

MAHENDRA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

(Affiliated to Periyar University)

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KALIPPATTI-637501



MASTER OF SCIENCE

SYLLABUS FOR M.Sc. Computer Science

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM

FOR THE STUDENTS ADMITTED FROM THE ACADEMIC

YEAR 2023 – 2024 ONWARDS

MAHENDRA ARTS & SCIENCE COLLEGE

(Autonomous)

(Affiliated to Periyar University)

Department of Computer Science & Applications

REGULATIONS FOR M.Sc. COMPUTER SCIENCE PROGRAMME

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM

(Effective from the academic year 2023-2024)

I. PREAMBLE

- Bring a new approach to syllabus, not a revision of the existing syllabus.
- Create a unique identity for M.Sc. Computer Science distinct from similar degrees in other related subjects.
- Recommend provision for specialization in M.Sc. Computer Science degree.
- The board of studies of M.Sc Computer Science has been taken after the meeting with head of departments, academic experts and a thorough analysis of various factors, for the welfare of the students, enhancement of quality of teaching and an overall development of the institution in all aspects.

II. GRADUATES ATTRIBUTES

- **In-depth knowledge and understanding of major concepts:**
Understanding of theoretical principles and experimental findings in different sub-areas available in respective disciplines
- **Creative and Critical thinking:** The capability of using creative and critical thinking in respective areas
- **Analytical ability:** The ability to analyze issues and problems in all the disciplines
- **Problem-solving skills:** The capability towards solving problems
- **Entrepreneur skills:** The inclusion of leadership, business management, time management skills
- **Communication skills:** The ability to transfer complicated/technical information in a precise manner
- **Mutual and multidisciplinary competence:** The ability of teamwork in interdisciplinary fields

- **Digital literacy:** The capability of utilizing modern digital tools to carry out the simulation process
- **Moral and ethical awareness:** Ability to adopt moral ethics
- **Social responsibility:** Creating socially responsible citizens

III. PROGRAMME EDUCATIONAL OBJECTIVES

Upon successful completion of a Major in M.Sc. Computer Science, students will be able to

- Demonstrate expertise through significant technical accomplishments and professional skills in industry.
- Exhibit continuous learning and research for the societal upliftment with human values and ethics.
- Demonstrate a breadth and depth of knowledge in the Discipline of Computer Science

IV. PROGRAMME OUTCOMES

- Broad knowledge in core areas of computer science, current and emerging technologies in IT.
- Reasoning skills required to learn advance in computer science and probing attitude and a search for deeper knowledge in science.
- Analytical and managerial skills to enhance employment potential.
- Holistic development with strong emphasis on values and ethics.
- Equip students with a step by step process for creating learning outcomes.

V. PROGRAMME SPECIFIC OUTCOMES

After completing the M.Sc. Computer Science Programme, the graduates will be able to

1. Implement the logic for solving the real life problems by using the knowledge gained
2. Understand, analyze, design, develop, test, implement and document software systems
3. Use their creative skill to evolve new ideas, defend their findings at the peer level and able to manage IT and ITES organizations.
4. Work in public and private sectors satisfying social and environmental obligations with multiple cultures
5. Act as socially responsible IT professionals or service minded entrepreneurs

VI. REGULATIONS

These regulations shall take effect from the academic year 2023-2024, i.e, for students who are to be admitted to the first year of the course during the academic year 2023-2024 and thereafter.

1. Eligibility for Admission

A candidate who has passed in B.Sc., Computer Science / BCA /B.Sc. Computer Technology / B.Sc. Information Science / B.Sc. Information Technology/ B.Voc.(Any Computer Science Related Programme) degree of Periyar University or any of the Degree of any other university accepted by the syndicate as equivalent thereto.

2. Duration of the Programme

The course of study for the M.Sc. Computer Science shall consist of two academic years divided into four semesters with **92 credits**. The Programme of study will comprise the course according to the syllabus.

3. Programme of Study

The Programme of study for the PG degree Programme of all branches shall consist of the following:

- (i) Cores
- (ii) Electives courses
- (iii) Extra Disciplinary Course
- (iv) Project
- (v) Enhancement Compulsory Courses.
- (vi) Internship Course
- (vii) Extension Activity
- (viii) Skill enhancement course

4. Examinations

The Programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester.

The candidates failing in any subjects(s) will be permitted to appear for the same in the subsequent semester examinations.

**STRUCTURE OF THE PROGRAMME:
SEMESTER: I**

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int	Ext	Total
CORE COURSE-I	Analysis & Design of Algorithms	M23PCS01	6	-	5	25	75	100
CORE COURSE-II	Object Oriented Analysis and Design & C++	M23PCS02	6	-	5	25	75	100
CORE COURSE-III	Python Programming	M23PCS03	6	-	4	25	75	100
ELECTIVE COURSE	Elective-I	-	4	-	3	25	75	100
PRACTICAL	Practical-I Algorithm and OOPS Lab	M23PCSP01	-	4	3	40	60	100
PRACTICAL	Practical-II Python Programming Lab	M23PCSP02		4	3	40	60	100
Total			22	08	23	180	420	600

SEMESTER: II

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int	Ext	Total
CORE COURSE- IV	Data Mining and Warehousing	M23PCS04	4	-	4	25	75	100
CORE COURSE - V	Advanced Operating Systems	M23PCS05	4	-	4	25	75	100
CORE COURSE -VI	Advanced Java Programming	M23PCS06	5	-	4	25	75	100
ELECTIVE COURSE	Elective - II	M23PCSE02	5	-	3	25	75	100
PRACTICAL	Practical - III Data Mining Lab using R	M23PCSP02		3	3	40	60	100
PRACTICAL	Practical - IV Advanced Java Programming Lab	M23PCSP03		3	3	40	60	100
ECC	Human Rights	M23PHR01	2	-	2	25	75	100
EDC	EDC	M23PMAED1	4	-	4	25	75	100
Total			24	6	27	230	570	800

SEMESTER: III

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE -VII	Digital Image Processing	M23PCS07	6	-	5	25	75	100
CORE COURSE -VIII	Cloud Computing	M23PCS08	6	-	5	25	75	100
CORE COURSE -IX	Network Security and Cryptography	M23PCS09	5	-	5	25	75	100
Elective Course	Elective III	-	5	-	3	25	75	100
PRACTICAL	Practical – V Digital Image Processing Lab using MATLAB	M23PCSP05	-	4	3	40	60	100
PRACTICAL	Practical – VI Cloud Computing Lab	M23PCSP06	-	4	2	40	60	100
Internship / Industrial Activity	Internship / Industrial Activity	M23PCISIS01	-	-	2	40	60	100
Total			22	8	25	220	480	700

SEMESTER: IV

Course Category	Title of the Course	Course Code	Hrs / Week		No. of Credits	Max. Mark		
			L	P		Int.	Ext.	Total
CORE COURSE - X	Data Science & Analytics	M23PCS10	6	-	5	25	75	100
PRACTICAL	Practical – VII Web Application development & hosting	M23PCSP07	-	5	5	40	60	100
CORE PROJECT	Project	M23PCSPR1	-	-	4	40	60	100
SEC - PCS	Data Visualization Practical	M23PCSS01	-	2	2	25	75	100
	Extension Activity	M23PEX01	-	-	1	-	-	-
Total			6	7	17	155	345	400
Grand Total			72	29	92	785	1815	2500

Summary of Credits, Hours, and Mark Distribution

Course Category	Credits				Total Credits	Total Hours	No. of Courses	Max. Marks
	I	II	III	IV				
Core	14	12	15	05	46	54	10	1000
Core Practical	06	06	05	05	22	27	07	700
Elective	03	03	03	-	09	12	03	300
EDC	-	04	-	-	04	04	01	100
SEC	-	-	-	02	02	02	01	100
Project	-	-	-	04	04	-	01	100
Human Rights	-	02	-	-	02	02	01	100
Internship	-	-	02	-	02	-	01	100
Extension Activity	-	-	-	01	01	-	-	-
TOTAL	23	27	25	17	92	101	25	2500

ELECTIVE SUBJECTS FOR M.Sc. STUDENTS

Semester	ELECTIVE – I	
	Course Title	Course Code
I	Advanced software Engineering	M23PCSE01
	Multimedia and Its Applications	M23PCSE02
	Embedded Systems	M23PCSE03
ELECTIVE – II		
	Course Title	Course Code
II	Artificial Intelligence & Machine Learning	M23PCSE04
	Internet of Things	M23PCSE05
	Mobile Computing	M23PCSE06
ELECTIVE – III		
	Course Title	Course Code
III	Critical Thinking ,Design Thinking and Problem Solving	M23PCSE07
	Web Services	M23PCSE08
	Robotic process automation For business	M23PCSE09

EXTRA DISCIPLINARY COURSES OFFERED FOR OTHER DEPARTMENT STUDENTS

Semester	Course Title	Course Code
II	Fundamentals of Computers and Communications	M23PCSED1
	Principles of Information Technology	M23PCSED2
	E-Commerce	M23PCSED3

VIII. SCHEME OF EXAMINATION:

1. Question Paper Pattern for Theory Examination

Time: Three Hours

Maximum Marks: 75

Knowledge Level	Sections		Marks	Total Marks	Meaning of K's
K1	Part - A 10 Questions - Objectives type *1 Marks (No Choice)	Two Questions from each unit	10	75	K1- Memory Level
K1, K2	Part - B 5 Questions *2 Marks (No Choice)	One Question from each unit	10		K2 - Understanding Level
K2, K3, K4,K5,K6	Part - C 5 Questions (either or type)	One Question from each unit	25		K3 - Application Level
K2, K3, K4, K5,K6	Part - D 3 out of 5 Questions	One Question from each unit	30		K4 - Analytical Level
					K5 - Evaluation Level
					K 6 - Create Level

2. Question Paper Pattern for Practical Examination

Time: Three Hours

Maximum Marks: 60

Answer ALL Questions

1. One compulsory question from the given list of practical's - 30 Marks

2. One either or type question from the list of practical's – 30 Marks

For each Practical question the marks should be awarded as follows (External)

- Algorithm / Flowchart – 20%
- Writing the program in the main answer book – 30%
- Test and debug the programs – 30%
- Printing the correct output – 20%

(Marks may be proportionately reduced for the error committed in each of the above)

3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory/Practical / Internship / Project courses of PG programmes.

END SEMESTER	CIA Total	EA Total	Total Marks Allotted	Passing Minimum for EA	Passing Minimum (ESE)
Theory	25	75	100	38	50
Practical	40	60	100	30	50
Project	40	60	100	30	50
Internship	40	60	100	30	50

The following are the Distribution of marks for the Continuous Internal Assessment in Theory / Practical papers of PG programme.

THEORY

EVALUATION OF INTERNAL ASSESSMENT

Test	:	10 Marks
Seminar	:	05 Marks
Assignment	:	05 Marks
Attendance	:	05 Marks

Total	:	25 Marks

PRACTICAL

EVALUATION OF INTERNAL ASSESSMENT

Test	:	20 Marks
Attendance	:	10 Marks
Observation	:	10 Marks

Total	:	40 Marks

PROJECT

EVALUATION OF INTERNAL ASSESSMENT

Review 1	:	10 Marks
Review 2	:	10 Marks
Review 3	:	10 Marks
Pre-Viva	:	10 Marks

Total	:	40 Marks

4. Passing Minimum:

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Theory Exam mark) with minimum of 38 marks (out of 75 marks) in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 50 marks in total (CIA mark + Practical Exam mark) with minimum of 30 marks (out of 60 marks) in the End Semester Practical Examinations.

5. Submission of Record Note Books for Practical Examinations

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations

6. Internship/Project:

Internship

Internship training (Minimum two weeks period) is mandatory for the entire PG programme during first year vacation period.

The Internship training Report should be valued for 60 marks by an External examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner / guide/ teacher concerned.

1. The Internship training Report may consist of minimum of 30 pages.
2. The candidate has to submit the Internship training Report 20 days before the commencement of the III Semester Examinations.

Project:

The following guidelines to be followed for the Project with Viva-voce:

The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner / guide/ teacher concerned.

1. The Project Report may consist of minimum of 60 pages.
2. The candidate has to submit the Project Report 10 days before the commencement of the IV Semester Examinations.
3. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification / correction / improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

IX. Note

a) SWAYAM / MOOC – Free Online Course

SWAYAM / MOOC are an instrument for self-actualization providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM / MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

SEMESTER - I

Core - I	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS01	ANALYSIS AND DESIGN OF ALGORITHMS	Contact Hours per week : 6

Objectives

1. To enable the students to learn the Elementary Data Structures and algorithms.
2. To presents an introduction to the algorithms, their analysis and design.
3. To discuss various methods like Basic Traversal and Search techniques, divide and conquer method, Dynamic programming, backtracking.
4. To understood the various design and analysis of the algorithms

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Recognize knowledge about algorithms and determines their time complexity. Demonstrate specific search and sort algorithms using divide and conquer Technique.	K1 – K6
CO2	Understanding of Greedy method and its algorithm.	K1 – K6
CO3	Describe about graphs using dynamic programming technique.	K1 – K6
CO4	Demonstrate the concept of backtracking & branch and bound technique.	K1 – K6
CO5	Design the traversal and searching technique and apply it for trees and graphs.	K1 – K6

UNIT I

18 Hours

Introduction: - Algorithm Definition and Specification – Space complexity-Time Complexity- Asymptotic Notations -
Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heap sort- Graph.

UNIT II

18 Hours

TRAVERSAL AND SEARCH TECHNIQUES: Basic Traversal And Search Techniques: Techniques for Binary Trees-Techniques for Graphs -Divide and Conquer - General Method – Binary Search – Merge Sort – Quick Sort.

UNIT III**18 Hours**

GREEDY METHOD: The Greedy Method- General Method- Knapsack Problem – Minimum Cost Spanning Tree – Single Source Shortest Path.

UNIT IV**18 Hours**

DYNAMICPROGRAMMING: Dynamic Programming – General Method- Multistage Graphs-All Pair Shortest Path-Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling. Components and DFS.

UNIT V**18 Hours**

BACKTRACKING: General Method – 8 – Queens Problem – Sum Of Subsets –Graph Coloring – Hamiltonian Cycles – **Branch and Bound:** - The Method – Traveling Salesperson.

Text Books				
S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Horowitz, Ellis, et	Computer Algorithms.	Galgotia Publications	1999
2.	Aho, Alfred V., et	Data Structures and Algorithms	Addison-Wesley	1983
Reference Books				
1.	Goodrich, Michael T., et	Data Structures and Algorithms in Java	Wiley.Com 6 th Edition	2014
2.	Skiena, Steven S	The Algorithm Design Manual	Springer	2012
3.	Levitin, Anany	Introduction to the Design & Analysis of Algorithms	Pearson	2012
4.	Sedgewick, Robert	An Introduction to the Analysis of Algorithms	Addison Wesley	2013

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	S
CO2	S	S	S	S	M
CO3	M	S	M	S	S
CO4	S	M	S	S	M
CO5	S	S	S	S	S

S-Strong M-Medium

SEMESTER - I

Core - II	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS02	OBJECT ORIENTED ANALYSIS AND DESIGN & C++	Contact Hours per week : 6

Objectives

1. To present the object model, classes and objects, object orientation, machine view and model management view.
2. To enable the students to learn the basic functions, principles and concepts of object oriented analysis and design.
3. To enable the students to understand C++ language with respect to OOAD

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of Object-Oriented development and modelling techniques	K1 – K6
CO2	Explain knowledge about the various steps performed during object design	K1 – K6
CO3	Perform object-based views for generic software systems	K1 – K6
CO4	Compare OOAD with C++ language	K1 – K6
CO5	Apply the basic concept of OOPs and familiarize to write C++ program	K1 – K6

UNIT I

18 Hours

OBJECT MODEL: The Object Model: The Evolution of the Object Model – Elements of the Object Model – Applying the Object Model. **Classes and Objects:** The Nature of an Object – Relationship among Objects.

UNIT II

18 Hours

Classes and Object: Nature of Class – Relationship Among classes – The Interplay of classes and Objects. **Classification:** The importance of Proper Classification –identifying classes and objects –Key Abstractions and Mechanism.

UNIT III**18 Hours**

Introduction to C++ -Input and output statements in C++ -
Declarations – control structures – Functions in C++.

UNIT IV**18 Hours**

INHERITANCE AND OVERLOADING: Classes and Objects–
Constructors and Destructors – operators overloading –Type
Conversion- Inheritance – Pointers and Arrays.

UNIT V**18 Hours**

POLYMORPHISM AND FILES: Memory Management Operators -
Polymorphism–Virtual functions – Files – Exception Handling –
String Handling –Templates.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Booch, Grady, et al.	Object-Oriented Analysis and Design with Applications.	Addison-Wesley Longman, Third Edition	2007
2.	Kamthane, Ashok.	Object-Oriented Programming with ANSI and Turbo C++.	Pearson Education Canada	2009
Reference Book				
1.	Balagurusamy, E.	Object Oriented Programming with C	Tata McGraw-Hill	2008

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	M
CO2	M	S	S	S	S
CO3	M	S	M	M	S
CO4	S	S	S	S	M
CO5	S	M	S	M	S

S-Strong M-Medium
SEMESTER - I

Core – III	M.Sc. Computer Science	Credits : 4
Course Code: M23PCS03	PYTHON PROGRAMMING	Contact Hours per week : 6

Objectives

1. To presents an introduction to Python, creation of web applications, net work applications and working in the clouds
2. To use functions for structuring Python programs
3. To understand different Data Structures of Python.
4. To represent compound data using Python lists, tuples and dictionaries

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concepts of Python Programming	K1 – K6
CO2	Discuss File operations, Classes and Objects	K1 – K6
CO3	Determine Object Oriented Skills in Python	K1 – K6
CO4	Develop web applications using Python	K1 – K6
CO5	Derive Client Server Networking applications	K1 – K6

UNIT I

18 Hours

INTRODUCTION: Numbers – Strings – Variables – Lists – Tuples– Dictionaries – Sets – Comparison.

UNIT II

18 Hours

Code Structures: if, else if, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions

UNIT III

18 Hours

Modules, Packages, and Programs: Standalone Programs – Command- Line Arguments – Modules and the import Statement – The Python Standard Library. **Objects and Classes:** Define a Class with class – Inheritance – Override a Method – Add a Method – Get Help from Parent with super – Inself Defence –Get and Set Attribute Values with Properties –Name Mangling for Privacy – Method Types –

Duck Typing – Special Methods –Composition.

UNIT IV

18 Hours

Data Types: Text Strings – Binary Data. **Storing and Retrieving Data :** File Input /Output–Structured Text Files – Structured Binary Files - Relational Databases – No SQL Data Stores. **Web:** Web Clients–Web Servers– Web Services and Automation.

UNIT V

18 Hours

Systems: Files – Directories – Programs and Processes – Calendars and Clocks. **Concurrency:** Queues – Processes – Threads –Green Threads and gevent – twisted – Red is. **Networks:** Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Zero MQ –Internet Services – Web Services and APIs – Remote Processing – Big Fat Data and Map Reduce –Working in the Clouds.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Lubanovic, Bill.	Introducing Python: Modern Computing in Simple Packages.	O’Reilly Media, Inc.,	2020
2.	Lutz, Mark.	Learning Python	O’Reilly	2013
Reference Books				
1.	Beazley, David M. Python.	Essential Reference	Addison- Wesley	2012
2.	Naveen, Kumar, and Taneja Sheetal	Python Programming: A Modular Approach	Pearson Education India	2017

Mapping with Programming Outcomes

Co’s / PSO’s	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S
CO2	S	S	S	S	S
CO3	S	M	S	M	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S-Strong; M-Medium

SEMESTER - I

Elective Course – I	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE01	Elective – I ADVANCED SOFTWARE ENGINEERING	Contact Hours per week : 4

Objectives

1. To introduce to Software Engineering, Design, Testing and Maintenance.
2. To enable the students to learn the concepts of Software Engineering.
3. To learn about Software Project Management, Software Design & Testing

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand about Software Engineering process	K1 – K6
CO2	Apply about Software project management skills, design and quality management	K1 – K6
CO3	Analyze on Software Requirements and Specification	K1 – K6
CO4	Classify on Software Testing, Maintenance and Software Re-Engineering	K1 – K6
CO5	Design and conduct various types and levels of software quality for a software Project	K1 – K6

UNIT I

12 Hours

Introduction: The Problem Domain – Software Engineering Challenges Software Engineering Approach – **Software Processes:** Software Process – Characteristics of a Software Process – Software Development Process Models – Other software processes

UNIT II

12 Hours

Software Requirements Analysis and Specification : Requirement engineering – Type of Requirements – Feasibility Studies – Requirements Elicitation – Requirement Analysis – Requirement Documentation – Requirement Validation – Requirement Management – SRS - Formal System Specification – Axiomatic Specification – Algebraic Specification - Case study: Student Result management system. Software Quality Management –Software Quality, Software Quality Management System, ISO 9000, SEI CMM.

UNIT III**12 Hours**

Software Project Management: Responsibilities of a software project manager – Project planning – Metrics for Project size estimation – Project Estimation Techniques – Empirical Estimation Techniques – COCOMO – Halstead’s software science – Staffing level estimation – Scheduling– Organization and Team Structures – Staffing – Risk management – Software Configuration Management – Miscellaneous Plan.

UNIT IV**12 Hours**

Software Design: Outcome of a Design process – Characteristics of a good software design – Cohesion and coupling - Strategy of Design – Function Oriented Design – Object Oriented Design - Detailed Design - IEEE Recommended Practice for Software Design Descriptions.

UNIT V**12 Hours**

Software Testing: A Strategic approach to software testing – Terminologies – Functional testing– Structural testing – Levels of testing – Validation testing - Regression testing – Art of Debugging– Testing tools- Metrics-Reliability Estimation. Software Maintenance - Maintenance Process - Reverse Engineering – Software Re-engineering - Configuration Management Activities.

Text Books

S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1	Jalote, Pankaj.	An Integrated Approach to Software Engineering.	Springer-Verlag New York Inc., Third Edition	2006
2	Lutz, Mark.	Learning Python	O’Reilly	2013

Reference Books

1	Beazley, David M. Python.	Essential Reference	Addison-Wesley	2012
2	Naveen, Kumar, and TanejaSheetal	Python Programming: A Modular Approach	. Pearson Education India	2017

Mapping with Programme Specific Outcomes

CO's/ PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	S
CO2	M	S	S	S	S
CO3	S	M	S	S	M
CO4	S	S	M	M	S
CO5	S	S	S	S	S

S-Strong; M-Medium

SEMESTER - I

Elective Course - I	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE02	Elective – I MULTIMEDIA AND ITS APPLICATIONS	Contact Hours per week : 4

Objectives

1. To introduce the students the concepts of Multimedia, Images & Animation.
2. To introduce Multimedia authoring tools
3. To understand the role of Multimedia in Internet
4. To know about High Definition Television and Desktop Computing– Knowledge based Multimedia systems

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concepts of Multimedia	K1 – K6
CO2	Demonstrate Multimedia authoring tools	K1 – K6
CO3	Analyze the concepts of Sound, Images, Video & Animation	K1 – K6
CO4	Apply the role of Multimedia in Internet and real time Applications	K1 – K6
CO5	Analyze multimedia applications using HDTV	K1 – K6

UNIT I

12 Hours

INTRODUCTION: What is Multimedia? – Introduction to making Multimedia–Macintosh and Windows Production platforms– Basic Software tools.

UNIT II

12 Hours

MULTIMEDIA TOOLS :Making Instant Multimedia – Multimedia authoring tools – Multimedia building blocks – Text – Sound.

UNIT III

12 Hours

ANIMATION: Images – Animation – Video

UNIT IV

12 Hours

INTERNET : Multimedia and the Internet – The Internet and how it works – Tools for World Wide Web – Designing for the World Wide Web.

UNIT V**12 Hours**

MULTIMEDIA SYSTEMS: High Definition Television and Desktop Computing
– Knowledge based Multimedia systems.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	TayVaughan	Multimedia making it work	Fifth Edition, Tata Mc Graw Hill	-
2.	JohnF.Koegel Bufford,	Multimedia Systems	Pearson Education.	-
Reference Book				
1.	Judith Jeffloate	Multimedia in Practice (Technology and Applications)	PHI	2003

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	S	S	M	S	M
CO3	M	M	S	M	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium

SEMESTER - I

Elective Course - I	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE03	Elective – I EMBEDDED SYSTEMS	Contact Hours per week : 4

Objectives

1. To present the introduction to 8051 Microcontroller Instruction Set, concepts on RTOS & Software tools.
2. To gain the knowledge about the embedded software development.
3. To learn about Microcontroller and software tools in the embedded systems.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of 8051 Microcontroller	K1 – K6
CO2	Explain the Instruction Set and Programming	K1 – K6
CO3	Analyze the concepts of RTOS	K1 – K6
CO4	Design various real time embedded systems using RTOS	K1 – K6
CO5	Recall the mal functioning system using various debugging techniques	K1 – K6

UNIT I

12 Hours

8051 MICROCONTROLLER: 8051 Microcontroller: Introduction - 8051 Architecture – Input / Output Pins, Ports and Circuits – External Memory- Counters/ Timers-Serial Data Input /Output-Interrupts

UNIT II

12 Hours

PROGRAMMING BASICS: Instruction Set and Programming Moving Data-Addressing Modes – Logical operations – Arithmetic Operation - Jump and Call Instructions – Simple Program. Applications: Keyboard Interface- Display Interface – Pulse Measurements – DIA and AID Conversions-Multiple Interrupts.

UNIT III

12 Hours

CONCEPTS ON RTOS: CONCEPTS ON RTOS: Introduction to RTOS- Selecting an RTOS - Task and Task states – Tasks and data-Semaphores and shared data. **More operating systems services:** Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions- Events – Memory Management – Interrupt Routines in an RTOS Environment.

UNIT IV**12 Hours**

DESIGN USING RTOS: Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power-introductions to RTL & QNX.

UNIT V**12 Hours**

SOFTWARE TOOLS: Embedded software Development Tools: Hosts and Target Machines- Linker/Locators for Embedded software-getting embedded software into the Target systems. **Debugging Techniques:** Testing on your Host machine -Instruction set simulators- The assert macro-using laboratory tools.

Text Books				
S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	David E.Simon	An Embedded Software primer	Pearson Education Asia	2003
2.	KennethJ Ayala	The8051 Microcontroller and Architecture programming and application	Second Edition, Penram International.	-
Reference Book				
1.	RajKamal	Embedded Systems– Architecture, programming and Design	Tata Mc Graw– Hill	2003

Mapping with Programming Outcomes

CO's/ PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M
CO2	M	M	M	S	M
CO3	M	S	S	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium

SEMESTER - I

Core Practical – I	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSP01	PRACTICAL - I : ALGORITHM AND OOPS LAB	Contact Hours per week : 4

Objectives

1. To course covers the basic data structures like Stack, Queue, Tree and List.
2. To course enables the students to learn the applications of the data structures using various techniques
3. To enable the students to understand C++language with respect to OOAD concepts
4. To Application of OOPS concepts.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Remember the concepts of object oriented with respect to C++	K3 & K4
CO2	Summarize OOPS concepts	
CO3	Apply data structures concepts like Stack, Queue, Tree, List using C++	
CO4	Develop data structures for Sorting, Searching using different Techniques.	
CO5	Develop a program for Employee Details using files.	

List of Practical's

1. Write a program to solve the tower of Hanoi using recursion.
2. Write a program to traverse through binary search tree using traversals.
3. Write a program to perform various operations on stack using linked list.
4. Write a program to perform various operation in circular queue.
5. Write a program to sort an array of an elements using quick sort.
6. Write a program to solve number of elements in ascending order using heap sort.
7. Write a program to solve the knapsack problem using greedy method

8. Write a program to search for an element in a tree using divide & Conquer strategy.
9. Write a program to place the 8 queens on an 8X8 matrix so that No two queens Attack.
10. Write a C++ program to perform Virtual Function.
11. Write a C++ program to perform Parameterized constructor.
12. Write a C++ program to perform Friend Function.
13. Write a C++ program to perform Function Overloading.
14. Write a C++ program to perform Single Inheritance.
15. Write a C++ program to perform Employee Details using files

SEMESTER - I

Core Practical – II	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSP02	PRACTICAL II : PYTHON PROGRAMMING LAB	Contact Hours per week : 4

Objectives

1. To Course presents an overview of elementary data items, lists, dictionaries, sets and tuples.
2. To understand and write simple Python programs.
3. To understand the OOPS concepts of Python.
4. To develop web applications using Python.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Apply OOPS concepts to write a program in Python	K3 & K4
CO2	To understand the concepts of File operations and Modules in Python	
CO3	Develop program for lists, dictionaries, sets and tuples	
CO4	Create web applications using Python	
CO5	Recite the creation of dynamic and interactive web pages using forms	

List of Exercises

Implement the following in Python:

1. Programs using elementary data items, lists, dictionaries and tuples
2. Programs using conditional branches,
3. Programs using loops.ss
4. Programs using functions
5. Programs using exception handling
6. Programs using inheritance
7. Programs using polymorphism
8. Programs to implement file operations.
9. Programs using modules.
10. Programs for creating dynamic and interactive web pages using forms

SEMESTER - II

Core -IV	M.Sc. Computer Science	Credits : 4
Course Code: M23PCS04	DATA MINING AND WAREHOUSING	Contact Hours per week : 4

Objectives

1. To enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
2. To develop skills of using recent data mining software for solving practical problems.
3. To develop and apply critical thinking, problem-solving, and decision- making skills.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Remember the basic data mining techniques and algorithms	K1 – K6
CO2	Understand the Association rules, Clustering techniques and Data warehousing contents	K1 – K6
CO3	Compare and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining	K1 – K6
CO4	Design data warehouse with dimensional modelling and apply OLAP operations	K1 – K6
CO5	Build appropriate data mining algorithms to solve real world problems	K1 – K6

UNIT I

12 Hours

BASICS AND TECHNIQUES :Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective. **Data mining techniques:** Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms

UNIT II

12 Hours

ALGORITHMS: Classification: Introduction –Statistical –based algorithms –distance – based algorithms-decision tree-based algorithms- neural network–based algorithms – rule- based algorithms – combining Techniques.

UNIT III**12 Hours**

CLUSTERING AND ASSOCIATION: Clustering: Introduction – Similarity and Distance Measures – Outliers – Hierarchical Algorithms – Partition Algorithms .**Association rules:** Introduction - large item sets - basic algorithms parallel & distributed algorithms – comparing approaches- incremental rules advanced association rules techniques – measuring the quality of rules.

UNIT IV**12 Hours**

DATA WAREHOUSING AND MODELING: Data warehousing: introduction-characteristics of a data warehouse – data marts – other aspects of data mart. **Online analytical processing:** Introduction –OLTP &OLAP systems. Data modeling – star schema for multidimensional view – data modeling – multi fact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.

UNIT V**12 Hours**

APPLICATIONS OF DATA WAREHOUSE: Developing a data WAREHOUSE: Why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse. **Applications of data warehousing and data mining in government:** Introduction - national data warehouses – other areas for data warehousing and data mining.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Dunham, Margaret H	<i>Data mining: Introductory and advanced topics.</i>	Pearson Education India	2006
2.	Prabhu, C. S. R.	Data warehousing: concepts, techniques, products and applications.	PHI Learning Pvt. Ltd.,	2008.
Reference Books				
1.	Pujari, Arun K.	Data Mining Techniques	(Edition 5): Hyderabad India: Universities Press (India) Private Limited	2003
2.	Berson, Alex, and Stephen J. Smith	Data warehousing, data mining, and OLAP.	McGraw-Hill, Inc.,	1997

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	S
CO2	S	S	M	S	M
CO3	M	S	S	S	S
CO4	S	M	S	M	S
CO5	S	S	M	S	S

S-Strong; M-Medium

SEMESTER - II

Core -V	M.Sc. Computer Science	Credits : 4
Course Code: M23PCS05	ADVANCED OPERATING SYSTEMS	Contact Hours per week : 4

Objectives

1. To enable the students to learn the different types of operating systems and their functioning.
2. To gain knowledge on Distributed Operating Systems
3. To gain in sight in to the components and management aspects of real time and mobile operating systems.
4. To learn case studies in Linux Operating Systems.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the design issues associated with operating systems	K1 – K6
CO2	Develop various process management concepts including scheduling, deadlocks and distributed file systems	K1 – K6
CO3	Apply the Real Time Task Scheduling	K1 – K6
CO4	Analyze Operating Systems for Handheld Systems	K1 – K6
CO5	Analyze Operating Systems like LINUX and iOS	K1 – K6

UNIT I

12 Hours

Basics of Operating Systems: What is an Operating System? – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems – Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments – Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks – Prevention – Avoidance – Detection – Recovery.

UNIT II**12 Hours**

Distributed Operating Systems: Issues – Communication Primitives – Lamport’s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.

UNIT III**12 Hours**

Real time Operating Systems: Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling.

UNIT IV**12 Hours**

HANDHELD SYSTEM: Operating Systems for Handheld Systems: Requirements– Technology Overview – Handheld Operating Systems –Palm OS- Symbian Operating System - Android – Architecture of android– Securing handheld systems.

UNIT V**12 Hours**

Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- **iOS** : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

Text Books

S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Silbers chatz, Abraham, Peter Baer Galvin, and Greg Gagne.	Operating system principles..	John Wiley & Sons	2006
2.	Singhal, Mukesh, and Niranjana G. Shivaratri	Advanced concepts in operating systems.	McGraw-Hill, Inc.,	2001.

Reference Books

1.	Mall, Rajib.	Real-time systems: theory and practice	Pearson Education India	2009
2.	Bhatt, Pramod Chandra P	An Introduction to Operating Systems: Concepts and Practice.	Prentice-Hall of India Pvt. Ltd	2019

3.	Bovet, Daniel P., and Marco CesatiKamber.	Understanding the Linux Kernel: from I/O ports to process management.	O'Reilly Media, Inc	2005
4.	Smyth, Neil.	iPhone iOS 4 Development Essentials–Xcode	Payload media	2014

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S
CO2	M	S	S	M	M
CO3	S	M	S	S	S
CO4	M	S	M	M	M
CO5	S	M	S	S	S

S-Strong; M-Medium

SEMESTER - II

Core -VI	M.Sc. Computer Science	Credits : 4
Course Code: M23PCS06	ADVANCED JAVA PROGRAMMING	Contact Hours per week : 5

Objectives

1. To enable the students to learn the basic functions, principles and concepts of advanced java programming.
2. To provide knowledge on concepts needed for distributed Application Architecture.
3. To learn JDBC, Servlet packages, JQuery, Java Server Pages and JAR file format.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the advanced concepts of Java Programming	K1 – K6
CO2	Understand JDBC and RMI concepts	K1 – K6
CO3	Apply and analyze Java in Database	K1 – K6
CO4	Analyze the different event in java using the delegation event model, event listener and class	K1 – K6
CO5	Design interactive applications using Java Servlet, JSP and JDBC	K1 – K6

UNIT I

15 Hours

Basics of Java: Java Basics Review: Components and event handling– Threading concepts – Networking features – Media techniques

UNIT II

15 Hours

Remote Method Invocation-Distributed Application Architecture- Creating stubs and skeletons- Defining Remote objects- Remote Object Activation-Object Serialization-Java Spaces.

UNIT III**15 Hours**

DATABASE: Java in Databases – JDBC principles–database access - Interacting- database search–Creating multimedia databases – Database support in web applications.

UNIT IV**15 Hours**

Java Servlets: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header- working with cookies **Java Server Pages:** JSP Overview-Installation-JSP tags- Components of a JSP page-Expressions- Scriptlets-Directives-Declarations-A complete example.

UNIT V**15 Hours**

ADVANCEDTECHNIQUES: JAR file format creation – Internationalization–Swing Programming–Advanced java Techniques.

Text Books

S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Jaworski, Jamie. Java 2 Platform Unleashed.	The Comprehensive Solution.	Macmillan Publishing Co., Inc.	1999.
2.	Campione, Mary, Kathy Walrath, and Alison Huml.	The Java tutorial: a short course on the basics.	Addison-Wesley Professional	2001

Reference Books

1.	Keogh, James. J2ME	The complete reference.	Osborne	2003.
2.	McFarland, David Sawyer	Javascript&jQuery: the missing manual.	O'Reilly Media, Inc."	2011

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M
CO2	M	M	S	M	S
CO3	S	S	M	S	M
CO4	M	S	S	S	S
CO5	S	M	S	S	S

S-Strong; M-Medium

SEMESTER - II

Elective Course - II	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE04	Elective – II ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	Contact Hours per week : 5

Objectives

1. To enable the students to learn the basic functions of AI, Heuristic Search Techniques.
2. To provide knowledge on concepts of Representations and Mappings and Predicate Logic.
3. To introduce Machine Learning with respect Data Mining, Big Data and Cloud.
4. To study about Applications & Impact of ML.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	List AI problems and techniques	K1 – K6
CO2	Understand machine learning concepts	K1 – K6
CO3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and Learning	K1 – K6
CO4	Analyze the impact of machine learning on Applications	K1 – K6
CO5	Design are all world problem for implementation and understand the dynamic behavior of a system	K1 – K6

UNIT I

15 Hours

Introduction: AI Problems - AI techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.

UNIT II

15 Hours

Heuristic Search techniques: Generate and Test - Hill Climbing- Best- First, Problem Reduction, Constraint Satisfaction, Means-end analysis. **Knowledge representation issues:** Representations and mappings - Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

UNIT III**15 Hours**

Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction.
Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming.

UNIT IV**15 Hours**

Understanding Machine Learning: What Is Machine Learning?- Defining Big Data- Big Data in Context with Machine Learning- The Importance of the Hybrid Cloud- Leveraging the Power of Machine Learning- The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.

UNIT V**15 Hours**

Looking Inside Machine Learning: The Impact of Machine Learning on Applications -Data Preparation-The Machine Learning Cycle.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Rich, Elaine, Kevin Knight, and Shiva shnkar B. Nair.	Artificial intelligence	Tata McGraw Hill Publishers company Pvt Ltd, Third Edition	2012
2.	Luger, George	Artificial intelligence: structures and strategies for complex problem solving.	Pearson education	2005
Reference Book				
1.	Hurwitz, Judith, and Daniel Kirsch.	Machine learning for dummies	IBM Limited Edition	2018

Mapping with Programme Specific Outcomes

CO's/P SO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	S	S
CO2	S	S	S	S	M
CO3	M	M	M	M	S
CO4	S	S	S	S	M
CO5	S	S	M	S	S

S-Strong; M-Medium

SEMESTER - II

Elective Course -II	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE05	Elective – II Internet of Things	Contact Hours per week : 5

Objectives

- To get familiar with the evolution of IOT with its design principles
- To outline the functionalities and protocols of internet communication
- To analyze the hardware and software components needed to construct IOT applications
- To identify the appropriate protocol for API construction and writing embedded code
- To realize various business models and ethics in Internet of Things

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the IoT evolution with its architecture and sensors	K1 – K6
CO2	Understand the networking concepts for communication and underlying IoT protocols	K1 – K6
CO3	Develop the embedded technologies and prototypes for the IoT products	K1 – K6
CO4	Evaluate the use of Application Programming Interface and design an API for IoT in real time	K1 – K6
CO5	Recognize the ethics of business models and perform security analysis	K1 – K6

UNIT I

15 Hours

Evolution of Internet of Things – Enabling Technologies – **IOT Architectures:** oneM2M, IOT World Forum (IOTWF) and Alternative IOT models – Simplified IOT Architecture and Core IOT Functional Stack -- Fog, Edge and Cloud in IOT – Functional blocks of an IOT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II

15 Hours

IOT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – **Network Layer:** IP versions, Constrained Nodes and Constrained Networks – **Optimizing IP for IOT:** From

6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application **Transport Methods:** Supervisory Control and Data Acquisition – **Application Layer Protocols:** CoAP and MQTT.

UNIT III

15 Hours

Prototyping Embedded Devices: Electronics - Embedded Computing Basics – Arduino - Raspberry Pi - Beagle Bone Black - Electric Imp. **Prototyping the Physical Design:** Non digital Methods - Laser Cutting - 3D printing - CNC Milling - Repurposing/Recycling.

UNIT IV

15 Hours

Prototyping Online Components: Getting started with an API - Writing a New API - Real-Time Reactions - Other Protocols. **Techniques for Writing Embedded Code:** Memory Management - Performance and Battery Life – Libraries - Debugging.

UNIT V

15 Hours

Business Models: History of Business Models – Model – Internet of Starting up – Lean Startups. Moving to Manufacture: Designing Kits - Designing Printed circuit boards – Certification – Costs - Scaling Up Software. **Ethics:** Privacy – Control – Environment – Solutions.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry,	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things	Cisco Press,	2017
2.	Adrian McEwen and Hakim Cassimally	Designing the Internet of Things	Wiley	2014.
Reference Books				
1.	Ovidiu Vermesan and Peter Friess,.	Internet of Things – From Research and Innovation to Market Deployment.	River Publishers,,	2014
2.	Peter Waher	Learning Internet of Things”	Packt Publishing	2015
3.	Donald Norris	The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black	McGraw Hill	2015

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	S	M
CO2	M	S	M	S	M
CO3	S	S	S	M	M
CO4	S	M	M	S	S
CO5	M	S	S	S	S

S-Strong; M-Medium

SEMESTER - II

Elective Course -II	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE06	Elective – II MOBILE COMPUTING	Contact Hours per week : 5

Objectives

1. To present the overview of Mobile computing, Applications and Architectures.
2. To describe the futuristic computing challenges.
3. To enable the students to learn the concept of mobile computing.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the need and requirements of mobile communication	K1 – K6
CO2	Describe on mobile computing applications and Techniques	K1 – K6
CO3	Demonstrate satellite communication in mobile computing	K1 – K6
CO4	Analyze about wireless local loop Architecture	K1 – K6
CO5	Categorize various mobile communication Technologies	K1 – K6

UNIT I

15 Hours

Introduction: Advantages of Digital Information – Introduction to Telephone Systems –**Mobile communication:** Need for Mobile Communication – Requirements of Mobile Communication –History of Mobile Communication

UNIT II

15 Hours

Introduction to Cellular Mobile Communication – Mobile Communication Standards – Mobility Management–Frequency Management – Cordless Mobile Communication Systems.

UNIT III

15 Hours

Mobile Computing: History of data networks – Classification of Mobile data networks – CDPD System– Satellites in Mobile

Communication: Satellite classification–Global Satellite Communication – Changeover from one satellite to other – Global Mobile Communication –Interferences in Cellular Mobile Communication.

UNIT IV

15 Hours

Mobile Communication System: Important Parameters of Mobile Communication System– **Mobile Internet:** Working of Mobile IP – Wireless Network Security – **Wireless Local Loop Architecture:** Components in WLL – Problems in WLL – Modern Wireless Local Loop – Local Multipoint Distribution Service – Wireless Application Protocol.

UNIT V

15 Hours

Communication Technology: WCDMA Technology and Fiber Optic Microcellular Mobile Communication – Ad hoc Network and Bluetooth technology – Intelligent Mobile Communication system– Fourth Generation Mobile Communication systems.

Text Books				
S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	T.G.Palanivelu ,R.Nakkeeran,	Wireless and Mobile Communication	PHI Limited	2009
2.	JochenSchiller	Mobile Communications	Second Edition, Pearson Education	2007
Reference Book				
1.	AsokeK Talukder,Hasan A hmed,RoopaYavag	Mobile Computing	TMH	2010

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

S-Strong; M-Medium

SEMESTER - II

Core Practical – III	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSP03	PRACTICAL III : DATA MINING USING R	Contact Hours per week : 3

Objectives

1. To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression.
2. To understand & write programs using the DM algorithms
3. To apply statistical interpretations for the solutions
4. To able to use visualizations techniques for interpretations.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Build programs using R for Association rules, Clustering techniques	K3 & K4
CO2	Apply data mining techniques like classification, prediction	
CO3	Give example of different visualizations techniques using R	
CO4	Apply different data mining algorithms to solve real world applications	
CO5	Evaluate the concepts of Linear Regression.	

List of Exercises:

1. Implement Apriori algorithm to extract association rule of data mining.
2. Implement k-means clustering technique.
3. Implement any one Hierarchical Clustering.
4. Implement Classification algorithm.
5. Implement Decision Tree.
6. Linear Regression.
7. Data Visualization.

SEMESTER - II

Core Practical – IV	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSP04	PRACTICAL IV : ADVANCED JAVA PROGRAMMING LAB	Contact Hours per week : 3

Objectives

1. To enable the students to implement the simple programs using JSP, JAR
2. To provide knowledge on using Servlets, Applets
3. To introduce JDBC and navigation of records
4. To understand RMI & its implementation
5. To introduce to Socket programming

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand to the implement concepts of Java using HTML forms, JSP & JAR	K3 & K4
CO2	Implementing JDBC and RMI concepts	
CO3	Apply the Applets with Event handling mechanism	
CO4	Create interactive web based applications using servlets and jsp	
CO5	Analyze to build a simple Client Server application using RMI.	

List of Exercises:

1. Display a welcome message using Servlet.
2. Design a Purchase Order form using Html form and Servlet.
3. Develop a program for calculating the percentage of marks of a student using JSP.
4. Design a Purchase Order form using Html form and JSP.
5. Prepare a Employee pay slip using JSP.
6. Write a program using JDBC for creating a table, Inserting, Deleting records and list out the records.
7. Write a program using Java servlet to handle form data.
8. Write a simple Servlet program to create a table of all the headers it receives along with their associated values.
9. Write a program in JSP by using session object.
10. Write a program to build a simple Client Server application using RMI.
11. Create an applet for a calculator application.
12. Program to send a text message to another system and receive the text message from the system (use socket programming).

SEMESTER - III

Core - VII	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS07	DIGITAL IMAGE PROCESSING	Contact Hours per week : 6

Objectives

1. To Learn basic image processing techniques for solving real problems.
2. To Gain knowledge in image transformation and Image enhancement techniques.
3. To Learn Image compression and Segmentation procedures.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the fundamentals of Digital Image Processing	K1 – K6
CO2	Explain the mathematical foundations for digital image representation, image acquisition, image transformation, and image enhancement	K1 – K6
CO3	Apply, Design and Implement solutions for digital image processing problems	K1 – K6
CO4	Evaluate the concepts of filtering and segmentation for digital image retrieval	K1 – K6
CO5	Classify the concepts of Multi-resolution process and recognize the objects in an efficient manner	K1 – K6

UNIT I

18 Hours

Introduction: What is Digital image processing – the origin of DIP – Examples of fields that use DIP – Fundamentals steps in DIP – Components of an image processing system. **Digital Image Fundamentals:** Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.

UNIT II

18 Hours

Image Enhancement in the spatial domain:- Background – some basic Gray level Transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.

UNIT III**18 Hours**

Image Restoration: A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.

UNIT IV**18 Hours**

Image Compression: Fundamentals – Image compression models – Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards.

UNIT V**18 Hours**

Image Segmentation: Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Rafael C. Gonzalez, Richard E. Woods	Digital Image Processing	PHI/Pearson Education..	Second Edition
2.	B. Chanda, D. Dutta Majumder	Digital Image Processing and Analysis.	PHI	2003
Reference Book				
1.	Nick Efford	Digital Image Processing a practical introducing using Java	Pearson Education	2004.

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M
CO2	M	M	S	M	S
CO3	S	S	M	S	M
CO4	M	S	S	S	S
CO5	S	M	S	S	S

S-Strong; M-Medium

SEMESTER - III

Core - VIII	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS08	CLOUD COMPUTING	Contact Hours per week : 5

Objectives

1. To Gain knowledge on cloud computing, cloud services, architectures and applications.
2. To Enable the students to learn the basics of cloud computing with real time usage.
3. To store and share, in and from cloud.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of Cloud and its services	K1 – K6
CO2	Outline the Cloud Event & Project Management	K1 – K6
CO3	Analyze on cloud in – Word Processing, Spread Sheets, Mail, Calendar, Database	K1 – K6
CO4	Select cloud in social networks	K1 – K6
CO5	Design cloud storage and sharing	K1 – K6

UNIT I 15 Hours

INTRODUCTION: Cloud Computing Introduction: From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits: **Developing cloud computing services:** Cloud service development, discovering cloud services.

UNIT II 15 Hours

CLOUD COMPUTING FOR EVERYONE: Centralizing email communications- **Cloud computing for community:** collaborating on schedules, collaborating on group projects and events. **Cloud computing for corporation:** managing schedules, managing projects, presenting on road.

UNIT III 15 Hours

USING CLOUD SERVICES Collaborating on calendars, **Schedules and task management:** exploring on line scheduling and planning, collaborating on event management, **Collaborating on contact management:** collaborating on project management, collaborating on word processing, spreadsheets, and databases.

UNIT IV**15 Hours**

OUTSIDE THE CLOUD: Evaluating web mail services, Evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating on line groupware, collaborating via blogs and wikis..

UNIT V**15 Hours**

STORING AND SHARING: Understanding cloud storage, evaluating on line file storage, exploring on line book marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.

Text Book				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Michael Miller	Cloud Computing,	Pearson Education, New Delhi	2009
Reference Book				
1.	Anthony T. Velte,	Cloud Computing: A Practical Approach	Tata McGraw Hill Education	1st Edition 2009

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M
CO2	M	M	S	M	S
CO3	S	S	M	S	M
CO4	M	S	S	S	S
CO5	S	M	S	S	S

S-Strong; M-Medium

SEMESTER - III

Core- IX	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS09	NETWORK SECURITY AND CRYPTOGRAPHY	Contact Hours per week : 5

Objectives

1. To Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.
2. To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.
3. To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
4. To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the process of the cryptographic algorithms	K1 – K6
CO2	Apply different encryption and decryption techniques to solve problems related to confidentiality and authentication	K1 – K6
CO3	Analyze appropriate security techniques to solve network security problem	K1 – K6
CO4	Derive suitable cryptographic algorithms	K1 – K6
CO5	Classify different digital signature algorithms to achieve authentication and design secure applications	K1 – K6

UNIT I

15 Hours

Introduction to Cryptography – Security Attacks – Security Services – Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

UNIT II

15 Hours

Public-key Cryptosystem: Introduction to Number Theory - RSA Algorithm – Key Management - Diffie-Hell man Key exchange – Elliptic Curve Cryptography Message Authentication and Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

UNIT III**15 Hours**

Network Security Practice: Authentication Applications – Kerberos – X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.

UNIT IV**15 Hours**

Web Security - Secure Socket Layer – Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls– Password Security.

UNIT V**15 Hours**

Case Study: Implementation of Cryptographic Algorithms – RSA – DSA – ECC (C / JAVA Programming). Network Forensic – Security Audit - Other Security Mechanism: Introduction to Stenography – Quantum Cryptography – Water Marking - DNA Cryptography.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	William Stallings	Cryptography and Network Security	PHI Limited	2009
2.	Bruce Schneir	Applied Cryptography	CRC Press	-
Reference Books				
1.	A.Menezes, P Van Oorschot and S.Vanstone	Hand Book of Applied Cryptography	CRC Press	1997
2.	AnkitFadia	Network Security	MacMillan	-

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

S-Strong; M-Medium

SEMESTER - III

Elective Course -III	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE07	Elective – III CRITICAL THINKING, DESIGN THINKING AND PROBLEM SOLVING	Contact Hours per week : 4

Objectives

1. Learn critical thinking and its related concepts.
2. Learn design thinking and its related concepts.
3. Develop Thinking patterns, Problem solving & Reasoning.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts of Critical thinking and its related technology	K1 – K6
CO2	Present the explicit development of critical thinking and problem solving skills	K1 – K6
CO3	Apply design thinking in problems	K1 – K6
CO4	Illustrate decision and take actions based on analysis	K1 – K6
CO5	Analyze the concepts of Thinking patterns, Problem solving & Reasoning in real time applications	K1 – K6

UNIT I

12 Hours

Critical Thinking: Definition, Conclusions and Decisions, Beliefs and Claims, Evidence – finding, evaluation, Inferences, Facts – opinion, probable truth, probably false, Venn diagram. **Applied critical thinking:** Inference, Explanation, Evidence, Credibility, Two Case Studies, critical thinking and science, critical evaluation, self assessment.

UNIT II

12 Hours

Design Thinking: Introduction, Need of Design Thinking, problem to question - design thinking process, Traditional Problem Solving versus Design Thinking, phases of Design Thinking, problem exploration, Stake holder assessment, design thinking for manufacturers, smart Idea to implementation.

UNIT III

12 Hours

Case Study: Thinking to confidence, fear management, duty Vs passion, Team management, Tools for Thinking, prototype design, Relevance of Design and Design Thinking in engineering, human centered design, case study: apply design thinking in problem.

UNIT IV**12 Hours**

Problem solving: problem definition, problem solving methods, selecting and using information, data processing, solution methods, solving problems by searching, recognizing patterns, spatial reasoning, necessity and sufficiency, choosing and using models, making choices and decisions.

UNIT V**12 Hours**

Reasoning: Deductive and hypothetical reasoning, computational problem solving; generating, implementing, and evaluating solutions, interpersonal problem solving. **Advanced problem solving:** Combining skills – using imagination, developing models, Carrying out investigations, Data analysis and inference. Graphical methods of solution, Probability, tree diagrams and decision trees.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	John Butterworth and Geoff Thwaites, , , 2013..	Thinking skills: Critical Thinking and Problem Solving	Cambridge University Press	2013
2.	H. S. Fogler and S. E. LeBlanc	Strategies for Creative Problem Solving	Pearson Education, Upper Saddle River, N	2nd edition, 2008.
Reference Books				
1.	A. Whimbey and J. Lochhead, ,.	Problem Solving & Comprehension	-	6th editio1999
2.	M. Levine, Effective	Problem Solving, 2nd edition	Prentice Hall, Upper Saddle River, NJ	1994
3.	Michael Baker	, The Basic of Critical Thinking,	Co press	2015
4.	David Kelley and Tom Kelley	Creative Confidence	-	2013

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

S-Strong; M-Medium

SEMESTER - III

Elective Course - III	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE08	Elective – III WEB SERVICES	Contact Hours per week : 4

Objectives

1. To Present the Web Services , Building real world Enterprise applications using Web Services with Technologies XML, SOAP , WSDL , UDDI.
2. To Get overview of Distributed Computing, XML, and its technologies.
3. To Update with QoS and its features.
4. To Develop Standards and future of Web Services.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand web services and its related technologies	K1 – K6
CO2	List XML concepts	K1 – K6
CO3	Analyze on SOAP and UDDI model	K1 – K6
CO4	Demonstrate the road map for the standards and future of web services	K1 – K6
CO5	Analyze QoS enabled applications in web services	K1 – K6

UNIT I

12 Hours

Introduction to web services – Overview of Distributed Computing- Evolution and importance of web services-Industry standards, Technologies and concepts underlying web services-Web services and enterprises-web services standards organization-web services platforms.

UNIT II

12 Hours

XML Fundamentals – XML documents - XML Namespaces- XML Schema –Processing XML.

UNIT III

12 Hours

SOAP: The SOAP model- SOAP messages-SOAP encoding- **WSDL:** WSDL structure interface definitions-bindings -services - Using SOAP and WSDL-**UDDI:** About UDDI- UDDI registry Specification- Core data structures- Accessing UDDI.

UNIT IV

12 Hours

Advanced web services technologies and standards: Conversations overview-web services conversation language-WSCL interface components. **Workflow:** business process management workflows and workflow management systems Security: Basics-data handling and forwarding data storage-errors-Web services security issues.

UNIT V**12 Hours**

Quality of Service: Importance of QoS for web services-QoS metrics-holes-design patterns-QoS enabled web services-QoS enabled applications. Web services management-web services standards and future trends.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Sandeep Chatterjee, James Webber.	Developing Enterprise Web Services: An Architects Guide	Prentice Hall	2003
2.	Keith Ballinger	NET Web services: Architecture and Implementation with .Net	Pearson Education, First Edition	2003
Reference Books				
1.	Ramesh Nagappan	Developing Java Web Services: Architecting and developing secure Web Services Using Java	John Wiley and Sons	first Edition Feb 2003
2.	Eric A Marks and Mark J Werrell	Executive Guide to Web services	John Wiley and sons	2003
3.	Anne Thomas Manes,	Web Services: A managers Guide	Addison Wesley	June 2003

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

S-Strong; M-Medium

SEMESTER - III

Elective Course -III	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSE09	Elective – III Robotic Process Automation For Business	Contact Hours per week : 4

Objectives

1. To Learn the concepts of RPA, its benefits, types and models.
2. To Gain the knowledge in application of RPA in Business Scenarios.
3. To Identify measures and skills required for RPA.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate the benefits and ethics of RPA	K1 – K6
CO2	Understand the Automation cycle and its techniques	K1 – K6
CO3	Identify inferences and information processing of RPA	K1 – K6
CO4	Apply RPA in Business Scenarios	K1 – K6
CO5	Analyze on Robots & leveraging automation	K1 – K6

UNIT I

12 Hours

Introduction to RPA - Overview of RPA - Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA - Centre of Excellence – Types and their applications - Building an RPA team - Approach for implementing RPA initiatives.

UNIT II

12 Hours

Role of a Business Manager in Automation initiatives - Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.

UNIT III

12 Hours

Automation Implementation Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.

UNIT IV**12 Hours**

ROBOT: Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behavior - Understand the skill of drawing inference or establishing causality by tracking the behavior of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

UNIT V**12 Hours**

ROBOT SKILL: Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behavior of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Text Books				
S.No	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Alok Mani Tripathi	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool	Packt Publishing Limited	2018
2.	Tom Taulli	The Robotic Process Automation Handbook	Apress	2020
Reference Book				
1.	Steve Kaelble	Robotic Process Automation	John Wiley and Sons	2018

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

S-Strong; M-Medium

SEMESTER - III

Core Practical - V	M.Sc. Computer Science	Credits : 3
Course Code: M23PCSP05	PRACTICAL V : DIGITAL IMAGE PROCESSING LAB Using MATLAB	Contact Hours per week : 4

Objectives

1. To understand the basics of Digital Image Processing fundamentals, image enhancement and image restoration techniques.
2. To enable the students to learn the fundamentals of image compression and segmentation.
3. To understand Image Restoration & Filtering Techniques.
4. To Implementation of the above using MATLAB

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Develop programs in MATLAB for image processing using the techniques	K3 & K4
CO2	Derive Image Enhancements & Restoration techniques	
CO3	Design Compression techniques in an Image	
CO4	Modify the image and Segment it	

List of Practical's:

1. Implement Image enhancement Technique.
2. Histogram Equalization
3. Image Restoration.
4. Implement Image Filtering.
5. Edge detection using Operators (Roberts, Prewitts and Sobels operators).
6. Implement image compression.
7. Image Subtraction.
8. Boundary Extraction using morphology.
9. Boundary Extraction using morphology.

SEMESTER - III

Core Practical - VI	M.Sc. Computer Science	Credits : 2
Course Code: M23PCSP06	PRACTICAL VI : CLOUD COMPUTING LAB	Contact Hours per week : 4

objectives

1. To enables the students to learn the applications of the data structures using various techniques.
2. To enable the students to understand C++ language with respect to OOAD concepts
3. To Apply of OOPS concepts

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the Google Drive to make spreadsheet and notes	K3 & K4
CO2	Develop to host a static website	
CO3	Explain the Working and installation of Google App Engine	
CO4	Design Amazon Red shift with S3 bucket	
CO5	Create and Query a NoSQL Table	

List of Practical's:

1. Working with Google Drive to make spreadsheet and notes
2. Launch a Linux Virtual Machine
3. To host a static website.
4. Exploring Google cloud for the following a) Storage b) Sharing of data c) manage your calendar, to-do lists, d) a document editing tool.
5. Working and installation of Google App Engine.
6. Working and installation of Microsoft Azure.
7. To Connect Amazon Red shift with S3 bucket.
8. To Create and Query a NoSQL Table.
9. Boundary Extraction using morphology.

1.

SEMESTER - IV

Core-X	M.Sc. Computer Science	Credits : 5
Course Code: M23PCS10	DATA SCIENCE & ANALYTICS	Contact Hours per week : 6

Objectives

1. To Introduce the students to data science, big data & its eco system.
2. To Learn data analytics & its life cycle.
3. To explore the programming language R, with respect to the data mining algorithms.
4. To Relate the relationship between artificial intelligence, machine learning and data science.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of data science and its techniques	K1 – K6
CO2	Restate data analytics	K1 – K6
CO3	Apply and determine appropriate Data Mining techniques using R to real time applications	K1 – K6
CO4	Analyze on clustering algorithms	K1 – K6
CO5	Develop on regression methods in AI	K1 – K6

UNIT I

18 Hours

Introduction of Data Science: data science and big data – facets of data-data science process Ecosystem- The Data Science process – six steps- Machine Learning.

UNIT II

18 Hours

Data Analytics life cycle - review of data Namaste analytics - Advanced data Analytics-technology and tools.

UNIT III

18 Hours

Basic Data Analytics using R : R Graphical User Interfaces – Data Import and Export – Attribute and Data Types –Descriptive Statistics – Exploratory Data Analysis –Visualization Before Analysis – Dirty Data – Visualizing a Single Variable – Examining Multiple Variables – Data Exploration Versus Presentation.

UNIT IV

18 Hours

Overview of Clustering : K-means – Use Cases – Overview of the Method – Perform a K-means Analysis using R –Classification – Decision Trees – Overview of a Decision Tree – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Tree in R – Bayes’ Theorem – Naive Bayes Classifier – Smoothing – Naïve Bayes in R.

UNIT V**18 Hours**

Artificial intelligence: Machine Learning and deep learning in data science - Clustering, association rules. Linear regression-logistic regression- Additional regression methods.

Text Books				
S.No.	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	-	Introducing-Data-Science-Big-Data-Machine-Learning-and-more-using-Python-tools	Pdf	2016
2.	-	Data science in big data analytics	John Wiley & Sons	2015
Reference Books				
1.	Lars Nielson	A simple introduction to Data Science	-	2015
2.	Arno D.B.Meysman, Mohamed Ali	Introducing Data Science Davy Cielen,	Manning Publication	2016
3.	Roger D.Peng	R Programming for Data Science	Lean Publication	2015
4.	-	Data Science & Big Data Analytics: Discovering, Analyzing , Visualizing and Presenting Data	-	-

Mapping with Programme Specific Outcomes

CO's / PSO's	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	S	M
CO2	S	M	S	M	M
CO3	S	S	S	S	M
CO4	M	S	M	M	S
CO5	S	S	S	M	M

SEMESTER - IV

Core Practical - VII	M.Sc. Computer Science	Credits : 5
Course Code: M23PCSP07	PRACTICAL VII : WEB APPLICATION DEVELOPMENT AND HOSTING	Contact Hours per week : 5

Objectives

1. To Able to design a web page using HTML tags.
2. To enable the students to use Framesets, hyper links and different formatting features of HTML tags.
3. To Enable the students to use Forms & other controls in a web page.
4. To create interactive applications using PHP.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Create the basic HTML tags to design static web pages	K1 - K6
CO2	Develop a Complete Web Page using Frames and Framesets	
CO3	Design the dynamic web applications using HTML forms	
CO4	Create a dynamic web applications in PHP & HTML tags using XAMPP	

List of Practical's:

1. Develop a website for your college using advanced tags of HTML
2. Write names of several countries in a paragraph and store it as an HTML document, world.html. Each country name must be a hot text. When you click India (for example), it must open india.html and it should provide a brief introduction about India.
3. Develop a HTML document to i)display Text with Bullets / Numbers - Using Lists ii) to display the Table Format Data.
4. Develop a Complete Web Page using Frames and Framesets which gives the Information about a Hospital using HTML.
5. Write a HTML document to print your Bio-Data in a neat format using several components.
6. Develop a HTML document to display a Registration Form for an inter-collegiate function.

7. Using HTML form accept Customer details like Name, City, Pin code, Phone number and Email address and validate the data and display appropriate messages for violations using PHP (Eg. Name is Mandatory field; Pin code must be 6 digits, etc.).
8. Write a program to accept two numbers n1 and n2 using HTML form and display the Prime numbers between n1 and n2 using PHP.

Skill Enhancement Course

SEMESTER - IV

SEC	M.Sc. Computer Science	Credits : 2
Course Code: M23PCSS01	SEC - Professional Competency Skill - Data Visualizations Lab	Contact Hours per week : 2

Objectives

1. To learn the basic functions and operations of Excel and tableau.
2. To explore to design, build, and deploy various charts for applications,
3. To comprehend, design and deploy the label and heat map
4. To understand and deploy dashboard
5. To understand the functions of tableau for data process.

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Enable to create and apply Spread sheet and Tableau for various data processing	K3 & K4
CO2	Gains knowledge to create and design various visualization tools in Excel and Tableau.	
CO3	Comprehend, create and deploy labels and heat map.	
CO4	Enable to create and apply dashboard for various data processing	
CO5	Illustrate and apply data visualization tool for any data set	

List of Practical's:

1. Create Pie chart for Sales and Sales % by Country (sorted in descending order)
2. Create Bar chart for Sales by Country by Year (rounded to nearest thousand and sorted by Grand Total).
3. Create Line char for Sales by Ship Mode (First Class, Same Day, Second Class and Standard Class).
4. Create Scatter chart for Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class).
5. Create heat map for Sales by Category by Sub-Category (in thousands and sorted by sales value in descending order).
6. Design and create the label for vendor list.
7. Design and create the dash board.

Implement the following using Tableau

8. Sales by Ship Mode (First Class, Same Day, Second Class and Standard Class) .
9. Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class)
10. Sales by Ship Mode by Country (rounded to the nearest dollar and sorted by First Class)

EXTRA DISCIPLINARY COURSES

SEMESTER – II

EDC	M.Sc Computer Science	Credits : 4
Course Code: M23PCSED1	EDC- FUNDAMENTALS OF COMPUTERS AND COMMUNICATION	Contact Hours per week : 4

Objectives

1. To Know the basics of Computers
2. To Learn the internal Components of Computers
3. To Understand the OS and its types
4. To Study the basics of networks and Internet
5. To Get a clear idea on DBMS and its concepts

Course Outcomes

On the Successful completion of the course, students will be able to

CO	Statement	Knowledge Level
CO1	Know the basics and internal parts of Computers	K1 – K6
CO2	Gain the knowledge on OS and its types	K1 – K6
CO3	Understand the basics of networks and Internet	K1 – K6
CO4	Learn the databases and DBMS concepts	K1 – K6
CO5	Understand the role of RDBMS in IT	K1 – K6

UNIT I

12 Hours

Introduction: What is computer – Components of Computers – Advantages and Disadvantages of using computers – Computer Software – Categories of Computers - Elements of information systems. **The Components of the Systems Unit:** Processor – Data representation – Memory – Mobile Computers and Devices.

UNIT II

12 Hours

Input and Output Device: What is input – what are input devices – keyboard – pointing device – mouse – other pointing devices – Voice input – Digital Cameras – Video input – Scanners and Reading devices Terminals – Biometric input - Input devices for physically challenged users-**Output:** What is output – display devices – Monitors – Printers –Speakers, Headphones and Ear phones – output device for physically challenged users – Storage devices.

UNIT III**12 Hours**

Operating Systems and Utility Programs: System software – Operating system – Operating system functions – types of operating systems – standalone operating systems–network operating systems – embedded operating system. **Application Software:** Application software – Business software – Graphics and Multimedia Software–Application software for Communication.

UNIT IV**12 Hours**

Internet and World Wide Web: Internet – History of the Internet – How the Internet works –WWW– E-commerce–**Communications and Networks:** Communications – Uses of Computer Communications – Networks – Communication software – Communication devices – Communications Channel – Physical transmission media and Wireless transmission media.

UNIT V**12 Hours**

Database Management: Databases, Data and Information, The Hierarchy of data–Maintaining data – File processing versus databases – database management systems–relational, object oriented and multi dimensional databases – web databases – database administration. **Computer Security:** Computer security risks – Internet and network attacks –Unauthorized access and use.

Text Book				
S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Gary B. Shelly, Thomas j. Cash man, Misty E.Ver maat	Introduction to Computers	Engage Learning	2008
Reference Books				
1.	Reema Thareja	Fundamentals of Computers	Oxford Univ. Press	2015
2.	Deborah Morley, Charles S. Parker	Understanding Computers- Today and Tomorrow	Thomson Course Technology	11 th Edition 2007
3.	Alexis Leon, Mathew's Leon	Fundamentals of Computer Science and Communication Engineering	Vikas Publishing House, New Delhi	1998.

Mapping with Programme Specific Outcomes

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	M
CO2	S	M	S	S	S
CO3	M	S	M	S	M
CO4	M	S	M	M	S
CO5	S	M	S	M	M

S-Strong; M-Medium.

SEMESTER-II

EDC	M.Sc Computer Science	Credits : 4
Course Code: M23PCSED2	EDC- PRINCIPLES OF INFORMATION TECHNOLOGY	Contact Hours per week : 4

Objectives

1. To learn the basic concept and skills associated with information technology
2. To know the Computer hardware and software technologies
3. To gain the knowledge of organizing data
4. To assess the current role of Information Science in an organization
5. To understand how IT relates to organizational goals.

Course Outcomes

On the Successful completion of the course, students will be able to

CO Number	Statement	Knowledge level
CO1	Understand the basics of information technology	K1 – K6
CO2	Gain the knowledge of Hardware and Software technologies	K1 – K6
CO3	Learn the method of organizing data	K1 – K6
CO4	Assess the role of Information Science to an organization.	K1 – K6
CO5	Understanding the role of IT in organizations	K1 – K6

UNIT I

12 Hours

Business Environment: Business and Information technology – business in the information age– about information technology–what is an information system– Information Technology in the Modern Organization.

UNIT II

12 Hours

Computer Hardware – Significance of Hardware – Central Processing Unit– Computer Memory – Computer Hierarchy – Input Technologies – Output Technologies. Computer Software: Software History and Significance–System Software–Application Software–Software issues–Programming languages–Enterprise Software.

UNIT III

12 Hours

Managing Organizational Data and Information: Basics of Data arrangement and Access – Traditional file environment – modern approach: database management systems – logical data models – data warehouses – Networks– Internet- Evolution of the Internet –Operation of the Internet–WWW-Intranets and Extranets.

UNIT IV**12 Hours****Functional, Enterprises, and Inter organizational Systems:**

Information system to support business functions – transaction processing information systems – accounting and finance system – marketing and sales system – production and operations management system –Integrated information system and enterprises resource planning–inter organizational/Global information system. –Electronic Commerce

UNIT V**12 Hours****Information Systems Development:**

Information system planning– Traditional systems development life cycle – alternative methods for system development –system development outside the IS department – building Internet and Intranet applications –Implementing: Ethics, Impacts and Security.

Text Book				
S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Turban, Rainer Potter	Introduction to Information Technology	Second edition Wiley India	2007
Reference Book				
1.	V. Rajaraman	Introduction to Information Technology	Prentice Hall of India	2007

Mapping with Programme Specific Outcomes

Cos	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	S	M	M
CO2	S	M	S	S	S
CO3	M	S	M	S	M
CO4	M	S	M	M	S
CO5	S	M	S	M	M

S-Strong; M-Medium.

SEMESTER-II

EDC	M.Sc Computer Science	Credits : 4
Course Code: M23PCSED3	EDC- E - COMMERCE	Contact Hours per week : 4

Objectives

1. To Know the mercantile and consumer process model
2. To understand the Consumer's and Merchant's perspective
3. To Understand the Electronic payment system
4. To Earn an in depth idea on electronic data interchange
5. To Gain the knowledge on Internet, growth of internet and its commercial uses

Course Outcomes

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

CO Number	CO Statement	Knowledge Level
CO1	Learn the introduction on e-commerce	K1 – K6
CO2	Understand the mercantile and consumer process models	K1 – K6
CO3	Analyse the consumers and merchant's perspective on e-commerce	K1 – K6
CO4	Getting an idea on Electronic Data Interchange	K1 – K6
CO5	Gaining the knowledge on Internet	K1 – K6

UNIT I

12 Hours

Electronic Commerce – Electronic Commerce Frame work – The Anatomy of Electronic Commerce Applications - Electronic Equipment Consumer Applications -Electronic Commerce Organization Applications - Components of I-Way – Network Access Equipment.

UNITII

12 Hours

Architecture Framework for Electronic Commerce- World Wide Web as the Architecture – Consumer Oriented Applications – Mercantile Process Models – Mercantile Models from the Consumer's Perspective and merchant's Perspective.

UNIT III

12 Hours

Electronic Payment Systems: Types of Electronic Payment Systems – Digital Token based Electronic Payment Systems–Smart Card and Credit Card Based Electronic Payment Systems– Risk and Electronic Payment Systems – Designing Electronic Payment Systems.

UNIT IV

12 Hours

Electronic Data Interchange – EDI Applications in Business – EDI: Legal, Security and Privacy issues EDI and Electronic Commerce – Standardization and EDI – EDI Software Implementation.

UNIT V**12 Hours**

Internet and World Wide Web: origin of the Internet – New uses for the Internet – Commercial use of the Internet–Growth of the Internet – Advertising on the Internet.

Text Books

S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHER	YEAR OF PUBLICATION
1.	Kalakota and Whinston.	Frontiers of Electronic Commerce	Pearson Education	2004
2.	Gray P.Scheider	Fourth Annual Edition Electronic Commerce	Thomson Course Technology	2003

Reference Books

1.	Kamalesh K. Baja, Debjani Nag	E-Commerce–The Cutting Edge of Business	TMH Publications	2005
2.	Agarwala, K.N, Deeksha Agarwala	Business on the Net: What’s and How’s of E-Commerce	Macmillan, New Delhi.	-
3.	Parag Diwan, Sunil Sharma	Electronic Commerce: A Manager's Guide to E- Business	Excel books	2005

Mapping with Programme Specific Outcomes

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	S	M	M	S
CO2	S	M	S	S	M
CO3	S	S	M	S	S
CO4	M	S	M	S	M
CO5	S	M	S	S	S

S-Strong; **M**-Medium

ENHANCEMENT COMPULSORY COURSES

SEMESTER - II

ECC	M.Sc. Computer Science	Credits : 2
Course Code: M23PHR01	HUMAN RIGHTS	Contact Hours per week : 2

Objectives

- To learn about Basic Facets of Human Rights.
- To understand the development of human rights in India.
- To know the various rights pertaining to marginalized and other disadvantaged people.
- To help the students to know various human rights movements.
- To make the students to be aware of human rights redressal mechanisms.

Course Outcomes

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

CO Number	CO Statement	Programme Outcomes
CO1	Understand the basic facets of human Rights	K1 – K6
CO2	Classify the Constitutional provisions of human rights in India	K1 – K6
CO3	List the rights of the marginalized and other disadvantaged people in India	K1 – K6
CO4	Outline the historical background of the various human rights movement in India.	K1 – K6
CO5	Understand the redressal mechanism of the human rights violations	K1 – K6

UNIT I

6 Hours

Introduction: Meaning and Definitions of Human Rights– Characteristics and Importance of Human Rights –Evolution of Human Rights– Formation, Structure and Functions of the UNO - Universal Declaration of Human Rights–International Covenants – Violations of Human Rights in the Contemporary Era.

UNIT II

6 Hours

Human Rights in India: Development of Human Rights in India– Constituent Assembly and Indian Constitution– Fundamental Rights and its Classification –Directive Principles of State Policy – Fundamental Duties.

UNIT III**6 Hours**

Rights of Marginalized and other Disadvantaged People: Rights of Women – Rights of Children – Rights of Differently Abled – Rights of Elderly- Rights of Scheduled Castes – Rights of Scheduled Tribes – Rights of Minorities – Rights of Prisoners – Rights of Persons Living with HIV/AIDS – Rights of LGBT.

UNIT IV**6 Hours**

Human Rights Movements: Peasant Movements (Tebhaga and Telangana) – Scheduled Caste Movements (Mahar and Ad-Dharmi) – Scheduled Tribes Movements (Santhal and Munda) – Environmental Movements (Chipko and Narmada Bachao Andolan) – Social Reform Movements (Vaikom and Self Respect).

UNIT V**6 Hours**

Redressal Mechanisms: 1993 (Amendment 2019) – Structure and Functions of National and State Human Rights Commissions – National Commission for SCs – National Commission for STs – National Commission for Women – National Commission for Minorities – Characteristics and Objectives of Human Rights Education.

Text Books				
S.NO	AUTHOR	TITLE OF THE BOOK	PUBLISHERS	YEAR OF PUBLICATION
1.	Sudarshanam Gankidi	Human Rights in India: Prospective and Retrospective	Rawat Publications,	2019
2.	Satvinder Juss	Human Rights in India	Routledge, New Delhi,	2020
3.	Namita Gupta	Social Justice and Human Rights in India	Rawat Publications,	2021
4.	MarkFrezo	The Sociology of Human Rights	John Willy & Sons U.K	2014
Reference Books				
1.	Dr.S.Mehartaj Begum	Human Rights in India: Issues and perspectives	APH Publishing Corporation,	2010
2.	Asha Kiran	The History of Human Rights	Mangalam Publications, New Delhi.	2011
3.	Bani Borgohain	Human Rights	Kanishka Publishers & Distributors	2007
4.	Jayant Chudhary	A Textbook of Human Rights	Wisdom Press, New Delhi	2011
5.	Anju Soni.	Human Rights in India	Venus Publication New Delhi.	2019