

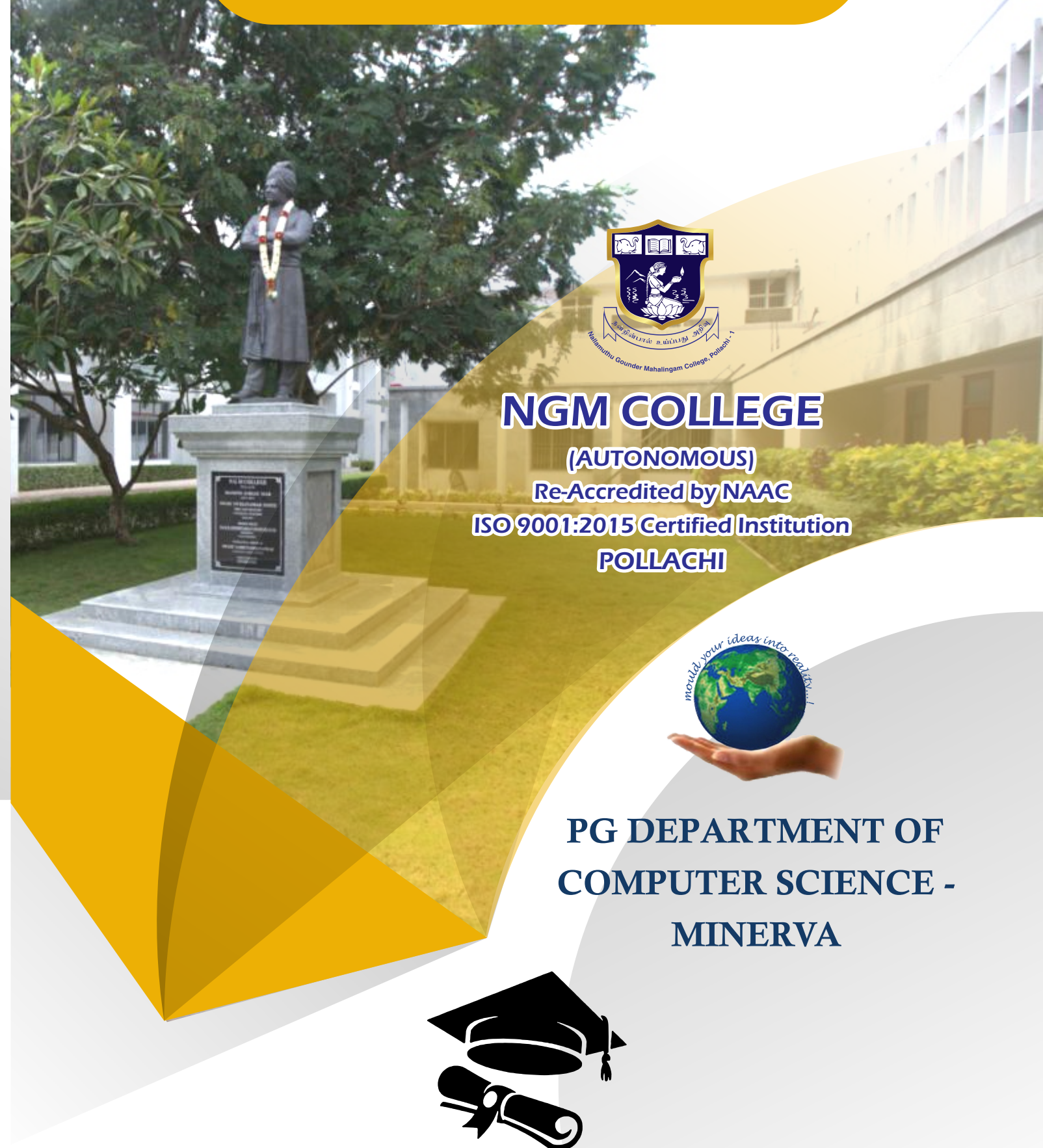


"A College is a temple of wisdom, seed bed of character, model of discipline, training ground of democracy and a nursery of great hearts, strong mind, true faith and willing hands. Hence, education has a pivotal role in harvesting the available resources to contribute to the prosperity of the nation"

- Arutchelvar Dr. N. Mahalingam

Holistic Education for the wholesome development of Human personality for the overall well-being of the Humanity as a whole.

Dr. B. K. Krishnaraj Vanavarayar
President



ACADEMIC COUNCIL MEETING

EMPOWER THE YOUTH TO ENRICH THE NATION

11.11.2020

P.G. DEPARTMENT OF COMPUTER SCIENCE

Nallamuthu Gounder Mahalingam College

(Autonomous)

(An ISO 9001:2015 Certified Institution)

Re-Accredited by NAAC

Pollachi-642001



SYLLABUS

M. Sc. COMPUTER SCIENCE

BATCH 2020-2022

NGM COLLEGE

VISION

Our dream is to make the College an institution of excellence at the national level by imparting quality education of global standards to make students academically superior, socially committed, ethically strong, spiritually evolved and culturally rich citizens to contribute to the holistic development of the self and society.

MISSION

Training students to become role models in academic arena by strengthening infrastructure, upgrading curriculum, developing faculty, augmenting extension services and imparting quality education through an enlightened management and committed faculty who ensure knowledge transfer, instill research aptitude and infuse ethical and cultural values to transform students into disciplined citizens in order to improve quality of life.

PG DEPARTMENT OF COMPUTER SCIENCE

VISION

Exploring innovative approaches to enhance learning opportunities through the integration of technology and to develop more responsive strategies for adapting curriculum and changing demands in the Computing Profession.

MISSION

To provide strong theoretical foundation complemented with extensive practical training. Provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team spirit, ethical responsibilities

Scheme of Examination

Part	Subject Code	Title of the Paper	Duration in Hours per week	Examination				
				Hours	CIA	ESE	Total	Credits
I SEMESTER								
III	20PCS101	Design & Analysis of Algorithms	5	3	30	70	100	5
	20PCS102	Internet of Things	5	3	30	70	100	5
	20PCS103	Advanced Database Management System	5	3	30	70	100	4
	20PCS104	Data Mining and Warehousing	5	3	30	70	100	4
	20PCS105	Programming Lab - I: Design & Analysis of Algorithms &Advanced DBMS	5	3	40	60	100	4
	20PCS106	Programming Lab –II: Internet of Things	5	3	40	60	100	4
II SEMESTER								
III	20PCS207	Advanced Java Programming	5	3	30	70	100	5
	20PCS208	Advanced Networks	4	3	30	70	100	5
	20PCS209	Cloud and Big Data Analytics	4	3	30	70	100	4
	20PCS210	Programming Lab -III : Advanced Java Programming	5	3	40	60	100	4
	20PCS211	Programming Lab-IV : Networks	5	3	40	60	100	4
	20PCS2P1	Pilot Project – I	2	-	-	100	100	2
	20PCS2EX	Elective – I	4	3	30	70	100	4
IV	20PCS2N1/ 20PCS2N2	Non Major Elective: Multimedia Packages Lab /Web Designing Lab	1	3	-	100	100	2

Part	Subject Code	Title of the paper	Duration in Hrs per week	Examination				
				Hours	CIA	ESE	Total	Credits
III SEMESTER								
III	20PCS312	Advanced Python Programming	4	3	30	70	100	5
	20PCS313	Android Programming	5	3	30	70	100	5
	20PCS314	Network Security & Cryptography	5	3	30	70	100	4
	20PCS315	Programming Lab-V : Advanced Python Programming	5	3	40	60	100	4
	20PCS316	Programming Lab-VI: Android Programming	5	3	40	60	100	4
	20PCS3EX	Elective-II	5	3	30	70	100	4
IV SEMESTER								
III	20PCS4P2	Project Work and Viva voce (Individual)	-	-	-	200	200	8
TOTAL MARKS							2200	90

ELECTIVE I

S.No	SUBJECT CODE	TITLE
1	20PCS2E1	SOFTWARE AGENTS
2	20PCS2E2	COMPUTING TECHNOLOGIES
3	20PCS2E3	MOBILE COMPUTING

ELECTIVE II

S.No	SUBJECT CODE	TITLE
1	20PCS3E1	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
2	20PCS3E2	MACHINE LEARNING
3	20PCS3E3	EMBEDDED SYSTEMS

Bloom's Taxonomy Based Assessment Pattern**K1-Remember; K2- Understanding; K3- Apply; K4-Analyze; K5- Evaluate****1. Theory Examination: 70 Marks****(i)Test- I & II and ESE:**

Knowledge Level	Section	Marks	Description	Total
K1 & K2 (Q1 – 10)	A (Q1 – 5 MCQ) (Q6 – 10 Define/Short answer)	10x1=10	MCQ	70
			Define	
K3 (Q11 – 15)	B (Either or pattern)	5x4=20	Short Answers	
K4 & K5 (Q16 – 21)	C (Q16 is Compulsory & Q17 – 21 answer any 3)	4x10=40	Descriptive/ Detailed	

2. Practical Examinations: 100 Marks

Knowledge Level	Section	Marks	Total
K3	Record work & Practical	60	100
K4		40	
K5			

Note:

- Question paper pattern for Non-Major Elective(NME) Practical Paper (Maximum Marks: 100 Marks)

Two questions from Computer Science Practical - 80 marks
Marks for Record - 20 marks

3. Components of Continuous Assessment

Components		Calculation	CIA Total
Test 1	70	$\frac{70+70+60+10}{7}$	30
Test 2 (Model)	70		
Assignment, Seminar/ Tutorial, Knowledge Enhancement	3 * 20		
Information Acquisition	10		

Programme Outcomes

- PO1.** Develop core competence in computer science and to take up a career in the IT industry as well as to impart the analytical skills in research and development.
- PO2.** Ability to instill various thrust areas of computer science with sound knowledge of theory and hands-on practical skills.
- PO3.** Ability to design, implement and evaluate the principles of computer science and apply these in the multidisciplinary environments to manage project.
- PO4.** Ability to analyze the local, global needs of computing in par with IT industry and society.
- PO5.** Develop innovative computing through information technology solutions and impart entrepreneurial skills.

Programme Specific Outcomes

- PSO1:** Ability to understand, analyze and develop computer programs in the areas related to various domains for efficient design of computer-based systems of varying complexity.
- PSO2:** To provide foundation for research into the theory and practice of programming and design of computer based systems.
- PSO3:** Able to apply the knowledge gained during the course of the program from advanced computing, in particular to identify, formulate and solve real life complex problems faced in society.
- PSO4:** To Enhance skills and adapt new computing technologies for attaining professional excellence and set a career path.
- PSO5:** Ability to take up higher studies, Research & Development and Entrepreneurships in the modern computing environment.

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS101	Title	Batch :	2020-2022
		Design & Analysis of	Semester	I
Hrs/Week:	5	Computer Algorithms	Credits:	5

Course Objective

On successful completion of the course the students should understand the various design and analysis of various data structure algorithms.

Course Outcomes (CO)

K1	CO1	To remember worst case running times of algorithms using asymptotic analysis
K2	CO2	To understand divide-and-conquer paradigm, dynamic-programming paradigm, greedy paradigm and branch and bound strategies and apply them for the appropriate problems
K3	CO3	To deploy different data structures
K4	CO4	To analyze major graph algorithms and to employ graphs to model engineering problems
K5	CO5	To validate divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm

CONTENTS		Hours
UNIT I Introduction: algorithm definition and specification – performance analysis –Elementary Data structures:- <i>stacks and queues</i> – <i>trees</i> – dictionaries – priority queues – sets and disjoint set union – graphs – Basic traversal and search techniques – Techniques for Binary Tree – Techniques for Graphs: Breadth First Search and Traversal, Depth First Search and Traversal.		13
UNIT II Divide – and – conquer: - General method – binary search – merge sort – quick sort –The Greedy method: - General method – knapsack problem – minimum cost spanning tree – single source shortest path.		13
UNIT III Dynamic Programming: General method – multistage graphs – all pair shortest path – optimal binary search trees – 0/1 Knapsack – <i>traveling salesman problem</i> – flow shop scheduling.		13
UNIT IV Backtracking: General method – 8-Queens problem – sum of subsets – graph coloring – Hamiltonian cycles – knapsack problem.		13

UNIT V	
Branch and bound: The method – Least Cost (LC) Search – The 15 puzzle: An Example – Control abstractions for LC Search – Bounding – FIFO Branch and Bound – LC Branch and Bound – 0/1 Knapsack problem – LC Branch and Bound solution – FIFO Branch and Bound solution – Traveling salesperson.	13
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment, Brain storming	
Text Books 1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, “Computer Algorithms”, 2 nd Edition, Galgotia Publications, 2008.	
Reference Books 1. Ellis Horowitz, Sartaj Sahni, “Fundamentals of data structures”, Reprinted Edition, Galgotia Publications, 2015. 2. Alfred V.Aho, John E.Hopcroft & Jeffery D Ullman, “Data structures and Algorithms”, Reprinted, 2009 Edition, PHI learning pvt Ltd 3. Adam Drozdek, “Data Structures and Algorithms in C++”, 4 th Edition, Vikas publishing house, NewDelhi, 2012.	

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	H	H	M	H	H
C02	H	M	M	H	H
C03	H	H	H	M	M
C04	M	H	M	H	M
C05	M	H	H	H	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: S.Sharmila	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS102	Title	Batch :	2020-2022
		Internet of Things	Semester	I
Hrs/Week:	5		Credits:	5

Course Objective

On successful completion of this course, students will understand the fundamentals of Internet of Things, IoT Protocols, built a small low cost embedded system using Raspberry Pi and to apply the concept of Internet of Things in the real world scenario.

Course Outcomes (CO)

K1	CO1	To remember web services to access/control IoT devices
K2	CO2	To understand the portable IoT using Raspberry Pi
K3	CO3	To deploy use of IoT application and connect to the cloud
K4	CO4	To analyze various protocols for IoT
K5	CO5	To evaluate Real World IoT Design Constraints, Industrial Automation in IoT.

CONTENTS	Hours
UNIT I Introduction to IoT: Introduction – Physical Design – Logical Design – IoT Enabling Technologies – IoT Levels & Deployment Templates – Domain Specific IoTs. IoT and M2M: M2M – Difference between IoT and M2M – SDN and – NFV for IoT.	13
UNIT II IoT System Management with NETCONF – YANG: Need for IoT Systems Management - Simple Network Management Protocol – Network Operator Requirements – NETCONF – YANG. IoT Platforms Design Methodology: Introduction – Design Methodology. IoT Architecture: M2M high-level ETSI Architecture – IETF Architecture for IoT.	13
UNIT III IoT Reference model – Domain model - Information model - Functional model – Communication model - IoT Reference Architecture. IoT Protocols: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols - SCADA and RFID Protocols – Protocols – IEEE 802.15.4 – BACNet Protocol - Modbus – Zigbee Architecture - Network Layer – 6LowPAN – CoAP – Security.	13
UNIT IV Building IoT with RASPBERRY Pi and ARDUINO: Building IoT with RASPBERRY Pi – IoT Systems – Logical Design using Python – IoT Physical Devices and Endpoints – IoT Device – Building blocks – Raspberry Pi – Board – Linux on Raspberry Pi – Raspberry Pi Interfaces - Programming Raspberry Pi with Python – <i>Other IoT Platforms</i> - Arduino	13
UNIT V Case studies: Home Automation – Cities – Environment – Agriculture – Productivity	13

Application. Tools for IoT: Chef – Chef Case Studies – Puppet – Puppet Case Study. <i>Amazon Web Services for IoT.</i>	
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment	
Text Book 1. Arshdeep Bahga , Vijay Madiseti , “Internet of Things –A hands –on pproach”,Universities Press , 2015.	
Reference Books 1. Dieter Uckelmann , Mark Harrison, Michahelles,Florian(Eds), “Architecting the Internet of Things”, Springer, 2011. 2. Honbo Zhou, “The Internet of Things in the cloud: A Middleware Perspective”, CRC Press, 2012. 3. Jan Holler ,Vlasios Tsiatsis ,Catherine Mulligan , Stamatis , Karnouskos Stefan Avesand , David Boyle , “From Machine – to- Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Elsevier 2014. 4. Olivier Hersent, David Boswarthick , Omar Elloumi – “The Internet of things – Key applications and Protocols”,Wiley 2012.	

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	H	H	M	H	H
C02	H	M	M	H	L
C03	M	H	H	H	M
C04	M	H	H	M	H
C05	H	M	M	H	L

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name:M. Dhavapriya	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name:Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS103	Title	Batch :	2019-2021
		Advanced Database	Semester	I
Hrs/Week:	5	Management Systems	Credits:	4

Course Objective

On successful completion of the course, the students should understand the concepts and terminology related to DBMS and various Databases.

Course Outcomes (CO)

K1	C01	To remember the underlying principles of Relational Database Management System.
K2	C02	To understand relational data model and ER with EER mapping
K3	C03	To deploy the concepts of various databases and its applications
K4	C04	To the design and implement various Databases with normalization
K5	C05	To evaluate and develop a database application system as part of a team

CONTENTS		Hours
UNIT I INTRODUCTION AND CONCEPTUAL MODELING: Database and database users – Characteristics of the Database Approach – Advantages of Using the DBMS Approach - Data Models, Schemas, and Instances - Three-Schema Architecture and Data Independence Database Languages and Interfaces The Database System Environment Centralized and Client/Server Architectures for DBMSs -Classification of Database Management Systems - data modeling using Entity-Relationship model – Enhanced Entity-Relationship model.		13
UNIT II THE RELATIONAL DATA MODEL: Relational model: Concepts, Constraints, Languages, Design and Programming – Relational data model and relational database constraints – relational algebra - relational database design by ER and EER-to-relational mapping – SQL – schema definition, constraints, Queries and Views.		13
UNIT III DATABASE DESIGN THEORY AND NORMALIZATION: Basics of Functional Dependencies and Normalization for Relational Databases - Informal Design Guidelines for Relation Schemas - Functional Dependencies - Normal Forms Based on Primary Keys - General Definitions of Second and Third Normal Forms - Boyce-Codd Normal Form Multivalued Dependency and Fourth Normal Form Join Dependencies and fifth normal form. Indexing Structures for Files and Physical Database Design: Types of Single - Level Ordered Indexes - Multilevel Indexes - Dynamic Multilevel Indexes Using B-Trees and B+ -Trees Indexes on Multiple Keys - Other Types of Indexes – Some General Issues Concerning Indexing - Physical Database Design in Relational Databases		13
UNIT IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL: Introduction to Transaction Processing - Transaction and System Concepts – Desirable Properties of Transactions - Characterizing Schedules Based on Recoverability – Characterizing Schedules Based on Serializability - Transaction Support in SQL Concurrency Control Techniques: Two-Phase Locking Techniques for Concurrency Control - Concurrency Control Based on Timestamp Ordering Multiversion Concurrency		13

Control Techniques - Validation (Optimistic) Techniques and Snapshot Isolation - Concurrency Control - Granularity of Data Items and Multiple Granularity Locking – Using Locks for Concurrency Control in Indexes - Other Concurrency Control Issues.	
UNIT V ADVANCED MODELING: Distributed Database Concept Distributed Database Concepts Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design - Overview of Concurrency Control and Recovery in Distributed Databases Overview of Transaction Management in Distributed Database – Query Processing and Optimization in Distributed Databases Types of Distributed Database Systems - Distributed Database Architectures - Distributed Catalog Management. NoSQL Databases and Big Data Storage Systems: Introduction to NoSQL Systems - The CAP Theorem – Document Based NoSQL Systems and MongoDB - NoSQL Key-Value Stores – Column Based or Wide Column NoSQL Systems - NoSQL Graph Databases and Neo4j.	13
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment, Activity, Case study	
Text Books 1. Ramez Elmasri and Shamkant B.Navathe, “Fundamentals of Database Systems”, 7 th Edition, Pearson, 2017.	
Reference Books 1. Silberschatz, H. Korth and S. Sudarshan, “Database System Concepts”, 6th Edition, McGraw-Hill International, 2011. 2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, “Database System The Complete Book”, 2 nd Edition, Pearson 2008.	

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	M	H	H	H	H
C02	M	M	H	H	H
C03	M	H	H	H	M
C04	M	H	M	M	H
C05	H	H	M	M	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: M. Dhavapriya	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS104	Title	Batch :	2020-2022
		Data Mining and Warehousing	Semester	I
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the students should understand the concept of data mining, classification and clustering techniques, Association rules and data warehousing.

Course Outcomes (CO)

K1	CO1	To remember the basic concepts of Data Mining and Data Warehouse Techniques
K2	CO2	To get the idea of raw data to make it suitable for various data mining algorithms
K3	CO3	To execute and measure interesting patterns from different kinds of databases
K4	CO4	To analyze the techniques of clustering, classification, association finding, feature selection and visualization to real world data
K5	CO5	To evaluate the performance of different data-mining algorithms

CONTENTS		Hours
UNIT I Introduction: Basic data mining tasks - <i>Data Mining versus Knowledge discovery in databases</i> – 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.		13
UNIT II Classification: Introduction – Statistical – based algorithms - distance – based algorithms – decision tree - based algorithms - neural network – based algorithms –rule – based algorithms – combining techniques		13
UNIT III Clustering: Introduction – Similarity and distance measures – Outliers. Hierarchical algorithms: Agglomerative algorithms – Divisive clustering. Partitioned algorithms: Minimum Spanning tree – Squared error clustering algorithm – K – means clustering – Nearest neighbor algorithm – PAM algorithm – Bond energy algorithm – Clustering with genetic algorithm – Clustering with neural networks.		13
UNIT IV Association rules: Introduction - large item sets. Basic algorithms: Apriori algorithm – Sampling algorithm – Partitioning. Parallel & distributed algorithms: Data parallelism – Task parallelism. Comparing approaches, Incremental rules. Advanced association rules techniques: Generalized association rules – Multiple level association rules – Quantitative association rules – Using multiple minimum supports – Correlation rules. Measuring the quality of rules.		13

UNIT V 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 – multifact star schema or snow flake schema–OLAPTOOLS–State of the market – OLAP TOOLS and the internet. 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. <i>Applications of data warehousing and data mining in government</i>	13
Total Hours	65
*Italicized texts are for self study	
Power point Presentations, Seminar , Assignment, Case study	
Text Books 1. Margaret H. Dunham, “Data Mining introductory and advanced topics”, 3 rd Edition, Pearson Education, 2008. 2. Prabhu C.S.R, “Data Warehousing concepts, techniques, products and a applications”, 3 rd Edition, PHI, 2000.	
Reference Books 1. Jiawei Han & Micheline Kamber, “Data Mining Concepts & Techniques”, 2 nd Edition, Academic Press, 2006. 2. Arun K.Pujari, “Data Mining Techniques”, Revised Edition, Universities Press (India) Pvt.Ltd, 2003.	

MAPPING

PSO CO \	PSO1	PSO2	PSO3	PSO4	PSO5
C01	H	H	H	H	M
C02	H	M	H	M	H
C03	M	H	M	M	M
C04	M	H	H	H	H
C05	M	H	H	H	L

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Yasodha Signature:	Name: Dr.M. Sakthi Signature:	Name: K. Srinivasan Signature:	Name: Dr. R. Muthukumaran Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS105	Title	Batch :	2020-2022
		Programming Lab-I: Design and Analysis of Algorithms & Advanced DBMS	Semester	I
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course, the students should understand the concepts of various data structures and advanced database concepts.

Course Outcomes (CO)

K3	CO1	To implement appropriate data structure for given contextual problem
K4	CO2	To analyze complexities of various data structure algorithms
K5	CO3	To prove appropriate data structure is applied to specified problem definition

Design and Analysis of Algorithm.

1. Write a program to implement the concept of Towers of Hanoi.
2. Write a program to implement the concept of Permutation Generator.
3. Write a program to implement the concept of Circular Queue .
4. Write a program to implement the concept of Stack using Linked list.
5. Write a program to implement the concept of Tree traversal(inorder, preorder, postorder).
6. Write a program to implement the concept of Graph traversal using Breadth first search.
7. Write a program to implement the concept of Graph traversal using Depth first search.
8. Write a program to implement the concept of Binary search.
9. Write a program to implement the concept of Merge sort using divide and conquer.
10. Write a program to implement the concept of Quick sort.
11. Write a program to implement the concept of insertion of elements into heap.
12. Write a program to implement the concept of Knapsack using Greedy Method.
13. Write a program to implement the concept of Minimum Cost Spanning tree.
14. Write a program to implement the concept of All pairs shortest path.
15. Write a program to implement the concept of Traveling sales man problem.
16. Write a program to implement the concept of Sum of Subsets.

Advanced Concepts of DBMS

1. Creation of a database and writing SQL queries to retrieve information from the database.
2. Creating an Employee database to set various constraints.
3. Creating relationship between the databases.
4. Is the Courses table in 4NF? If answer to yes, say why. If not, decompose the table such that the resulting tables are in 4th normal form. For each of the resulting tables, give the table name, column names, primary keys, and foreign keys.
5. Write the query to create the views
6. Create a Concept design with E-R Model for "Roadway Travels".
7. Consider the ER-schema generated for the UNIVERSITY database .
8. WAP to implement insertion, deletion, display and search operation in m-way B tree for the given data as integers (Test the program for m=3, 5, 7)
9. Create the B+ tree that would result from inserting a data entry with key 3 into the original tree. How many page reads and page writes does the insertion require?
10. Show the B+ tree that would result from deleting the data entry with key 8 from the

original tree, assuming that the left sibling is checked for possible redistribution.

11. Write a MongoDB query to display all the documents in the Library

12. Express the following Cypher query for the following : Find actors born in 1965 or later • Return actor names and years they were born • Sort the result using years (in descending order) and then names (in ascending order)

13. Assume a graph consisting of students, courses, projects, rooms, and relationships between. The nodes and relationships are specified in Cypher query.

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	M	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: S. Sharmila M. Meena krithika	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS106	Title	Batch :	2020-2022
		Programming Lab –II:	Semester	I
Hrs/Week:	5	Internet of Things	Credits:	4

Course Objective

On successful completion of the course, the students should be able to design & develop IOT Devices.

Course Outcomes (CO)

K3	C01	To implement IOT to different applications
K4	C02	To analyze the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
K5	C03	To design IoT applications in different domain and be able to analyze their performance

1. Design an IOT application using Arduino to measure temperature and humidity in digital / analog mode.
2. Design an IOT application using Arduino to illustrate the working of ultrasonic sensor.
3. Design an IOT application using Arduino to illustrate the working of touch sensor.
4. Design an IOT application using Arduino to illustrate the working of vibration sensor.
5. Design an IOT application using Arduino to illustrate the working of IR sensor.
6. Design an IOT application using Arduino to illustrate the working of PIR sensor.
7. Design an IOT application using Arduino to illustrate the working of ultrasonic sensor with LED.
8. Design an IOT application using Arduino to illustrate the working of touch sensor with buzzer.
9. Design an IOT application using Arduino to illustrate the working of LED in digital and analog mode.
10. Design an IOT application using Arduino to illustrate the working of stepper motor.
11. Design an IOT application to allocate IP address to NodeMCU using WiFi.
12. Design an IOT application using WiFi to demonstrate data communication with MQTTFx.
13. Design an IOT application using WiFi to demonstrate data communication with Windows application (.NET).
14. Design an IOT application using ThingSpeak to demonstrate data communication with cloud.

MAPPING

CO \ PSO	PS01	PS02	PS03	PS04	PS05
C01	M	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: M. Dhavapriya	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

SEMESTER II

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS207	Title	Batch :	2020-2022
		Advanced Java Programming	Semester	II
Hrs/Week:	5		Credits:	5

Course Objective

On successful completion of this course, the students will be able to understand the advanced Java concepts, to develop Java based applications and hands on practices by applying these advanced concepts to implement in web based applications.

Course Outcomes (CO)

K1	CO1	To recollect different classes, constructors and methods of Swing components
K2	CO2	To get an idea to construct an enterprise application using Java Beans
K3	CO3	To deploy RMI programs for real world applications
K4	CO4	To analyze session tracking using Session objects and Cookies
K5	CO5	To validate server side java programs using Servlets and JSP

CONTENTS		Hours
UNIT I Java Swings: JPanel-JFrame-JApplet-JSplitPane-JTabbedPane-JViewport-JMenu-Items and Labels - JTextField - JTextArea - JButtons - JButton Classes - JCheckBoxes - JRadioButton-JComboBoxes-JList.		13
UNIT II Advanced Components: JTree - JTable - JInternalFrame - JDesktopPane -JTextPane - JProgressbar.		13
UNIT III Java Beans: Introduction to Java Bean-Advantages of a Java Bean-Application Builder tools-The Bean Developer Kit (BDK)-Jar files-Introspection-Developing a Simple Bean-Using Bound Properties-Using Bean Info Interface-Constrained Properties-Persistence-Customizers-Java Bean API.		13
UNIT IV Servlet Overview and Architecture: Movement to Server Side Java-Practical Applications for Java Servlets-Java Servlet Alternatives-Reason to use Java Servlets-Java Server Architecture – Servlet Basics-The Lifecycle of Servlet-A Basic Servlet. Servlet Chaining: Definition for Servlet Chaining-Uses of Servlet Chains-A Practical example using Servlet Chaining-Servlets and JDBC-Two Tier and Three Tier Database access models-JDBC Servlet-Session Tracking-Using Cookies-Using Session Objects.		13
UNIT V Java Server Page (JSP): Introduction-Server-side programming-Life Cycle of JSP- To create and run JSP- Architecture of JSP-Scripting tag Elements- Implicit Object- Beans - Conditions - Directives - Declarations – Implicit Variables -Expressions. RMI (Remote Method Invocation): Introduction - RMI Architecture-Bootstrapping and RMI Registry - The RMI Compiler - Object Specialization and Parameter Passing - A Simple example.		13
Total Hours		65
<i>*Italicized texts are for self study</i>		
Power point Presentations, Seminar , Assignment, Brain storming		

Text Books

1. Herbert Schildt, “Java-2, The Complete Reference”, 11th Edition, Tata McGraw Hill, 2019.
2. Jim Keogh, “The Complete Reference J2EE”, Tata McGraw Hill, 2007.
3. KogentSolutionss, “Java Server Programming Java EE7 Black Book”, Dreamtech Press, 2014.
4. Sams Series, James GoodWill, “Developing Java Servlets”, 1st Edition, SAMS Techmedia, 2004.
5. Sam Series, “Java RMI”, Tata McGraw Hill, 2006.

Reference Books

1. Brian Cole, Robert Eckstein, James Elliott, Marc Loy, David Wood, “Java Swing”, 2nd Edition, O’Reilly Publishers, 2002.
2. Stephen Potts, Mike Kopack, “Web Services”, Kindle Edition, Pearson Education, 2004.

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H
CO2	M	M	H	M	H
CO3	H	H	H	H	M
CO4	H	H	H	H	H
CO5	H	H	M	H	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Arul kumar	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS208	Title	Batch :	2020-2022
		Advanced Networks	Semester	II
Hrs/Week:	4		Credits:	5

Course Objective

On successful completion of the course the students should gain in-depth knowledge of Internet protocols and their functionalities.

Course Outcomes (CO)

K1	CO1	To recollect OSI and TCP/IP layers and their tasks. Interpret and explain physical, logical and port addresses
K2	CO2	To comprehend Standard Ethernet and Mapping techniques
K3	CO3	To deploy Logical addressing and discuss the format of Ipv4 and Ipv6 addresses
K4	CO4	To analyze the problems and solutions associated with delivery and forwarding of packets
K5	CO5	To present knowledge on Mobile IP, Client-Server interactions

CONTENTS		Hours
UNIT I Introduction and overview: TCP/IP internet, Internet Service: Application Level, Network Level. Network Technologies: Two Approaches To network Communication-Wide Area and Local Area Networks-Hardware addressing scheme, Ethernet (IEEE802.3),WiFi (IEEE 802.11),ZigBee (IEEE 802.15.4). Internetworking Concept and Architectural Model. Protocol Layering: Introduction-Needs-Conceptual Layer-Functionality –X.25 and ISO Model – TCP/IP 5-Layer Reference Model -Locus of intelligence-principle-.Layering in Mesh Networks-Two important boundaries in the TCP/IP Model-Cross Layer Optimizations-Basic idea behind Multiplexing and De-Multiplexing.		11
UNIT II Internet Addressing: Introduction-Universal Host Identifiers-The Original IPv4-Classful Addressing Scheme-Dotted Decimal Notation Used With IPv4 -IPv4 Subnet Addressing-Fixed Length IPv4 Subnets-Variable-Length IPv4 Subnets-Implementation Of IPv4 Subnets With Masks-IPv4 Subnet Mask Representation And Slash Notation-The Current Classless IPv4 Addressing Scheme-IPv4 Address Blocks And CIDR Slash Notation-A Classless IPv4 Addressing Example-IPv4 CIDR Blocks Reserved For Private Networks-The IPv6 Addressing Scheme-IPv6 Colon Hexadecimal Notation -IPv6 Address Space Assignment-Embedding IPv4 Addresses In IPv6 For Transition-IPv6 Unicast Addresses and / 64-IPv6 Interface Identifiers And MAC Addresses -IP Addresses , Hosts, And Networks Connections -Special Addresses-Weaknesses In Internet Addressing-Internet Address -Assignment And Delegation of Authority-An Example IPv4 Address Assignment. Mapping Internet Addresses to Physical Addresses (ARP): Introduction-The Address Resolution Problem-Two Types of Hardware Addresses-Resolution Through Direct Mapping-Resolution in a Direct – Mapped Network-IPv4 Address Resolution Through Dynamic Binding-ARP Cache Timeout-ARP Refinements-Relationship of ARP To Other Protocols-ARP Implementation-ARP Encapsulation and Identification-ARP Message Format-Automatic ARP Cache Revalidation-Reverse Address Resolution (RARP)-Proxy ARP-IPv6 Neighbor Discovery. Internet Protocol : Connectionless Datagram Delivery(IPV4 , IPV6): Introduction-A		11

Virtual Network-Internet Architecture and Philosophy-Principles Behind the Structure-Connectionless Delivery System Characteristics-Purpose and Importance of The Internet Protocol-The IP Datagram-Datagram Type of Service and Differentiated Services-Datagram Encapsulation-Datagram Size, Network MTU, and Fragmentation-Datagram Reassembly-Header Fields Used For Datagram Reassembly-Time to Live (IPv4) and Hop Limit (IPv6)-Optional IP Items-Options Processing during Fragmentation-Network Byte Order.	
UNIT III Internet Protocol : Forwarding IP Datagrams: Introduction-Forwarding in an Internet-Direct and Indirect Delivery-Transmission Across a Single Network-Indirect Delivery-Table-Driven IP Forwarding-Next - Hop Forwarding-Default Routes and A Host Example-Host-Specific Routes-The IP Forwarding Algorithm -Longest-Prefix Match Paradigm-Forwarding Tables and IP Addresses-Handling Incoming Datagram-Forwarding In The Presence Of Broadcast And Multicast-Software Routers And Sequential Lookup-Establishing Forwarding Tables. Internet Protocol: Error and Control Messages(ICMP)-Introduction-The Internet Control Message Protocol -Error Reporting Vs. Error Correction-ICMP Message Delivery-Conceptual Layering-ICMP Message Format-Example ICMP -Message Types Used With IPv4 And IPv6-Testing Destination Reachability And Status (Ping)-Echo Request And Reply Message Format-Checksum Computation And The IPv6 Pseudo-Header -Reports Of Unreachable Destinations-ICMP Error Reports Regarding Fragmentation-Route Change Requests From Routers-Detecting Circular or Excessively Long Routes-Reporting Other Problems-Older ICMP Messages Used At Startup. User Datagram Protocol(UDP):Introduction-Using a Protocol Port as an Ultimate Destination-The User Datagram Protocol-UDP Message Format-UDP Checksum Computation And The Pseudo-Header-IPv4 UDP Pseudo-Header Format-IPv6 UDP Pseudo-Header Format-UDP Encapsulation And Protocol Layering-Layering and The UDP Checksum Computation-UDP Multiplexing, Demultiplexing, and Protocol Ports-Reserved and Available UDP Port Numbers.	10
UNIT IV Reliable Stream Transport Service (TCP): Needs-properties-Reliability-Sliding Window paradigm-TCP Layering, ports, connection and end points-passive and active open-segments, streams and sequence number-variable window size and flow control-TCP segment format, options, checksum, acknowledgment, retransmission and timeouts. Routing among Autonomous Systems (BGP):Introduction-The Scope of a Routing Update Protocol-Determining A practical Limit on Group Size-A Fundamental Idea : Extra Hops-Autonomous System Concept-Exterior Gateway Protocols and Reachability-BGP Characteristics-BGP Functionality And Message Types-BGP Message Header-BGP OPEN Message-BGP UPDATE Message-Compressed IPv4 Mask-Address Pairs-BGP Path Attributes-BGP KEEPALIVE Message-Information from the Receiver's Perspective-The Key Restriction of Exterior Gateway Protocols-The Internet Routing Architecture and Registers-BGP NOTIFICATION Message-BGP Multiprotocol Extensions for RIPv6 -Multiprotocol Reachable NLRI Attribute-Internet Routing And Economics. Label Switching , Flows , and MPLS: Introduction-Switching Technology-Flows and Flow Setup-Large Networks , Label Swapping, and Paths-Using Switching with IP-IP Switching Technologies and MPLS-Labels And Label Assignment-Hierarchical Use of MPLS and a Label Stack-MPLS Encapsulation-Label Semantics-Label Switching Router-Control Processing and Label Distribution-MPLS and Fragmentation-Mesh Topology and Traffic Engineering.	10

Packet Classification: Introduction-Motivation for Classification-Classification Instead of Demultiplexing-Layering When Classification is used-Classification Hardware and Network Switches-Switching Decisions and VLAN Tags-Classification Hardware-High-Speed Classification and TCAM-The Size or a TCAM-Classification-Enabled Generalized Forwarding.	
UNIT V Network Visualization : VPNs , NATs and Overlays- Introduction –Virtualization-Virtual Private Networks (VPNs)-VPN Tunneling and IP-in-IP Encapsulation-VPN Addressing and Forwarding-Extending VPN Technology to Individual Hosts-Using A VPN With Private IP Addresses-Network Address Translation (NAT)-NAT Translation Table Creation-Variant of NAT-An Example of NAT Translation-Interaction Between NAT And ICMP-Interaction Between NAT and Applications-NAT In The presence of Fragmentation-Conceptual Address Domains-Linux, Windows, and MAC Versions of NAT-Overlay Networks-Multiple Simultaneous Overlays. Bootstrap And Autoconfiguration (DHCP , NDP , IPv6 – ND): Introduction-History of IPv4 Bootstrapping-Using IP to Determine An IP Address-DHCP Retransmission And Randomization-DHCP Message Format-The Need For Dynamic Configuration-DHCP Leases and Dynamic Address Assignment-Multiple Addresses And Relays-DHCP Address Acquisition States-Early Lease Termination-Lease Renewal States-DHCP Options and Message Type-DHCP Option Overload-DHCP and Domain Names-Managed and Unmanaged Configuration-Managed and Unmanaged Configuration for IPv6-Ipv6 Configuration Options and Potential Conflicts-IPv6 Neighbor Discovery Protocol (NDP)-ICMPv6 Router Solicitation Message -ICMPv6 Router Advertisement Message-ICMPv6 Neighbor Solicitation Message-ICMPv6 Neighbor Advertisement Message-ICMPv6 Redirect Message. Electronic Mail (SMTP,POP,IMAP,MIME): Introduction -Electronic Mail-Mailbox Names And Aliases-Alias Expansion And Mail Forwarding-TCP/IP Standards For Electronic Mail Service-Simple Mail Transfer Protocol (SMTP)-Mail Retrieval And Mailbox Manipulation Protocols-The MIME Extensions For Non-ASCII Data-MIME Multipart Messages. Voice and Video Over IP (RTP,RSVP,QoS): Introduction -Digitizing and Encoding-Audio and Video Transmission and Reproduction-Jitter and Playback Delay-Real-time Transport Protocol(RTP)-Streams, Mixing, And Multicasting-RTP Encapsulation-RTP Control Protocol (RTCP)-RTCP Operation-IP Telephony and Signaling-Quality of service Controversy-QoS, Utilization, and Capacity-Emergency Services and Preemption-IntServ and Resource Reservation-DiffServ And Per-Hop Behavior-Traffic Scheduling-Traffic policing and Shaping.	10
Total Hours	52
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar ,Assignment, Experience Discussion, Brain storming	
Text Book 1. Douglas E. Comer, “Internetworking with TCP/IP Principles, protocols and Architecture” -Volume I,6 th Edition, 2017.	
Reference Books 1. Douglas E. Comer, “Internetworking with TCP/IP Volume I”, Prentice Hall, 2015. 2. Douglas E. Comer, David L.Stevens, “Internetworking with TCP/IP Volume II”, Prentice Hall, 2010. 3. Uyles Black, “TCP/IP & Related Protocols”, Tata McGraw-Hill, 2005. 4. Menezes.A, Van Oorschot.P and Vanstone. S, “Hand Book of Applied Cryptography”,CRC Press, 2011.	

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	H	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	H	M
C04	M	H	H	M	H
C05	M	M	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: R. Nandha Kumar	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS209	Title	Batch :	2020-2022
		Cloud and Big Data Analytics	Semester	II
Hrs/Week:	4		Credits:	4

Course Objective

On successful of this course, students will understand the concept of Virtualization and design of cloud Services and will be able to analyze the big data using intelligent techniques.

Course Outcomes (CO)

K1	C01	To remember the fundamental concepts of big data	
K2	C02	To understand the applications using Map Reduce Concepts	
K3	C03	To deploy the concept of Virtualization and design of cloud Services	
K4	C04	To analyze the big data using intelligent techniques	
K5	C05	To present the broad perceptive of cloud architecture and model	
CONTENTS			Hours
UNIT I Cloud Architecture and Mode: Technologies for Network-Based System – System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture. Cloud Models:-Characteristics – Cloud Services – Cloud Models (IaaS,PaaS,SaaS) – Public vs Private Cloud – Cloud Solutions – Cloud ecosystem – Service Management – Computing on demand, Virtualization : Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures - Tools and Mechanism – Virtualization of CPU, Memory I/O Devices - Virtual Clusters and Resource Management – Virtualization for Data-Center Automation.			11
UNIT II Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources. Programming Model: Parallel and Distributed Programming Paradigms – MapReduce, Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications – Programming Support – Google App Engine, Amazon AWS – Cloud Software Environments – Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim.			11
UNIT III Getting Started with Big Data: Introduction – Grasping the Fundamentals of Big Data-Examining Big Data Types – Old Meets New - Technology Foundation for Big Data : Digging into Big Data Technology Components – Virtualization and How It Supports Distributed Computing – Examining the Cloud and Big Data – Big Data Management: Operational Databases - Map Reduce Fundamentals – Exploring the World of Hadoop – The Hadoop Foundation and Ecosystem – Appliances and Big Data Warehouses.			10
UNIT IV Analytics and Big Data: Defining Big Data Analytics – Understanding Text Analytics and			10

Big Data – Customized Approaches for Analysis of Big Data. Big Data Implementation: Integrating Data Sources – Dealing with Real-Time Data Streams and Complex Event Processing – Operationalizing Big Data – Applying Big Data within Your Organization – Security and Governance for Big Data Environments.	
UNIT V Big Data Solutions in the Real World: The Importance of Big Data to Business – Analyzing Data in Motion – Improving Business Process With Big Data Analytics. The Part of Tense: Ten Big Data Best Practices-Ten Great Big Data Resources – Ten Big Data Do's and Don'ts.	10
Total Hours	52
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar ,Assignment, Experience Discussion, Brain storming	
Text Books 1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012 from Parallel (Unit I – II). 2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman, “Big Data for Dummies” A Wiley Brand Publications.2013. (Unit III–V). 3. Jeffrey Stanton, “An Introduction to Data Science” Syracuse University, 2012(Case Study).	
Reference Books 1. Michael Miller, ”Cloud Computing”, Que Publishing , 2008 2. Nick Antonopoulos, Cloud Computing, Springer Publications, 2010.	

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	M	M	M	M	H
C02	M	H	H	M	M
C03	H	H	H	M	M
C04	H	M	M	M	H
C05	M	M	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: M. Dhavapriya	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS210	Title	Batch :	2020-2022
		Programming Lab -III :	Semester	II
Hrs/Week:	5	Advanced Java Programming	Credits:	4

Course Objective

On successful completion of the course the students should understand the advanced Java concepts such as Swing, Servlets, Web Services, Beans, RMI and JSP.

Course Outcomes (CO)

K3	CO1	To implement server side validations with session and database using JDBC
K4	CO2	To analyze web application using Servlet, Java Server Pages and RMI
K5	CO3	To validate Swing component events in an application

Swing:

1. Demonstrate Swing components – JLabel, JTextField, JTextArea and JButton
2. Demonstrate Swing component - JMenu
3. Demonstrate Swing component - JTree
4. Demonstrate Swing component - JTable
5. Demonstrate Swing component - JProgressBar
6. Demonstrate Swing component – JScrollPane
7. Demonstrate Swing component – JTabbedPane
8. Demonstrate Swing component - JComboBox
9. Demonstrate Swing component - JRadioButton
10. Demonstrate Swing component - JCheckBox
11. Demonstrate Swing component – JList

Servlet:

12. Demonstrate Generic Servlet.
13. Demonstrate HTTP Servlet
14. Demonstrate Servlet Chaining
15. Demonstrate JDBC Connectivity
16. Demonstrate JDBC using Servlet
17. Demonstrate Cookies.

Bean:

18. Demonstrate Juggler Bean
19. Demonstrate Molecular Bean
20. Implement Simple Property Bean
21. Write a program for Introspection

JSP:

22. Write a JSP program for Fibonacci Series
23. Write a JSP program for Employee salary details.

RMI:

24. Write a RMI Program for Student Mark list
25. Write a RMI Program for finding the greatest of two numbers

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	H	H	M	H	H
C02	M	H	H	H	H
C03	H	M	H	M	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Arul kumar	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS211	Title	Batch :	2020-2022
		Programming Lab-IV: Networks	Semester	II
Hrs/Week:	5		Credits:	4

Course Objective

On Successful completion of the course the students should understand the concepts of Client/Server, TCP,UDP.

Course Outcome

K3	CO1	To implement the features of Networks to design and deploy computer networks.
K4	CO2	To analyze the various routing techniques helps the students to fix up the shortest path routes for packets in the network
K5	CO3	To Understand the various routing techniques helps in analyzing and interpreting the quality of networks.
• Program to implement the concepts CRC. • Program to Parse URL Address into its components. • Program to find Shortest Path between nodes. • Implement the concept of Sliding Window Protocol. • Program to read Source code of a Website. • Write a Java program to find the IP address of a given Website. • Write a Java program to Download a file from the internet and save a copy. • Write a Java program to calculate the Area with the radius between C/S. • Write a Java program to generate IP of the machine. • Write a Java program to establish Single side communication using TCP. • Write a Java program to establish Double side communication using TCP. • Write a Java program to establish Single side communication using UDP. • Write a Java program to establish Double side communication using UDP. • Write a Java program to send a single message to multiclient[Broadcasting]. • Write a Java program to implement UDP packets Send and Receive. • Write a Java program to generate Conversion of lowercase to uppercase. • Write a Java program to establish Gossip Client and Server. • Write a Java program to generate Daytime Client and Server. • Write a Java program to establish a Commandline who is client. • Write a Java program to implement the Concurrent Server. • Write a Java program to implement Ping Server using raw sockets. • Write a Java program to demonstrate the ECHO command. • Write a Java program to demonstrate the PING command. • Write a Java program to print DNS record of an internet address. • Write a Java program to establish Chatting. • Write a Java program to validate a Client Password. • Write a Java program to perform File Transfer using FTP. • Write a Java program to generate Asynchronous Protocol. • Write a Java program to implement Stop and Wait Protocol. • Write a Java program to implement Client-Server Cryptography. • Write a Java program to implement User Interface. • Write a Java program to send a mail using SMTP.		
Total Contact Hrs		75

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	M	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: R.Nandha Kumar Signature:	Name: Dr.M.Sakthi Signature:	Name: K. Srinivasan Signature:	Name: Dr. R. Muthukumaran Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2P1	Title	Batch :	2020-2022
		Pilot Project-I	Semester	II
Hrs/Week:	2		Credits:	2

Prerequisite Knowledge: SDLC, Models for Software Engineering, OOPs, Basic DBMS concepts, Design Techniques like DFD or UML etc., Basic Information of Business Processes according to project title.

Instructional Notes: Students are required to develop entire new software system or to enhance/modify functionalities of existing software or to provide customization based on existing technology/framework to fulfill specific requirements.

Rules for the Project:

1. The duration of the project will be 50 days. The students can develop their project individually or in a group of not more than 2 students. Group size can be increased with prior approval of head of institution.
2. The passing standard is 40% jointly in Internal and External examination.
3. The project can be developed in any language or platform but it is required to get approved by the head of the institution. For the purpose of approval, Students have to submit their project titles and proposals with the name of Internal and External Guides to the Head of Institution. In case, if the student proposal is rejected, the revised proposal in the same or other area is required to submit and get it sanctioned. Failing to do this, his/her term will not be granted.
4. The students have to report to the internal guide for at least 4 times during the project life span with the progress report duly signed by external guide. Moreover they have to bring these reports with the final report at the time of external examination.

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr. M. Sakthi	Name: Dr. M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

ELECTIVE I

S.No	SUBJECT CODE	TITLE
1	20PCS2E1	SOFTWARE AGENTS
2	20PCS2E2	COMPUTING TECHNOLOGIES
3	20PCS2E3	MOBILE COMPUTING

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2E1	Title	Batch :	2020-2022
		ELECTIVE – I: Software Agents	Semester	II
Hrs/Week:	4		Credits:	4

Course Objective

On successful completion of the course the students should be able to understand the agent programming paradigms and to develop agents for intelligent and mobile applications using Java.

Course Outcomes (CO)

K1	CO1	To remember the principles and fundamentals of designing agents
K2	CO2	To understand the agent framework
K3	CO3	To deploy the agents for assisting the users in day to day activities
K4	CO4	To analyze the various issues in the security of agents
K5	CO5	To validate the authentication for agents

CONTENTS		Hours
UNIT I Agents: Agent Definition – Agent Programming Paradigms – Agent Vs Object – Aglet – Mobile Agents – Agent Frameworks – Agent Reasoning.		10
UNIT II Java Agents: Processes – Threads – Daemons – Components – Java Beans – ActiveX – Sockets – RPCs – Distributed Computing – Aglets Programming – Jini Architecture – Actors and Agents – Typed and Proactive Messages.		10
UNIT III Multi Agent Systems: Interaction between Agents – Reactive Agents – Cognitive Agents – Interaction Protocols – Agent Coordination – Agent negotiation – Agent Cooperation – Agent Organization – Self-Interested Agents in Electronic Commerce Applications.		11
UNIT IV Intelligent Software Agents: Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications.		11
UNIT V Agents and Security: Agent Security Issues – Mobile Agents Security – Protecting Agents against Malicious Hosts – Untrusted Agent – Black Box Security – Authentication for Agents – Security Issues for Aglets.		10
Total Hours		52
<i>*Italicized texts are for self study</i>		
Power point Presentations, Seminar , Assignment, Brain storming		
Text Books		
1. Jeffrey M. Bradshaw, “Software Agents”, Pearson Education, 2010		
2. Richard Murch, Tony Johnson, “Intelligent Software Agents”, 1 st edition, Prentice Hall, 2000.		

3. Mohammad Essaaidi, Maria Ganzha, Marcin Paprzycki, “Software Agents, Agent Systems and Their Applications”, IOS press, 2012.

Reference Books

1. Bigus & Bigus, “Constructing Intelligent agents with Java”, Wiley, 1997.
2. Russel & Norvig, “Artificial Intelligence: a modern approach”, Prentice Hall, 1994.
3. Michael Wooldridge, “An Introduction to Multi Agent Systems”, 2nd edition, John Wiley, 2009

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	H	H
CO2	H	H	H	H	M
CO3	M	H	H	H	H
CO4	H	M	H	M	M
CO5	H	H	M	H	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Arul kumar	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2E2	Title	Batch :	2020-2022
		ELECTIVE- I:	Semester	II
Hrs/Week:	4	Computing Technologies	Credits:	4

Course Objective

On successful completion of the course the students should understand the concepts of cloud computing, developing cloud services, Centralizing Email communications, cloud computing services and grid computing.

Course Outcomes (CO)

K1	C01	To understand the architecture and concept of different Cloud models- SaaS,PaaS,Web Services and On-Demand Computing
K2	C02	To provide a strong fundamental concepts in the underlying principle of cloud virtualization , cloud storage, data management and data visualization
K3	C03	To implement various applications by utilizing cloud platforms such as Google AppEngine and Amazan's web services(AWS)
K4	C04	To analyze various Grid computing technologies such as OGSA and OGSi
K5	C05	To Create application by utilizing cloud platforms such as Google app Engine and Amazon Web Services

CONTENTS	Hours
UNIT I Fundamentals of grid and cloud computing: Introduction to Grid computing- Merging the Grid Services Architecture with the Web Services Architecture. Introduction to Cloud computing – History of Cloud Computing –How Cloud Computing works-Companies in the Cloud Computing Today	13
UNIT II Developing cloud services: Computing in the Cloud - The Pros and Cons of Cloud Computing- Benefits of Cloud Computing. Developing Cloud Services: Web Based Application – Pros and Cons of Cloud Service Development – Types of Cloud Service Development – Software as a Service – Platform as a Service – Web Services – On-Demand computing – Discovering Cloud Services Development Services and Tools – Amazon Ec2- Google App Engine – IBM Clouds.	13
UNIT III Cloud computing for everyone: <i>Centralizing Email communications</i> – collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation	13
UNIT IV Using cloud services: Collaborating on Calendars, Schedules and Task Management – Exploring Online Scheduling Applications – Exploring Online Planning and Task Management – Collaborating on Event Management – Collaborating on Contact Management – Collaborating on Project Management –Collaborating on Databases – Storing and Sharing Files – Evaluating Web	13

Mail Services – Evaluating Web Conference Tools – Collaborating via Social Networks and Groupware – Collaborating via Blogs and Wikis	
UNIT V Grid computing: Open Grid Services Architecture (OGSA) – Sample Use Cases that drive the OGSA – The OGSA Platform Components – Open Grid Services Infrastructure (OGSI) – OGSA Basic Services	13
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Group discussions, Seminar ,Quiz, Assignment, Experience Discussion, Brain storming, Activity	
Text Books 1. Joshy Joseph & Criag Fellenstein, “Grid Computing”, PHI, PTR, 2009. 2. Michael Miller, “Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online”, Que Publishing, August 2009.	
Reference Books 1. Jose C.Cunha, Omer F.Rana (Eds), “Grid Computing”, Springer International Edition, 2006. 2. Anthony T. Velte and others, “Cloud Computing” TATA Mc-Graw Hill Publications, New Delhi, 2011.	

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	M	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	M	M
C04	M	H	H	M	H
C05	H	M	L	H	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr.A.Kanagaraj	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2E3	Title	Batch :	2020-2022
		ELECTIVE – I : Mobile Computing	Semester	II
Hrs/Week:	4		Credits:	4

Course Objective

On successful completion of the course the students should understand Mobile Computing Architecture and Emerging Technologies and understand about fundamentals of GSM and CDMA Technologies.

Course Outcomes (CO)

K1	CO1	To remember the features and challenges of mobile devices, native app development frameworks, hybrid app development frameworks
K2	CO2	To understand and select appropriate framework for developing applications based on the problem requirements
K3	CO3	Apply the UI components, multimedia usage, location based services, data storage mechanisms for the given problem
K4	CO4	Design an application based on the user requirements
K5	CO5	Be able to apply problem solving approaches to work challenges and make decisions using sound engineering methodologies

CONTENTS		Hours
UNIT I Introduction: Mobility of Bits and Bytes – Wireless-the beginning – Mobile computing – Dialog control – Networks – Middle ware and gateways – Application and Services– Developing Mobile computing applications – Security in Mobile computing – Standards –Why is it necessary? – Standard bodies – Players in the wireless space. Mobile Computing Architecture: History of computers – History of internet– Internet-the Ubiquitous Network – Architecture for mobile computing – Three-Tire architecture – Design considerations for mobile computing – Mobile computing through Internet– Making Existing applications Mobile-enabled.		13
UNIT II Mobile Computing Through Telephony: Evolution of telephony – Multiple access procedures – Mobile computing through telephone – Developing an IVR application –Voice XML – Telephony applications programming interface(TAPI). Emerging Technologies: Introduction – Bluetooth – Radio Frequency Identifications (RFID) – Wireless Broadband (WiMAX) – Mobile IP – Internet Protocol Version 6 (IPv6) – Java card.		13
UNIT III Global System For Mobile Communication (GSM): GSM Architecture –GSM Entities – Call routing in GSM – PLMN Interfaces – GSM Address and Identifiers –Network aspects in GSM – GSM frequency allocation – Authentications and Security. Short Message Services (Sms): Mobile computing over SMS – Short Message Services (SMS) – Value added services through SMS – Accessing SMS bearer.		13
UNIT IV		13

General Packet Radio Service (GPRS): GPRS and Packet data network –GPRS Network architecture – GPRS Network operations – Data services in GPRS –Applications for GPRS – Limitations of GPRS – Billing and charging in GPRS.	
Wireless Application Protocol (WAP): WAP – MMS – GPRS applications.	
UNIT V CDMA and 3G: Spread Spectrum technology – Is-95 – CDMA Vs GSM – Wireless data– 3rd Generation networks – Applications on 3G. Wireless LAN: Advantages – IEEE 802.11 Standards – Wireless LAN architecture –Mobility in Wireless LAN – Deploying Wireless LAN – Mobile ADHOC networks and Sensor networks – Wireless LAN Security – Wi-Fi Vs 3G.	13
Total Hours	65
*Italicized texts are for self study	
Power point Presentations, Seminar , Assignment, Experience Discussion, Brain storming	
Text Books 1. Ashoke K Talukder, Roopa R Yavagal, “Mobile Computing”, Tata McGraw –Hill, 2005, Fourth Reprint 2007.	
Reference Books 1. Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007. 2. Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.	

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	H	H	M	M	H
C02	H	M	H	M	H
C03	L	H	H	M	M
C04	M	H	H	M	H
C05	H	M	L	H	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Yasodha	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2N1	Title	Batch :	2020-2022
		Non-Major Elective I:	Semester	II
Hrs/Week:	1	Multimedia Packages Lab	Credits:	2

Course Objective

On successful completion of the course the students should understand the concepts of Photoshop, Flash and Macromedia Director.

Course Outcomes (CO)

K3	CO1	To implement the concepts of Image segmentation and video segmentation
K4	CO2	To analyze the concepts of Storage models and Access Techniques of Multimedia devices
K5	CO3	To access Text, Audio Text and Audio tools

	PHOTOSHOP • Use of basic tools • Merging two images • Cloning an image • Changing color of an image • Give Light effect to the image • Icy Image • Paint and Rainbow effect • Design a flex for college using Photoshop • Rain effect • <i>Bubbled effect</i>	FLASH • Motion Tween • Text Bouncing • Text Animate • Image fading • Butterfly Animation • <i>Bouncing Ball</i> MACROMEDIA DIRECTOR • Basic Animation • Slide Interaction
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**Italicized texts are for self study*

Power point Presentations , Brain storming, Activity

MAPPING

PSO \ CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	H	M
CO2	H	M	H	H	H
CO3	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: R.Nandhakumar	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS2N2	Title	Batch :	2020-2022
		Non-Major Elective I: Web Designing Lab	Semester	II
Hrs/Week:	1		Credits:	2

Course Objective

The objective of this course is to enable the students to develop and design various applications using Web Technology.

Course Outcomes (CO)

K3	CO1	To apply critical thinking skills to design and create websites
K4	CO2	To analyze and write a well formed / valid XML document
K5	CO3	To access and analyze website performance by interpreting analytics to measure site traffic, SEO, engagement, and activity on social media

• HTML Tags • Tables • Forms • Frames • Web Creation • CSS Rules • CSS Grouping Style • XML using CSS	• <i>Address Book</i> • DTD for Book Information • Resume Creation using DTD • XSL Transformation • XSL Sorting • Event Handling • Filters
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**Italicized texts are for self study*

Power point Presentations, Experience Discussion, Brain storming, Activity

MAPPING

PSO \ CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	H
CO2	H	M	H	L	H
CO3	H	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name:N.Arulkumar	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R.Muthukumaran
Signature:	Signature:	Signature:	Signature:

III SEMESTER

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS312	Title	Batch :	2020-2022
		Advanced Python	Semester	III
Hrs/Week:	4	Programming	Credits:	5

Course Objective

On successful completion of this course the students should understand the core principles of the Python Language and use the tools to produce well designed programs in python and create effective GUI applications.

Course Outcomes (CO)

K1	CO1	To remember the principles of structured programming Recognize and construct common programming idioms: variables, loop, branch, subroutine, and input/output.
K2	CO2	To understand the common programming idioms: variables, loop, branch, subroutine, and input/output
K3	CO3	To deploy the concepts of lists, tuples, dictionaries, standard libraries, modular programming and the design of user interfaces
K4	CO4	To figure out ability to analyze and solve the problems using advanced facilities of the Python language
K5	CO5	To evaluate and apply the functions and python libraries to analyze and solve various data analytics problems

CONTENTS		Hours
UNIT I Introduction to Python: Introduction – Python overview – Getting started – Comments – Python identifiers – Reserved keywords – Variables – Standard data types – Operators – Statements and Expressions – String operations – Boolean expressions. Classes and Objects: Overview of OOP – Data encapsulation – Polymorphism – Class definition – Creating objects – <i>Inheritance</i> – Multiple inheritances – Method overriding – Data encapsulation – Data hiding.		10
UNIT II Control Statements and Functions: <i>Control Statements:</i> The for loop – While statement – if elif else statement – Input from keyboard. <i>Functions:</i> Introduction – Built-in functions – Type conversion – Type coercion – Date and time – dir() function – help() function – User defined functions – Parameters & arguments – Function calls – The return statement – Python recursive function. Strings and Lists: Strings – Compound data type – len function – String slices – String traversal – Escape characters – String formatting operator – String formatting functions. Lists – Values and accessing elements – Traversing a list – Deleting elements from list – Built-in list operators – Built-in list methods.		10
UNIT III Tuples and Dictionaries: Tuples – Creating tuples – Accessing values in tuples – Tuple assignment – Tuples as return values – Basic tuple operations – Built-in tuple functions. Dictionaries – Creating dictionary – Accessing values in dictionary – Updating dictionary – Deleting elements from dictionary – Operations in dictionary Built-in dictionary methods. Files and Exceptions: Introduction to File Input and Output-Using loops to process files-Processing Records-Exception.		10

UNIT IV Data Analysis with Python: Reading and Writing Data in Text format – Reading Text Files in Pieces- writing data to text formats –Binary data formats-Reading Microsoft Excel Files- Interacting with Web API’s-Interacting with Databases. Data Cleaning and Preparation: Handling Missing Data-Filtering Out Missing Data- Filling In Missing Data. Data Transformation: Removing Duplicates. Plotting and Visualization: A Brief matplotlib API Primer-Figures and Subplots-Colors, Markers, and Line Styles-Annotations and Drawing on a Subplot-Saving Plots to File-matplotlib Configuration.	11
UNIT V Numpy Basics: Arrays and Vectorized Computation –The NumPy ndarrays: A multidimensional Array Object –Creating ndarrays-Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing-Boolean Indexing –Fancy Indexing-Methods for Boolean Arrays-Mathematical and Statistical Methods-File Input and Output with Arrays-Sorting.	11
Total Hours	52
* <i>Italicized</i> texts are for self study	
Power point Presentations, Group discussions, Seminar , Assignment	
Text Books 1. Mark Summerfield. “Programming in Python 3: A Complete introduction to the Python Language”, Addison-Wesley Professional, 2009. 2. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinney, O’Reilly Media, 2012. ISBN 978-1-4493-1979-3 3. Wesley J Chun, “Core Python Applications Programming”, Prentice Hall, 2012.	
Reference Books 1. Mark Lutz, “Learning Python”, 5th Edition, 2013. 2. Welsey J. Chun, “Core Python Programming”, Prentice Hall, 2001. 3. E Balagurusamy, “Introduction to computing and problem solving using python”, McGrawHill publication, 2016.	

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	M
CO2	H	M	H	H	H
CO3	M	H	L	M	H
CO4	H	H	H	M	H
CO5	M	M	H	H	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr. R. Deepa Signature:	Name: Dr.M. Sakthi Signature:	Name: K. Srinivasan Signature:	Name: Dr. R. Muthukumaran Signature:

M.Sc Computer Science Programme code:	M.Sc	Programme Title :	Effective from 2020 Onwards Master of Computer Science	
Course Code:	20PCS313	Title	Batch :	2020-2022
		Android Programming	Semester	III
Hrs/Week:	5		Credits:	5

Course Objective

On successful completion of this course, students will understand the Android Operating System and also able to develop applications using Google's Android open-source platform.

Course Outcomes (CO)

K1	CO1	To keep in mind about the application lifecycle, configuration files, intents and activities.
K2	CO2	To get an idea of the user interface components, layout managers, event handling, screen orientation and fragments.
K3	CO3	To deploy a basic application that acts as a working example with various concepts using SQLite database.
K4	CO4	To analyze the functions of various sensors.
K5	CO5	To evaluate the run time security during the deployment of an application.

CONTENTS		Hours
UNIT I Android: Introduction – Android’s Fundamental Components – Exploring the Structure of an Android Application – Examining the Application Life Cycle. Introduction to Android Application Architecture: Exploring a simple Android Application – Defining UI through Layout Files – Specifying Comments in Layout Files – Adding Views and View groups in Layout Files – Specifying Control Properties in Layout Files – Indicating View Group Properties – Controlling Width and Height of a Control – Introducing Resources and Backgrounds – Working with Text Controls in the Layout File – Working with Auto generated IDs for Controls – Loading the Layout File into an Activity – Gathering Controls – Placing the Files in the Android Project – Android Activity Life Cycle – Resources.		13
UNIT II User Interface Development and Controls: UI Development in Android - Building a UI Completely in Code - Building a UI Completely in XML - <i>Building a UI in XML with Code</i> . Android’s Common Controls: Text Controls – Button Controls – The ImageView Control – Date and Time Controls – The MapView Control. Adapters and List Controls: SimpleCursorAdapter – ArrayAdapter – The Basic List Control ListView – The GridView Control – The Spinner Control – The Gallery Control – Styles and Themes – Layout Managers - Menus and Action Bars		13
Unit III Fragments: Introduction-Use of Fragments-The Structure of Fragment-Sample Program of Fragment .Broadcast Receivers-Coding a Simple Receiver-Registering a Receiver-Multiple Receivers. SQLite: Saving State using SQLite-SQLite Packages and Classes_Creating an SQLite Database-Migrating a Database-Inserting Rows-Deleting Rows- Reading Rows-Exploring Databases on the Emulator and available devices-Content Providers		13
UNIT IV Touch Screens and Sensors: Understanding Motion Events – The Motion Event Object – Recycling Motion Events – Using Velocity Tracker – Multi-touch – Gestures. Implementing Drag and Drop: Exploring Drag and Drop – Basics of Drag and Drop in 3.0+ – <i>Drag-and-Drop</i> Example Application. Sensors: Introduction – Detecting Sensors – Getting Sensor Events – Interpreting Sensor Data.		13
UNIT V Application Security and Deployment: Security and Permissions – Understanding the Android Security Model – Performing Runtime Security Checks – Deploying the Application: Becoming a		13

Publisher – Preparing the Application for Sale – Uploading the Application.	
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment, Activity, Case study	
Text Books	
1. Dave MacLean, Satya Komatineni, Grant Allen, “Pro Android 5”, Apress Publications, 2015.	
2. Wei-Meng-Lee, “Beginning Android Tablet Application Development”, Wiley Publications, 2012.	
Reference Books	
1. Barry Burd, “Android Application Development – All-in-one for Dummies”, 2 nd Edition, Wiley India, 2016.	
2. Lauren Darcey, Shane Conder, “Sams Teach Yourself Android Application Development in 24 hours”, 2nd edition, Pearson Education, 2013.	
3. Paul Deitel, Harvey Deitel, Alexander Wald, “Android 6 for Programmers – An App-driven Approach”, 3 rd Edition, Pearson education, 2016.	
4. Jerome (J. F) DiMarzio, “Android – A Programmer’s Guide”, McGraw Hill Education, 8 th reprint, 2015.	

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	M	H	M	H	M
C02	M	M	H	H	H
C03	M	H	H	M	M
C04	M	H	M	M	H
C05	H	H	M	M	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Arul kumar	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS314	Title	Batch :	2020-2022
		Network Security & Cryptography	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of this course, students will understand Cryptography Theories, Algorithms and necessary approaches and techniques to build protection mechanisms in order to secure computer networks.

Course Outcomes (CO)

K1	CO1	To remember the basics of network security and cryptography
K2	CO2	To understand the symmetric key cryptography and Mathematics of symmetric key cryptography
K3	CO3	To apply the mathematics of asymmetric key cryptography
K4	CO4	To analyze differential message authentication and integrity
K5	CO5	To evaluate various security practice and system security

CONTENTS		Hours
UNIT I Introduction: Security trends – Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies – Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.		13
UNIT II Symmetric Key Cryptography Mathematics Of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic- Euclid's algorithm- Congruence and matrices – Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard – RC4 – Key distribution.		13
UNIT III Public Key Cryptography Mathematics Of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange – ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography		13

UNIT IV Message Authentication And Integrity: Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509	13
UNIT V Security Practice And System Security: Electronic Mail security – PGP, S/MIME – IP security – Web Security – System Security: Intruders – Malicious software – viruses – Firewalls.	13
Total Contact Hrs	
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment	
Text Books	
1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.	
Reference Books	
1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security Wiley India Pvt.Ltd	
2. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw Hill 2007.	
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2	

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	M	H	H
CO2	H	M	H	H	L
CO3	H	H	H	M	M
CO4	M	H	H	H	H
CO5	H	M	H	H	L

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N. Karthikeyan	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS315	Title	Batch :	2020-2022
		Programming Lab-V : Python Programming	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the students should write well-documented programs in the Python language, including use of the logical constructs of that language.

Course Outcomes (CO)

K3	C01	To implement, Interpret, Contrast of various operators.
K4	C02	To review and analyze database with variables, loop, branch, subroutine, and input/output
K5	C03	To validate how databases are integrated with components ,modular programming and the design of user interfaces

1. Write a program that displays the following information: Your name, Full address, Mobile number, College name, Course subjects.
2. Write a program to find the largest three integers using if-else and conditional operator.
3. Write a program that asks the user to enter a series of positive numbers (The user should enter a negative number to signal the end of the series)and the program should display the numbers in order and their sum.
4. Write a program to find the product of two matrices [A]m_xp and [B]p_xr
5. Write recursive and non-recursive functions for the following:
 - a. To find GCD of two integers.
 - b. To find the factorial of positive integer
 - c. To print Fibonacci Sequence up to given number n
6. Write a program to display two random numbers that are to be added, such as: 247 + 129, the program should allow the student to enter the answer. If the answer is correct, a message of congratulations should be displayed. If the answer is incorrect, a message showing the correct answer should be displayed.
7. Write recursive and non-recursive functions to display prime number from 2 to n.
8. Write a program that writes a series of random numbers to a file from 1 to n and display.
9. Write a program to create file, write the content and display the contents of the file with each line preceded with a line number (start with 1) followed by a colon.
10. In a program, write a function that accepts two arguments: a list and a number n. The function displays all of the numbers in the list that are greater than the number n.
11. Write a program with a function that accepts a string as an argument and returns the no. of vowels

that the string contains. Another function to return number of consonants.

12. Write a program that opens a specified text file and then displays a list of all the unique words found in the file. (Store each word as an element of a set.)
13. Write a program to analyze the contents of two text files using set operations.
14. Write a program to implement the inheritance and dynamic polymorphism.
15. Write a GUI program that converts Celsius temperatures to Fahrenheit temperatures.
16. Write a GUI program that displays your details when a button is clicked.
17. Write a python program to do stack operations using numpy.
18. Write a python program to transpose a matrix.
19. Write a python program for slicing a matrix.
20. Merge two datasets using pandas
21. Write a pandas program to cluster data in python.

Power point Presentations, Experience Discussion, Brain storming

MAPPING

PSO CO	PS01	PS02	PS03	PS04	PS05
C01	H	H	M	H	H
C02	H	M	M	H	H
C03	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr. R. Deepa	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R.Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS316	Title	Batch :	2020-2022
		Programming Lab-IV: Android Programming	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the students should be equipped with skills for developing mobile applications for Android platform devices.

Course Outcomes (CO)

K3	C01	To implement the features of Java to build Android applications and use the development tools in the Android development environment.
K4	C02	To figure out UI-rich applications using all the major UI components like Fragments Action bars, Menus and Layouts.
K5	C03	To access and manipulate data using Content Providers, Shared Preferences and Notifications with SQLite database.

1. Develop an application using Text Control
2. Develop an application using Button Control
3. Develop an application using AutocompleteTextView Control
4. Develop an application using MultiAutocompleteTextView Control
5. Develop an application using RadioButton, Control
6. Develop an application using ImageView Control
7. Develop an application using Date Control
8. Develop an application using Time Control
9. Develop an application using TextClock and Analog Control
10. Develop an application using ListView Control
11. Develop an application using Spinner Control
12. Develop an application using Gallery Control
13. Develop an application using GridView Control
14. Develop an application using MapView Control
15. Develop an android application using styles and themes.
16. Develop an application using GridView Control
17. Develop an application using different types of layout managers.
18. Develop an application using Menus and Actionbars
19. Develop an application using Fragement
20. Develop an application using Fragement
21. Develop an application using Broadcast Receivers
22. Develop an application using SQLite Database
23. Develop an application to implement Drag and Drop concept
24. Develop an application using single touch and multi touch
25. Develop an application to display the various sensors available in an android device
26. Develop an application to measure and display gravity from accelerometers

MAPPING

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	M	H	M	H	H
C02	H	M	H	H	H
C03	M	H	H	M	M

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Arul kumar	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

ELECTIVE II

S.No	SUBJECT CODE	TITLE
1	20PCS3E1	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS
2	20PCS3E2	MACHINE LEARNING
3	20PCS3E3	EMBEDDED SYSTEMS

M.Sc Computer Science Programme Code:	M.Sc	Programme Title :	Effective from 2020 Onwards Master of Computer Science	
Course Code:	20PCS3E1	Title	Batch :	2020-2022
		ELECTIVE – II: Artificial Intelligence and Expert Systems	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the students have basic understanding of overview of artificial intelligence (AI) principles and approaches and enable the student to apply these techniques in applications which involve perception, reasoning and learning

Course Outcomes (CO)

K1	CO1	To remember basic exposition to the goals and methods of Artificial Intelligence
K2	CO2	To understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.
K3	CO3	To apply these techniques in applications which involve perception, reasoning and learning.
K4	CO4	To analyze and design a real world problem for implementation and understand the dynamic behavior of a system.
K5	CO5	To evaluate and design a real world problem for implementation and understand the dynamic behavior of a system

CONTENTS	Hours
UNIT I Problem solving and AI – Puzzles and Games – Problem States and operators – Heuristic programming – state space representations – state descriptions – graph notations – non-deterministic programs.	13
UNIT II State space search methods – breadth first and depth first search – heuristic – admissibility – optimality of algorithms – performance measures – problem reduction representations – AND/OR graphs and higher level state space.	13
UNIT III Problem reduction search methods – cost of solution trees – ordered search – alpha beta and minimum procedure – theorem proving in predicate calculus – syntax, semantics, Herbrand universe: variables, qualifiers, unification, resolvents.	13
UNIT IV Predicate calculus in problem solving – answer extraction process – resolution – Automatic program writing – predicate calculus – proof finding methods.	13
UNIT V Expert systems: Expert systems and conventional programs – expert system organization – Knowledge engineering: knowledge representation techniques – knowledge acquisition – acquiring knowledge from experts – automating knowledge acquisition –Building an expert system – difficulties in developing an expert system.	13
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment	

Text Books

1. E Charnail, CK Reiesbeck and D V Medermett, “Artificial Intelligence Programming”, Lawrence Erlbaum Associates, N J, 2011.
2. Donald A Waterman, “A Guide to Expert Systems”, Tech knowledge series in knowledge Engineering, 2010.

Reference Books

1. N J Nilson, “Principles of Artificial Intelligence” , Tiega Press, Polo Alto, 2009.
2. Elain Rich and Kevin Knight, “Artificial Intelligence”, McGraw Hill, 2000.

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	H	H	M	H	H
C02	M	H	M	H	H
C03	M	H	H	M	H
C04	H	H	H	H	M
C05	M	H	H	M	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: N.Karthikeyan	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS3E2	Title	Batch :	2020-2022
		Elective- II: Machine Learning	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the student should have: Understood the techniques in machine learning and apply machine learning techniques to any domain of interest. This course presents the foundations of learning, linear models, distance based models, tree and rule based model and reinforcement learning.

Course Outcomes (CO)

K1	CO1	To remember the components of learning models, training and testing.
K2	CO2	To understand different regression models, generalization and validation details.
K3	CO3	To apply various distance based models in machine learning.
K4	CO4	To evaluate tree and rule based models
K5	CO5	To analyze different types of reinforcement learning techniques.

CONTENTS	Hours
UNIT I Foundations of Learning : Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – bias and variance – learning curve.	13
UNIT II Linear Models: Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – generalization and over fitting – regularization – validation.	13
UNIT III Distance-Based Models: Nearest neighbor models – K-means – clustering around medoids – silhouettes – hierarchical clustering – k- d trees – locality sensitive hashing – non - parametric regression – ensemble learning – bagging and random forests – boosting – meta learning.	13
UNIT IV Tree And Rule Models: Decision trees – learning decision trees – ranking and probability estimation trees – Regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first -order rule learning.	13
UNIT V Reinforcement Learning: Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal - difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control.	13

Total Contact Hrs	65
* <i>Italicized</i> texts are for self study	
Power point Presentations, Seminar, Quiz and Assignment	
Text Books: 1. Y. S. Abu - Mostafa, M. Magdon-Ismael, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012. 2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2012. 3. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012. 4. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007. 5. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.	
Reference Books 1. John Slavio, "Machine Learning for Beginners: A Plain English Introduction to Artificial Intelligence and Machine Learning", Kindle Edition, 2017. 2. Oliver Theobald, "Machine Learning For Absolute Beginners: A Plain English Introduction", Second Edition, Machine Learning For Beginners Book 1, Kindle Edition, 2017.	

Mapping

CO \ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M
CO2	M	M	M	M	M
CO3	M	H	H	H	M
CO4	H	H	H	M	M
CO5	M	H	M	H	H

H-High; M-Medium; L-Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr A.Kanagaraj	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr.R.Muthukumaran
Signature:	Signature:	Signature:	Signature:

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS3E3	Title	Batch :	2020-2022
		ELECTIVE – II: Embedded Systems	Semester	III
Hrs/Week:	5		Credits:	4

Course Objective

On successful completion of the course the students should gain knowledge on Hardware fundamentals, Software Architecture, Interrupts, Embedded software lifecycle and tools.

Course Outcomes (CO)

K1	CO1	To remember the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
K2	CO2	To understand the RTOS and its programming aspects.
K3	CO3	To apply the of design real time embedded systems using the concepts of RTOS.
K4	CO4	To Analyze various examples of embedded systems based on ATOM processor.
K5	CO5	To evaluate hardware fundamentals, interrupts, RTOS environment Basic design, embedded software Lifecycle, Software development tools.

CONTENTS		Hours
UNIT I Hardware Fundamentals: Terminology-Gates-Timing Diagrams-Memory Advanced Hardware Fundamentals: Microprocessors-Microprocessor architecture-Direct Memory Access-Conventions and Schematics-Introduction to embedded systems: An embedded system-Processor in the system-Exemplary embedded systems.		13
UNIT II Interrupts and Software Architecture Interrupts: Interrupt basics-Interrupt service routines Survey of Software Architectures: Round Robin with interrupts-Function-Queue-Scheduling Architecture-Real Time Operating Systems Architecture Introduction to Real Time Operating Systems: Selecting in RTOS-Tasks and Task States-Tasks and Data-Semaphores and shared data.		13
UNIT III Concepts of RTOS More Operating System Services: Interrupt process communication-Message queues-Mailboxes and pipes-Timer functions-Events-Memory management-interrupt routines in an RTOS environment Basic design using a Real Time Operating System: Principles-encapsulating semaphores and queues-hard real time scheduling considerations-saving memory space and power-introduction to RTL & QNX.		13
UNIT IV Embedded software life cycle and tools Embedded software Lifecycle: Software Algorithm complexity-Software development process life cycle and its models.		13
UNIT V Software development tools: development tools-hosts and target machine-linker/locators for embedded software-getting embedded software into the target		13

machine Debugging techniques: testing on your host machine-instruction set simulators-the asset macro-using laboratory tools - Case Study.	
Total Hours	65
<i>*Italicized texts are for self study</i>	
Power point Presentations, Seminar , Assignment	
Text Books 1. David.E.Simon, “An embedded system primer”, Addison Wesley-2001. 2. Raj Kamal, “Embedded Systems architecture, programming and design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2003.	
Reference Books 1. K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009. 2. Lori Matassa and Max Domeika, Break Away with Intel® Atom™ Processors, Intel press, 2010.	

MAPPING

PSO CO	PSO1	PSO2	PSO3	PSO4	PSO5
C01	H	H	M	H	H
C02	M	H	M	H	H
C03	M	H	H	M	H
C04	H	H	H	H	M
C05	M	H	M	H	H

H: High M: Medium L: Low

Course Designed by	Verified by HOD	Checked by	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: M.Meenakirithika	Name: Dr.M.Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

SEMESTER IV

Programme code:	M.Sc	Programme Title :	Master of Computer Science	
Course Code:	20PCS4P2	Title	Batch :	2020-2022
		Industrial Project Work and Viva voce (Individual)	Semester	IV
Hrs/Week:	-		Credits:	8

Instructional Notes: Students are required to develop entire new software system or to enhance/modify functionalities of existing software or to provide customization based on existing technology/framework to fulfill specific requirements.

MAXIMUM MARKS : 200

Project Evaluation & Viva Voce : 150 (Both Internal & External Examiner)

Paper Publications in UGC Journals : 50 (Only Internal Examiner)

Course Designed by	Verified by HOD	Checked byf	Approved by
Name and Signature	Name with Signature	CDC	COE
Name: Dr.M. Sakthi	Name: Dr.M. Sakthi	Name: K. Srinivasan	Name: Dr. R. Muthukumaran
Signature:	Signature:	Signature:	Signature:

Department of Computer Science (SF)

Value Added Course – (2020-2021)

DIGITAL ART AND DESIGN LAB

Course Objective

On successful completion of this course students should learn various photo editing features and animation techniques and demonstrate proficiency in developing the multimedia presentations.

Course Outcomes (CO)

CO1	Apply various tools in an given image
CO2	Develop strong concept abilities and an understanding of a creative design practice
CO3	Leverage on various methodologies of summarizing data and to perform various data analysis functions

1. Corporate Identity Designing

- Visiting Card Letter head, cover
- News paper advertisement designing
- Effects usage for raster graphics
- Filters usage for vector graphics
- Poster and Banner Designing

2. Brochure Designing

- Brochure concept, Types of Brochures, Bi fold brochure, Tri fold brochure
- Package Print Designing

3. Photoshop

- DVD cover Designing
- Label Designing
- Adding 3D Layers

4. Flash

- Procedure to create an animation to indicate a ball bouncing on steps.
- Procedure to draw the fan blades and to give proper animation
- Procedure to create an animation with the following features.

* Letters should appear one by one

* Fill color of the text should change to a different colour after the display of the full word.

PROJECT:

- Digital Painting
- Greeting Card Designing
- Portfolio Creation
- Procedure to simulate a ball hitting another ball