamental algorithms in semi-supervised and reinforcement learning.
CO5	Apply	Apply real-world applications of supervised and unsupervised learning across diverse domains.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction of ML** 1.1 Overview of Machine Learning 1.2. Machine Learning Vs Statistical Learning 1.3. Type of Machine Learning 1.4 Machine Learning Workflow 1.4.1 Problem Definition and Data Collection 1.4.2 Data Preparation and Preprocessing 1.4.3 Model Selection and Training 1.4.4 Model Evaluation and Validation 1.5 Key Concepts and Terminology 1.5.1 Features, labels, datasets 1.5.2 Training set, test set, validation set 1.5.3 Overfitting vs. underfitting 1.5.4 Bias-variance tradeoff	10	8

*Mapping of Course Outcomes for Unit 1:CO1

2	**Supervised Learning** 2.1. Introduction to Supervised Learning 2.2. Linear Regression 2.2.1 Simple Linear Regression 2.2.2 Multiple Linear Regression 2.3. Classification 2.3.1 Introduction to Classification 2.3.2 Logistic Regression 2.3.3 Decision Trees 2.3.4 k-Nearest Neighbors 2.3.5 Support Vector Machines 2.3.6 Naive Bayes Classifier 2.4. Evaluation Metrics: Accuracy, Precision, Recall, F1-Score 2.5. Model Evaluation and Validation 2.5.1 Train/Test Split 2.5.2 Cross-Validation 2.5.3 Overfitting and Underfitting 2.5.4 Confusion Matrix *Python Implementation of Supervised machine learning algorithm using Scikit-Learn	25	12
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Unsupervised learning** 3.1 Introduction to Unsupervised Learning 3.1.1 Definition 3.1.2 Purpose 3.1.3 Unsupervised Learning Approaches 3.1.4 Applications and scenarios where unsupervised learning is used 3.2 Clustering Algorithms- 3.2.1 K-means Clustering 3.2.2 Hierarchical Clustering 3.2.3 Density-based Clustering (DBSCAN) 3.3 Dimensionality Reduction Techniques 3.4 Case studies	25	10
*Mapping of Course Outcomes for Unit 3:CO3			
4	**Semi Supervised and Reinforcement:** 4.1 Introduction to Semi-Supervised Learning 4.1.1 Importance of Semi-Supervised Learning 4.1.2 Applications in real-world scenarios 4.2 Techniques in Semi-Supervised Learning 4.2.1 Self-Training 4.2.2 Co-Training	20	8

	4.2.3 Graph-Based Methods 4.2.4 Semi-Supervised Support Vector Machines 4.2.5 Generative Models (e.g., Gaussian Mixture Models) 4.3 Introduction to Reinforcement Learning 4.3.1 Key concepts: Agent, Environment, State, Action, Reward 4.3.2 Applications of Reinforcement Learning 4.4 Markov Decision Processes (MDPs) 4.5 Temporal-Difference Learning- SARSA and Q-Learning 4.6 Advanced Topics in Reinforcement Learning 4.6.1 Deep Q-Networks (DQN) (brief introduction) 4.6.2 Exploration vs. Exploitation Trade-off 4.6.3 Reinforcement Learning in complex environments		
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Case studies** 5.1 REGRESSION Case Studies 5.1.1 Retail Store Sales Prediction 5.1.2 Restaurant Sales Prediction 5.1.3 Inventory Prediction for Optimum Inventory Management 5.1.4 Sport Player Salary Prediction 5.1.5 Machine Learning case study on Dell 5.2 CLASSIFICATION Case Studies 5.2.1 Diabetes Prediction for Preventive Care 5.2.2 Telecom Network Disruptions Prediction for Planning Preventive Maintenance 5.2.3 Breast Cancer Prediction for Preventive Care 5.2.4 Credit Card Fraud Detection 5.2.5 Heart Diseases Prediction for Preventive Care 5.2.6 Loan Application Classification 5.2.7 Computer Price estimation 5.2.8 House price prediction	20	7
*Mapping of Course Outcomes for Unit 5:CO5			

Learning Resources

Text Books:

- "Foundations of Machine Learning" by Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar
- Machine Learning: An Algorithmic Perspective" by Stephen Marsland
- Statistics and Data Science -Paperback, Dr. Swapnaja, Dr. Minakshi, Dr. Mukul Kulkarni, Dr. Santosh Deshpande, Dr. Ravikant Zirmite

Reference Books:

- "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems" by Aurélien Géron
- "Pattern Recognition and Machine Learning" by Christopher M. Bishop
- "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto
- "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney

Recommended Learning Material:

1. Coursera: Machine Learning by Andrew Ng - https://www.coursera.org/learn/machine-learning
2. GitHub: Awesome Machine Learning - https://github.com/josephmisiti/awesome-machine-learning

ECS563MJ: Essentials of Cyber Security		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Basics of cyber security concepts

Course Objectives:

- To provide students with a comprehensive understanding of Cyber Security and cyber crime
- To equip students with Security Management, Infrastructure, Frameworks, Standards to handle data security and privacy issues in Cyber World

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the importance of cybersecurity practices, understand how to secure a network against intrusion tactics, understand types cyber-crime attacks
CO2	Understand	Understand how data is sent and received over a network, Incidence response, Disaster Recovery
CO3	Apply	Identify common risks, threats, and vulnerabilities, as well as techniques to mitigate them
CO4	Apply	Evaluate risk and identify security management tools, apply cyber security technologies
CO5	Understand	Understand digital forensics and its needs

Unit No.	Units Details	Weightage in %	No of Sessions
1	**Evolution of Cyber Security** 1.1 Evolution of Cyber security 1.2 Cyber security increasing threat landscape 1.3 Introduction to cyber security 1.4 Confidentiality, integrity, and availability (CIA) 1.5 Security management, frameworks and standards	15	5
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Networking Basics and security Infrastructure** 2.1 Network Design and Configuration 2.2 Essential components of Data Transfer Governance in Cyber Space 2.3 Security Infrastructure 2.4 Contingency planning - Incidence response, Disaster Recovery, BCP 2.5 Cyber security policy - ESSP, ISSP, SYSSP	23	10

	2.6 Case studies of Cyber Policy		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Protecting Data and Privacy** 3.1 Cyber Threats and Vulnerabilities 3.2 Risk Management 3.3 Cyber security: Industry perspective 3.4 Cyber security tools and technologies 3.5 Foundations of privacy 3.6 Privacy regulation 3.7 Honey pots & Canary in Cyber security	25	12
*Mapping of Course Outcomes for Unit 3: CO1, CO3, CO4			
4	**Cyber Crime** 4.1 Computer, Cybercrime and legal landscape around the world 4.2 Criminals motive of attackers and types of attacks 4.3 Cyber Threats-Cyber Warfare 4.4 Comprehensive Cyber Security Policy 4.5 Cybercrimes targeting Computer systems and Mobiles 4.6 Online scams and frauds 4.7 Cybercrime and punishments 4.8 Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and social media 4.9 Case Studies on Online scams and frauds/Cybercrime and punishments	22	12
*Mapping of Course Outcomes for Unit 4: CO1, CO3			
5	**Cyber Forensics** 5.1 Threat Management and Response 5.2 Digital Forensics 5.3 Cyber forensics and digital evidence 5.4 Forensic analysis of email 5.5 Digital Forensics Life Cycle 5.6 Challenges in Digital Forensics	15	6
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
- Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. (Pearson, 13th November, 2001)

- Michael E. Whitman, Herbert J. Mattord, (2018). Principles of Information Security, 6th edition, Cenage Learning, N. Delhi

Reference Books

- "Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short
- "Introduction to Cyber Security: Stay Safe Online" by Simplilearn
- "Cyberlaw: The Law of the Internet and Information Technology" by Brian Craig
- Cyber Law: Indian and International Perspectives" by Dr. Karnika Seth
- Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management" by Thomas R. Peltier
- "Stealing Your Life: The Ultimate Identity Theft Prevention Plan" by Frank W. Abagnale
- "Cyber Laws and IT Protection" by Dr. S. R. Srinivasan

Recommended Learning Material

- www.unodc.org
- www.studocu.com
- cod.pressbooks.pub
- clearias.com/cybercrime
- www.kaspersky.com

Recommended Certification

- Certified Ethical Hacker (CEH)
- Certified Information Systems Security Professional (CISSP)
- Certified Information Security Manager (CISM)
- Certified Information Systems Auditor (CISA)
- Certified Information Privacy Professional (CIPP)
- Certified Information Security Manager (CISM)

ECS564MJ: Essentials of Cloud Computing and Security		
Teaching Scheme: **Theory Sessions**: 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal(TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Understanding of cloud computing concepts (such as virtualization and service models like SaaS, PaaS, IaaS), networking fundamentals (like TCP/IP, DNS), and a grasp of foundational cybersecurity principles (such as encryption, authentication, and access control).

Course Objectives:

- To introduce the fundamental concepts of Cloud Software Security.
- To give Insights into Cloud Programming Environments.
- To provide knowledge on Emerging Trends in Cloud Computing.
- To know about Resource pooling, sharing and provisioning.
- To impart the knowledge on different Cloud Platforms.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Describe the concepts of Cloud Software Security Fundamentals.
CO2	Understand	Discuss and Classify different Programming Environments.
CO3	Understand	Define Emerging Trends in Cloud Computing.
CO4	Understand	Discuss Resource pooling, Sharing and Provisioning
CO5	Apply	Demonstration of various applications in cloud computing.

Unit No.	Contents	Weightage in %	No of Sessions
1	**Cloud Computing Software Security Fundamentals** 1.1 Cloud Information Security Objectives, Confidentiality, Integrity, Availability 1.2 Security Services 1.3 Cloud Security Policy Implementation. 1.4 Infrastructure Security 1.5 Network-level security 1.6 Host level security 1.7 Data Security and Storage Cloud Access: authentication, authorization and accounting	20	9
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Programming Environments** 2.1 Cloud and Grid Computing 2.2 Programming support of google App Engine 2.3 Programming on Amazon AWS	15	6

	2.4 Microsoft Azure		
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Emerging Trends in Cloud Computing** 3.1 Overview of Emerging Trends in Cloud Computing. 3.2 Multi-Cloud Environment. 3.3 Omni Cloud. 3.4 Blockchain Technology. 3.5 Types of Blockchain technology. 3.6 Cloud AI. 3.7 Edge Computing	25	12
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Resource pooling, Sharing and Provisioning** 4.1 Overview of Resource pooling 4.2 Commoditization of data center. 4.3 Standardization Automation and Optimization 4.4 Resource sharing. 4.5 Resource provisioning	20	9
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Deploying Applications in cloud computing** 5.1 Introduction 5.2 Cloud Migration 5.3 Challenges and Benefits of cloud Migration 5.4 Moving Applications to Cloud 5.5 Application Hosting in Azure 5.6 Google Cloud Applications	20	9
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books:

- CSA Guide to Cloud Computing: Implementing Cloud Privacy and Security by Raj Samani, Brian Honan, And Jim Reavis
- Enterprise Cloud Security and Governance: Efficiently Set Data Protection and Privacy Principles by Zeal Vora
- Mastering AWS Security by Albert Anthony
- Ahead In The Cloud: Best Practices For Navigating The Future Of Enterprise IT by Stephen Orban, Andy Jassy , Adrian Cockcroft
- Cloud Computing: Concepts, Technology, Security, And Architecture (The Pearson Digital
- Enterprise Series from Thomas Erl) 2nd Edition by Thomas Erl, Eric Monroy

Reference Books:

- Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" by Tim Mather, Subra Kumaraswamy, and Shahed Latif
- Programming Google App Engine with Python: Build and Run Scalable Python Apps on Google's Infrastructure" by Dan Sanderson

- Hybrid Cloud Computing and Cost Optimization Maximizing Efficiency in A Mixed Environment by Anant Mittal
- Multi-Cloud Architecture and Governance: Leverage Azure, AWS, GCP, and VMware vSphere for management and governance" by Jeroen Mulder
- The Cloud at Your Service: The When, How and Why Of Enterprise Cloud Computing By Jothy Rosenberg And Arthur Mateos.
- Cloud Resource Provisioning and Scheduling Strategies" by Malay K. Pakhira

Recommended Learning Material

Web Reference:

- http://www.cloudcomputingpatterns.org/
- http://whatiscloud.com
- www.w3schools.com
- www.Geekflare.com

Recommended Certification:

- Amazon Web Services (AWS)
- Google Cloud Platform (GCP)
- Microsoft Azure (M.Azure)
- Sales Force
- IBM Cloud

AWD565MJ: Advance Web Development		
Teaching Scheme: Theory Sessions: Total 45 hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**

Prerequisites: Student must have hands-on working knowledge of JavaScript, Web Design & Development

Course Objectives:

- Build APIs using Node and Express.js
- Create single-page applications with one of the most modern JavaScript frameworks
- Develop modern, complex, responsive and scalable web applications with Angular
- Understand the architecture of Angular application and how to use it

Course Outcomes: On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Implement a Web Server in Node
CO2	Apply	Apply TypeScript features such as decorators, generics, and modules for creating reusable and maintainable code
CO3	Apply	Implement concepts and methods of Angular
CO4	Apply	Implement Angular services, dependency injections and Asynchronous operations
CO5	Create	Develop website using Next.js

Unit No.	Contents	Weightage in %	No of Sessions
1	**Node.js** 1.1 Introduction to Node JS, what is Node JS, Node.js Process Model, Advantages of Node JS 1.2: Setup Development Environment, Install Node.js on Windows, Working in REPL, Node JS Console 1.3: Node JS Modules, Functions, Buffer, Core Modules, Local Modules, Modules Types, Modules Exports 1.4 Node Package Manager What is NPM, Installing Packages Locally, globally, Adding dependency in package JSON 1.5: Creating Web Server Creating Web Server, Handling http requests, Sending Requests 1.6: File System Fs.readFile, Writing a File, Opening a file, Deleting a file, other IO Operations, Writing a file asynchronously 1.7: Events Event Emitter class, Returning event emitter, Inheriting Events 1.8 Express.js , web development with Express.js	15	8

*Mapping of Course Outcomes for Unit 1: CO1			
2	**Typescript** 2.1 Typescript Basics, Types 2.2 Functions in Typescript 2.3 Classes & interfaces 2.4 Generics 2.5 Modules 2.6 Ambients	10	7
*Mapping of Course Outcomes for Unit 2: CO2			
3	**Angular (Latest version)** 3.1 Components - Create, Use, and Manage Components 3.2 Directives - add, remove, or manipulate elements in the DOM 3.3 Modules 3.4 Data Binding 3.5 Expressions, String interpolation 3.6 Pipes - Pipes in Angular, use of pipes, Chaining Multiple pipes in angular, Parameterizing a pipe, Filter Pipe, Impure & Pure Pipe, async Pipes 3.7 Routing - create and manage routes 3.8 Form designing - using Bootstrap, template driven forms 3.9 Single Page Applications (SPAs)	25	10
*Mapping of Course Outcomes for Unit 3: CO3			
4	**Services & Dependency Injection** 4.1 Introduction of Services & Dependency Injection 4.2 Building a Service 4.3 Working with Injectors 4.4 Working with Providers 4.5 Registering Providers with real time examples 4.6 Reactive Forms 4.6.1 What is Reactive Forms 4.6.2 Create Reactive form through code 4.6.3 Syncing of HTML and Form 4.6.4 Adding Validation 4.6.5 Sumit Forms 4.6.6 Grouping 4.6.7 Form Control Arrays 4.6.8 Custom Validators 4.6.9 Relative Forms 4.6.10 Async validation 4.6.11 Value changes and reacting to status 4.7 ASYNCHRONOUS OPERATIONS & HTTP	25	10

	4.7.1 Introduction to Async 4.7.2 Promises 4.7.3 Working with Observables 4.7.4 EventEmitter 4.7.5 Async Pipes 4.7.6 Handling HTTP Request / Response 4.7.7 Headers & Request Settings 4.7.8 Providing HTTP		
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Next.js** 5.1 Introduction to Next.js 5.2 Next.js Pages(Static and Dynamic) 5.3 Style Next.js app with CSS module 5.4 Create a Next.js App 5.4.1 Setup 5.4.2 Editing the Page 5.4.3 Navigate Between Pages 5.4.4 Assets, Metadata, and CSS 5.4.5 Pre-rendering and Data Fetching 5.4.6 Dynamic Routes 5.4.7 API Routes 5.4.8 Deploying Next.js App	25	10
*Mapping of Course Outcomes for Unit 5: CO5			

Learning Resources

Text Books

- Beginning Node.js by Basarat Ali Syed
- Beginning Node.js, Express & MongoDB Development by Greg Lim
- Essential TypeScript 4: From Beginner to Pro by Adam Freeman
- Angular: Up and Running- Learning Angular, Step by Step by Shyam Seshadri 5. Beginning PHP, Apache, MySQL web development

Reference Books

- Node.js in Action, 2ed by Alex Young, Bradley Meck
- Mastering Node.js by Pasquali Sandro
- TypeScript Crash Course: A hands-on guide to building safer and more reliable web applications (English Edition) by Daniel Cavalcante
- Angular Essentials by Kumar Dhananjay
- Complete Ref. PHP

Recommended Learning Material

- Server-side Development with NodeJS, Express and MongoDB – The Hong Kong

University of Science and Technology https://www.coursera.org/learn/server-side-nodejs

- Front-End Web UI Frameworks and Tools: Bootstrap 4 – The Hong Kong University of Science and Technology https://www.coursera.org/learn/bootstrap-4
- Front-End JavaScript Frameworks: Angular – The Hong Kong University of Science and Technology https://www.coursera.org/learn/angular
- Single Page Web Applications with AngularJS – John Hopkins University https://www.coursera.org/learn/single-page-web-apps-with-angularjs
- Web Applications for Everybody Specialization https://www.coursera.org/specializations/web-applications

Recommended Certification

- Certification available on MOOC Platform.

PBI566MJ: Power BI		
Teaching Scheme: **Theory Session**: 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal(TH)**: 25 Marks **External (TH)** : 50 Marks **Total :75 Marks**

Prerequisites: Database Knowledge, Business Understanding

Course Objectives:

- To utilize Power BI tools effectively for data connectivity, transformation, and visualization.
- To Apply data modelling techniques to build relationships and optimize data analysis.
- To Incorporate slicers, filters, and bookmarks to enhance user interactivity and exploration.
- To Understand Power BI concepts like Microsoft Power BI desktop layouts, BI reports, dashboards, and Power BI DAX commands and functions
- To Gain a competitive edge in creating customized visuals and deliver a reliable analysis of vast amount of data using Power BI

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Demonstrate the concepts and importance of data modelling, data source, data cleaning, data transformation in Power BI.
CO2	Analyse	Analyse data relationships and model data using DAX
CO3	Analyse	Assess the interactivity of visualizations using slicers, filters, and drill through features.
CO4	Apply	Use M Queries to extract, transform, and load data from various sources
CO5	Analyse	Examine Power BI solutions that solve real-world business problems as outlined in case studies

Unit No.	Contents	Weightage in %	No of Sessions
1	**Introduction to Data Visualization and BI** 1.1 Overview of Business Intelligence (BI) 1.2 Introduction to Power BI 1.3 Data Modelling in Power BI 1.3.1 Introduction to data modelling concepts 1.3.2 Creating and managing relationships between tables 1.3.3 Star schema and snowflake schema 1.3.4 Data normalization and de-normalization 1.4 Data Visualization Tools 1.4.1 Power BI 1.4.2 Tableau	15	8

	1.4.3 Google Data Studio 1.4.4 Microsoft Excel 1.5 Power BI Desktop and Data Transformation 1.5.1 Overview of Data Preparation 1.5.2 Data Connection and Import 1.5.2.1 Connecting to Different Data Sources 1.5.2.2 Direct Query vs. Import Mode 1.5.3 Data Cleaning Basics 1.5.3.1 Handling Missing Data 1.5.3.2 Data Deduplication 1.5.3.3 Handling Outliers 1.5.4 Data Transformation Technique 1.5.4.1 Merging and Appending Queries 1.5.4.2 Pivoting and Unpivoting Data 1.5.4.3 Using Conditional Columns 1.5.5 Data Formatting and Structuring 1.5.5.1 Data Formatting 1.5.5.2 Creating Custom Columns 1.5.5.3 Grouping and Aggregating Data		
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Filter and Data Analysis Expression (DAX)** 2.1 Filtering Data Using Slicers, Visual Filters, Page Filters, Report Level, Drill Through Filter, cross report filters 2.2 DAX in Power BI 2.2.1 Introduction of DAX 2.2.2 Data Types in DAX 2.2.3 DAX Formula – Syntax 2.2.4 DAX Calculation Types 2.2.5 Steps to Create Calculated Columns 2.2.6 Measures in DAX 2.2.7 DAX Functions 2.2.8 DAX Operators 2.2.9 DAX Tables and Filtering	15	7
*Mapping of Course Outcomes for Unit 2:CO2			
3	**Data Visualization and Reports** 3.1 Types of Report 3.1.1 Standard Reports 3.1.2 Interactive Reports 3.1.3 Paginated Reports 3.1.4 Dashboards 3.1.5 Analytical Reports 3.1.6 Custom Reports	20	10

	3.2 Visualization 3.2.1 Visualization Charts in Power BI 3.2.2 Matrixes and Tables 3.2.3 Slicers and Map Visualizations 3.2.4 Gauges and Single Number Cards 3.2.5 Modifying Colors in Charts and Visuals Shapes, Text Boxes, and Images 3.2.6 Custom Visuals 3.2.7 Page Layout and Formatting 3.2.8 Bookmarks and Selection Pane 3.2.9 KPI Visuals 3.2.10 Z-order 3.2.11 Grouping and Binding 3.3 Introduction to Power BI Service 3.3.1 Creating a Dashboard 3.3.2 Quick Insights in Power BI 3.3.3 Configuring a Dashboard 3.3.4 Power BI Q&A 3.3.5 Ask Questions about your Data 3.3.6 Power BI Embedded 3.3.7 Bookmarks and buttons		
*Mapping of Course Outcomes for Unit 3:CO3			
4	**Introduction of SQL Server** 4.1 Power Query & M Language 4.1.1 Introduction to Power Query and M Language 4.1.2 Introduction to Power Query Editor 4.1.3 Understanding M language fundamentals 4.1.4 Basic M Query syntax and functions 4.1.5 Data types and operators in M Query 4.2 Data Transformation with M Query 4.2.1 Importing and cleaning data 4.2.2 Filtering, sorting, and grouping data 4.2.3 Pivoting and unpivoting columns 4.2.4 Merging and appending queries 4.2.5 Creating custom functions 4.2.6 Error handling in M Query	25	10
*Mapping of Course Outcomes for Unit 4:CO4			
5	**Real World Use Cases and Case studies** 5.1 Real-World Use Cases 5.1.1 Financial Services-Risk Management 5.1.2 Healthcare-Patient Care Improvement 5.1.3 Retail-Sales Performance Analysis 5.1.4 Education-Student Performance Monitoring	25	10

	5.1.5 Manufacturing-Production Line Optimization 5.1.6 Marketing-Campaign Performance Analysis 5.2 Case Studies Charles Schwab, The Texas Rangers, Deloitte, University of British Columbia, Cisco, Tata Consultancy Services (TCS), ICICI Bank, Reliance Industries Limited (RIL), Flipkart, Indian School of Business (ISB)		

*Mapping of Course Outcomes for Unit 5:CO5

Learning Resources

Text Books:

- Mastering Microsoft Power BI" by Brett Powell
- "Analyzing Data with Power BI and Power Pivot for Excel" by Alberto Ferrari and Marco Russo
- "Microsoft Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards" by Brett Powell -

Reference Books:

- Business Intelligence Guidebook: From Data Integration to Analytics" by Rick Sherman
- "Pro Power BI Desktop" by Adam Aspin
- "The Definitive Guide to DAX, Second Edition: Business intelligence with Microsoft Excel, SQL Server Analysis Services, and Power BI" by Marco Russo and Alberto Ferrari
- "Successful Business Intelligence: Unlock the Value of BI & Big Data" by Cindi Howson
- "Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence" by Brett Powell

Recommended Learning Material:

- Microsoft Learn: Power BI Learning Path
- https://docs.microsoft.com/en-us/learn/powerplatform/power-bi
- Microsoft Learn: Introduction to DAX in Power BI
- https://docs.microsoft.com/en-us/learn/modules/dax-power-bi/
- Power BI Documentation - Microsoft Docs
- https://docs.microsoft.com/en-us/power-bi/

Recommended Certification:

- LinkedIn Learning: Learning Power BI
- Udemy: Power BI A-Z: Hands-On Power BI Training for Data Science!
- Coursera: Data Visualization with Power BI Specialization

EIS567MJ: Essentials of Information Security		
Teaching Scheme: **Theory Sessions**: Total 45 Hours	**Credit: 03**	**Examination Scheme:** **Internal (TH)**: 25 Marks **External (TH)**: 50 Marks **Total :75 Marks**
Prerequisites: Basic knowledge of Cyber Security		

Course Objectives:

- Conduct a cyber-security risk assessment using tool.
- Measure the performance and troubleshoot audit.
- Design and develop a security architecture for an organization.
- Design operational and strategic cyber security strategies and policies.

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Understand	Understand the fundamental concepts of cybersecurity, including its importance and various threats in cyberspace.
CO2	Understand	Understand the vulnerable to threats in systems
CO3	Apply	Design and Apply the need for security architecture and its relevance to systems, service continuity and reliability
CO4	Understand	Ability to describe the various auditing tools that can be used in cybersecurity management
CO5	Apply	Identifies the needs of users in the field of developing information systems and building secure computer networks.

Unit No.	Contents	Weightage in %	No of Sessions
1	**CYBER SECURITY ESSENTIALS** 1.1 Information Assurance Fundamentals 1.1.1 Basic Cryptography 1.1.2 Symmetric Encryption 1.1.3 Public Key Encryption 1.1.4 The Domain Name System (DNS) 1.1.5 Firewalls 1.1.6 Virtualization 1.1.7 Radio-Frequency Identification 1.2 Microsoft Windows Security Principles 1.2.1 Windows Tokens 1.2.2 Window Messaging 1.2.3 Windows Program Execution 1.2.4 The Windows Firewall	20	9
*Mapping of Course Outcomes for Unit 1: CO1			
2	**Information Security**	15	6

	2.1 Introduction 2.2 Security Threat Supply 2.3 Information Assurance 2.4 Quantitative Risk Analysis Techniques and Tools 2.5 Introduction to IT Auditing and Reporting Techniques		
*Mapping of Course Outcomes for Unit 2: CO2, CO4			
3	**Development of Secure Information System** 3.1 Introduction 3.2 Developing Secure Information Systems 3.3 Key Elements of an Information Security Policy 3.4 Information System Development Life Cycle 3.5 Application Security 3.6 Information Security Governance 3.8 Security Architecture and Design 3.9 Case Study based information system design	25	12
*Mapping of Course Outcomes for Unit c 3: CO3			
4	**Security Threats and Policies** 4.1 Introduction to Security Threats 4.2 Network and Denial of Services Attack 4.3 Security Threats to E-Commerce 4.4 Introduction to Security Policies 4.5 Why can we would like Security Policy? 4.6 Security Policy Development 4.7 Email Security Policies 4.8 Advanced persistent threat 4.9 Case Study based on security threat and policy	25	12
*Mapping of Course Outcomes for Unit 4: CO4			
5	**Securities in Operating System And Networks** 5.1 Introduction to Securities in Operating System Network 5.2 Rootkit and Anti Rootkit Tools (Antivirus Based) 5.3 Threats to Network Communication 5.4 Wireless Network Security 5.5 Network Security Attack	15	6
*Mapping of Course Outcomes for Unit 5: CO5			
Learning Resources			
Text Books • Michael E. Whitman, Herbert J. Mattord, (2018). Principles of Information Security, 6th edition, Cenage Learning, N. Delhi • Cryptography and Network Security by William Stallings • Network Security Essentials by William Stallings • Computer Security and the Internet: Tools and Jewels from Malware to Bitcoin,			

Second Edition, by Paul C. van Oorschot. Springer, 2021.

- Applied Cryptography by Bruce Schneier

Reference Books

- Computer Security: Principles and Practice by Stallings and Brown
- Computer Security by Dieter Gollmann
- Information Security: Principles and Practice (2011, 2/e; Wiley) by Mark Stamp
- Hacking: The Art of Exploitation by Jon Erickson
- The Web Application Hacker's Handbook by Dafydd Stuttard and Marcus Pinto
- Web Security Sourcebook: A Complete Guide to Web Security Threats and Solutions by Rubin, Geer and Ranum
- Cybersecurity Essentials" by Charles J. Brooks, Christopher Grow, Philip Craig, and Donald Short
- "Introduction to Cyber Security: Stay Safe Online" by Simplilearn
- Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management" by Thomas R. Peltier

Recommended Learning Material

- www.unodc.org
- www.studocu.com
- cod.pressbooks.pub

Recommended Certification

- Certificate in Information Systems Audit and Control Association (ISACA)
- Certified Information Systems Security Professional (CISSP)
- Certified Information Security Manager (CISM)
- Certified Information Systems Auditor (CISA)
- Certified Information Privacy Professional (CIPP)
- Certified Information Security Manager (CISM)

PBJ555MJP: Practical based on Java		
Teaching Scheme: **Practical Sessions**:45 Sessions (Each session of 2 Hrs)	**Credit: 03**	**Examination Scheme:** **Internal(TH)**: 50 Marks **Total :50 Marks**

Prerequisites - Basic knowledge of Java Programming

Course Objectives:

- To implement foundation of Object Oriented Concepts
- To explore use of Java Servlets
- To design and develop web application using JSP

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Demonstrate fundamental concepts of Java
CO2	Create	Design and implement classes and objects in Java, applying principles of inheritance, polymorphism, encapsulation, and abstraction
CO3	Create	Establish database connectivity using JDBC, execute SQL queries, handle result sets, and manage database transactions from Java applications
CO4	Create	Develop dynamic web applications using Java Servlets and JSP,
CO5	Create	Use spring MVC framework to build web application.

Learning Resources

References

- https://docs.oracle.com/javase/8/docs/api/
- https://www.oracle.com/in/java/technologies/downloads/
- https://docs.spring.io/spring-framework/docs/3.2.x/spring-framework-reference/html/mvc.html

MPR581MRP - Mini Project		
Teaching Scheme: **Sessions**: 45 Hours.	**Credit: 03**	**Examination Scheme:** **Internal(PJ)**: 50 Marks **Total :50 Marks**

Prerequisites - Knowledge of Software Requirement Specification, technology, tools and techniques.

Course Objectives:

- Enhance programming skills, software development methodologies and proficiency in relevant technologies/tools
- Gain experience in project planning, requirement analysis, design, implementation, testing, and documentation
- Enhance problem solving capability through implementation
- Improve presentation skills by effectively communicating project goals, methodologies, results and conclusions to peers, faculty, and potentially external stakeholders
- Foster teamwork and collaborative skills through group-based project work, including division of tasks, coordination, and communication
- Encourage creative thinking and innovation in designing solutions that meet specified requirements and constraints

Course Outcomes:

On completion of the course, learners should be able to

CO#	Cognitive Domain	Course Outcomes
CO1	Apply	Apply knowledge of software engineering principles and methodologies in designing and implementing the project
CO2	Apply	Demonstrate the ability to develop a functioning software application or solution that meets specified requirements and objectives
CO3	Apply	Design comprehensive documentation that includes project requirements, design specifications, implementation details, testing strategies, and user manuals

Savitribai Phule Pune University, Pune
Curriculum 2024 Pattern

Faculty of Commerce and Management

Master of Computer Application (MCA) 2nd Year

Applicable to

The students who have completed MCA first year 2024 NEP pattern (52 Credits)

OR

PG Diploma in Computer Management (56 Credits)

As per MCA NEP guidelines.

OR

Direct Second Year Lateral Entry

After Four Years of Graduation

With effect from Academic AY 2025 - 26

Course Structure

MCA Semester III					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Organizational Behaviour	OBE**601**MJ	3	50	25
2	Design and Analysis of Algorithm	DAA**602**MJ	3	50	25
3	**Elective- IV (Select any one from following)**		3	50	25
	Cloud API's and Services	CAS**610**MJ			
	Mobile Application Development	MAD**611**MJ			
	Tableau	TAB**612**MJ			
	End -Point Security	EPS**613**MJ			
4	**Elective- V (Select any one from following)**		3	50	25
	Cloud Migration and Management	CMM**614**MJ			
	MERN Stack Development	MSD**615**MJ			
	Deep Learning	DEL**616**MJ			
	Ethical Hacking	EH**617**MJ			
5	**Elective- VI (Select any one from following)**		3	50	25
	Enterprise Resource Planning (ERP)	ERP**618**MJ			
	E-Commerce	EC**619**MJ			
	Social media Marketing	SMM**620**MJ			
	Innovation and Entrepreneurship Development	IED**621**MJ			
***Practical**					
6	Practical based on Electives IV and V	PBE**603**MJP	3	-	50
7	Research Project	RP**641**RP	6	-	100
Soft Skills					
8	Soft Skills- III	SSK**604**MJ	1	-	25
		Semester Total	**25**	**250**	**300**

MCA Semester IV					
Sr. No.	**Course Title**	**Course Code**	**CP**	**EXT**	**INT**
1	Internship/Project Work (FP/OJT)	IPW**681**FP	12	300	150
2	MOOC- I	MOO**682**MJ	3	-	50
3	MOOC- II	MOO**683**MJ	3	-	50
		Semester Total	**18**	**300**	**250**