M.Sc. COMPUTER SCIENCE

Sem	Course Code	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
						CIA	ESE	
I	26PCS1CC01	Core - I	Mathematics for Computer Science	6	5	25	75	100
	26PCS1CC02	Core - II	OOAD with Java	6	5	25	75	100
	26PCS1CC03	Core – III	Advanced Computer Architecture	6	5	25	75	100
	26PCS1CP04A	Core -IV(a)	Java Programming - Practical	3	2	10	40	50
	26PCS1CP04B	Core-IV(b)	Web Programming - Practical	3	2	10	40	50
	26PCS1DE01:1/2	Discipline Specific Electives-I		6	4	25	75	100
			Total	**30**	**23**			**500**
II	26PCS2CC05	Core -V	Design and Analysis of Algorithms	6	5	25	75	100
	26PCS2CC06	Core-VI	Database Systems	6	5	25	75	100
	26PCS2CC07	Core -VII	Python for Data Science	6	5	25	75	100
	26PCS2CP08A	Core-VIII (a)	RDBMS - Practical	3	2	10	40	50
	26PCS2CP08B	Core –VIII (b)	Data Science - Practical	3	2	10	40	50
	26PCS2DE02:1/2	Discipline Specific Electives -II		6	4	25	75	100
	26PCN2OR01	Community Outreach	JAMCROP	-	@	-	-	@
	@Only grades will be given		**Total**	**30**	**23**			**500**
III	26PCS3CC09	Core-IX	Principles of Compiler Design	6	5	25	75	100
	26PCS3CC10	Core –X	AI and Machine Learning	6	5	25	75	100
	26PCS3CC11	Core-XI	Digital Image Processing	6	5	25	75	100
	26PCS3CP12A	Core -XII(a)	Machine Learning - Practical	3	2	10	40	50
	26PCS3CP12B	Core -XII(b)	Image Processing - Practical	3	2	10	40	50
	26PCS3SL01	Self-Paced Learning Course	Cyber Security & Ethical Hacking	-	2	-	100	100
	26PCS3DE3:1/2	Discipline Specific Electives -III		6	4	25	75	100
	26PCS3EC01	Extra Credit Course - I*	Online Course	-	*	-	-	-
			Total	**30**	**25**			**600**
IV	26PCS4CC13	Core -XIII	Web Framework and Middleware Technologies	6	5	25	75	100
	26PCS4CP14A	Core-XIV (a)	Web Framework - Practical	3	2	10	40	50
	26PCS4CP14B	Core-XIV(b)	Middleware Technology - Practical	3	2	10	40	50
	26PCS4PW01	Project Work	Industrial Experience and Project Work	18	9	-	300	300
	26PCN4OC01	Mandatory Online Course**	Online Course	-	1	-	100	100
	26PCS4EC02	Extra Credit Course - II*	Online Course	-	-	-	-	-
	26PCN4EC03	Extra Credit Course - III+	Innovation and Intellectual Property Rights	-	+	-	-	-
	26PCN6DN01/MR01	Deeniyath / Moral Education	Deeniyath / Moral Education	-	@	-	-	@
	@Only grades will be given ***Programme Specific Online Course for Advanced Learners** ****Any Online Course for Enhancing Additional Skills**		**Total**	**30**	**19**			**600**
			Grand Total	**120**	**90**			**2200**

DISCIPLINE SPECIFIC ELECTIVES

Semester	Course Code	Course Title
I	26PCS1DE01:1	Parallel and Distributed Systems
	26PCS1DE01:2	Big Data Analytics
II	26PCS2DE02:1	Embedded Systems and IoT
	26PCS2DE02:2	Computer Networks & Cryptography
III	26PCS3DE03:1	Recent Trends in Computer Science
	26PCS3DE03:2	Software Engineering Methodologies

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1CC01	Core - I	6	5	25	75	100
Course Title	Mathematics for Computer Science						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Mathematical Logic:** Introduction – Statements and Notation – Connectives – (AND, OR, NOT) Negation, Conjunction, Disjunction, Statement formulas and truth tables - Conditional and Biconditional – Tautologies, Related Problems – Equivalence of formulas.	18
	Activities – Construction of logical statements and verification of tautologies and equivalence using truth tables.	
II	**Tautological Implications:** Normal forms – Disjunctive Normal forms- Conjunctive Normal forms - Principal Disjunctive Normal forms - Principal Conjunctive Normal forms – Ordering and Uniqueness of Normal forms.	18
	Activities – Verification of tautological implications and conversion of logical expressions into DNF, CNF, PDNF, and PCNF with justification of ordering and uniqueness.	
III	**Basic Concept of Set Theory:** Notation-Inclusion and Equality of sets- The Power set-some operations on sets- Venn diagrams - Some basic set identities-Cartesian products.	18
	Activities – Construction of Venn diagrams to verify set operations, set identities, power sets, and Cartesian products.	
IV	**Graphs:** Applications of Graphs – Finite and Infinite graphs – Incidence and Degree – Isolated vertex, pendant vertex, and Null graphs. Paths and Circuits: Isomorphism – Sub-graphs – Walks, Paths, and Circuits – Connected and disconnected graphs – Euler graphs- Operations on Graphs- More on Euler Graphs- Hamiltonian Paths and Circuits.	18
	Activities – Construction and analysis of graph models to identify degrees, paths, circuits, connectivity, Euler graphs, and graph operations.	
V	**Trees and fundamental circuits:** Trees – Properties of Trees – Pendant vertices in a Tree – Distance and centers in a Tree- Spanning Trees – Fundamental circuits – Finding all spanning trees of graph -Spanning Trees in a Weighted Graph.	18
	Activities – Construction of trees and spanning trees, identification of pendant vertices, centres, and fundamental circuits, and finding all spanning trees of a given graph.	

Text Book(s):

T.B- 1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Education Private Limited, 38th reprint 2010.

T.B-2. Narsingh Deo, Graph theory with application to Engineering and Computer Science, Prentice Hall of India Pvt. Ltd. (2005).

UNIT-I: Chapter 1: Sections: 1-1,1-2.1 to 1- 2.9 (TB1)

UNIT-II: Chapter 1: Sections: 1-2.11,1-3.1 to 1-3.5 (TB1)

UNIT-III: Chapter 2: Sections: 2-1.1 to 2-1.9 (TB1)

UNIT-IV: Chapter 1: Sections: 1.1-1.5, Chapter 2: Sections:2.1-2.9 (TB2)

UNIT-V: Chapter 3: Sections: 3.1- to 3.4, 3.7 to 3.10 (TB2)

Reference Book(s):
1. G. Shanker Rao, Discrete Mathematical Structures, New Age International (P) Limited, Second Edition, 2009 2. Edgar G. Goodaire and Michael M. Paramenter, Discrete Mathematics with Graph Theory,Prentice Hall, Second Edition, 2001
Web Resource(s):
1. https://onlinecourses.nptel.ac.in/noc20cs82 2. https://youtu.be/UwYJUKVc-Hs 3. https://youtu.be/tyDKR4FG3Yw 4. https://youtu.be/yC1wXymtBoI **5.** https://teachmint.storage.googleapis.com/public/224619601/StudyMaterial/35957954-ed0c-4c03-9772-f1b2a3dfc756.pdf 6. https://www.shahucollegelatur.org.in/Department/Studymaterial/sci/it/BCS/FY/book.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Apply the principles of mathematical logic including statements, connectives, truth tables, and tautologies to solve problems.	K2
CO2	Verify tautological implications and convert logical expressions into DNF, CNF, PDNF, and PCNF, with justification of ordering and uniqueness.	K3
CO3	Explain and apply set theory concepts, including operations, inclusion, equality, power sets, Cartesian products, and Venn diagrams.	K3
CO4	Analyze graphs, including finite and infinite graphs, incidence, degree, walks, paths, circuits, connectivity, Euler graphs, and operations.	K4
CO5	Evaluate & Construct trees and fundamental circuits, determine pendant vertices, distances, centers, and find all spanning trees of a graph	K5 & K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	2	3	2	2.7
CO2	3	3	3	3	2	2	2	3	2	3	2.6
CO3	3	3	3	3	2	3	2	2	3	3	2.7
CO4	3	3	3	3	2	3	2	3	3	2	2.7
CO5	2	3	2	3	2	2	3	3	3	3	2.6
Mean Overall Score											2.66
Correlation											High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. V. Krishnan **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1CC02	Core - II	6	5	25	75	100

Course Title	OOAD with Java

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction to OOAD** – Unified Process – UML diagrams – Use Case – Class Diagrams – Interaction Diagrams – State Diagrams – Activity Diagrams – Package, component and Deployment Diagrams. Relating Use cases – include, extend and generalization – Domain Models – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition.	18
	Activities: Design simple usecase diagrams for Register, Login, Browse Products, Place Order and Make Payment for Online Shopping system, Design state diagram of a real-time application. Design associations in Library Management System	
II	**Introducing Classes in Java:** Class Fundamentals – Declaring Objects – Introducing Methods – Constructors – The this keyword – Garbage Collection – Overloading Methods – Call by value, Call by reference – Recursion – Understanding static and final. Inheritance: Inheritance Basics – Using super – Method overriding – Dynamic Method Dispatch- Using Abstract Classes.	18
	Activities: Design an UML diagram for an Employee class, Perform addition of different types of data using overloading methods-Develop a logic for finding factorial of a given number using recursion	
III	**Packages and Interfaces:** Defining a Package – Access Protection – Importing Packages – Defining, Implementing, Applying Interfaces - Exception Handling: Exception Types – try, catch – throw – throws – finally – Creating User-defined Exceptions. Multithreaded Programming: The Java Thread Model – Creating a Thread – Thread Priorities – Synchronization – String Handling.	18
	Activities: Create threads for solving real-life problems, create user-defined exception for validating eligibility for voting - Implement inheritance and method overriding using sample programs.	
IV	**The Collection Interfaces and Utility Classes:** ArrayList, LinkedList, Vector, Stack. Files and IO Streams: File - Byte streams – FileInputStream – FileOutputStream – PrintStream - Object Serialization- Character Streams. **Networking:** Networking Basics-The Networking classes and Interfaces – InetAddress-URLConnection-TCP/IP Server Sockets-Datagrams– Remote Method Invocation(RMI)-Architecture-Simple Client-Server Application using RMI- Advantages and Disadvantages.	18
	Activities: Create files and perform read/write operations using byte and character streams – develop a program to implement object serialization.	
V	**Java Database Connectivity:** Establishing a connection – Creation of data tables – Entering data into table – Table Updating – Use of PreparedStatement –Obtaining metadata.Event Handling: The Delegation Event Model – Event Classes – Sources of Events - Event Listeners and Interfaces-Adapter classes. Introducing Swing: Features of Swing – Components and Containers – JLabel and ImageIcons - JText Fields – The Swing Buttons –JCheckBoxes – JRadioButtons – JComboBoxes -JList.	18
	Activities: Apply DML commands in Java for accessing a Database-Demonstrate usage of colors, fonts, and basic graphics in Java GUI programs- Design a simple calculator	
VI	**Current Trends(For CIA only) –** Network Programming, JDBC and JavaFX.	

Text Book(s):
1. E. Balagurusamy, Programming with JAVA, McGraw Hill India, Sixth Edition, 2019. 2. Herbert Schildt, Java The Complete Reference, Eleventh Edition, McGraw-Hill Education Pvt. Ltd., 2019.
Reference Book(s):
1. Sachin Malhotra and Saurabh Choudhary, Programming in Java,2nd Edition, Oxford University Press,2018. 2. C. Muthu, Programming with Java, Vijay Nicole imprints private Limited, 2004
Web Resource(s):
1. https://www.programiz.com/java-programming 2. https://www.javatpoint.com/java-tutorial 3. https://onlinecourses.nptel.ac.in/noc22_cs102/preview 4. https://openjfx.io/openjfx-docs

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the role of UML diagrams, concepts such as Generalization, Abstraction, Associations, Aggregation and Composition	K1, K2
CO2	Apply the concept of class, inheritance, interfaces and packages into real-world entities	K3
CO3	Analyze the stream classes for manipulating files	K4
CO4	Explain the importance of Multithreading and Exception handling techniques	K5
CO5	Develop the small window-based real-life applications using Java Swing	K5, K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	3	3	2	2.8
CO2	3	3	2	2	3	3	3	3	3	2	2.7
CO3	3	3	2	2	2	3	3	3	2	2	2.5
CO4	3	3	3	3	3	3	2	3	3	3	2.9
CO5	3	2	2	2	3	3	3	3	3	3	2.7
										Mean Overall Score	2.72
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Abdul Saleem **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1CC03	Core – III	6	5	25	75	100
Course Title	Advanced Computer Architecture						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Parallel Computer Models:** The state of computing - Multiprocessors and multi computers – Multi-vector and SIMD computers. Program and Network properties:- Conditions of parallelism–Program partitioning and scheduling– program flow mechanisms–System interconnect architectures- Principles of Scalable Performance : Parallel Processing Applications.	18
	Activities – Make a comparative architecture analysis of the following topics, Multiprocessors, Multicomputers, SIMD, Multi-vector computers, Interconnect Architectures. Parallel Program Partitioning & Scalability Experiment	
II	**Processors and memory hierarchy:** Advanced processor Technology–Super scalar and vector processors–Memory Hierarchy Technology. Bus Cache and Shared Memory: Bus Systems – Shared-Memory Organizations. Pipelining and Superscalar Techniques: Linear Pipeline Processors – Nonlinear Pipeline Processors.	18
	Activities – Draw a 5-stage linear pipeline, identify hazards (data, structural, control), Apply forwarding and stall techniques, Calculate CPI. Case Study on Memory Hierarchy & Bus Organization.	
III	**Multiprocessors and Multicomputers:** Multiprocessor System Interconnects – Cache Coherence and Synchronization Mechanisms - Message Passing Mechanisms. Multivector and SIMD Computers: SIMD Computer Organizations –The Connection Machine CM-5. Scalable, Multithreaded, and Dataflow Architectures : Fine-Grain Multicomputers.	18
	Activities – Make an interconnection network analysis. Draw Cache Coherence & Synchronization Simulation	
IV	**Software for Parallel Programming:** Parallel Programming Models – Parallel Languages and Compilers – Dependence Analysis of Data Arrays –Parallel Program Development and Environments : Parallel Programming Environments – Synchornization and Multiprocessing Modes–Message Passing Program Development.	18
	Activities – Compare the model identification of the following, Shared Memory Model (OpenMP), Message Passing Model (MPI), Data Parallel Model, Task Parallel Model. Make a data dependence analysis.	
V	**Instruction and System Level Parallelism:** Instruction Level Parallelism **–** Trends in Parallel Systems: Brief Overview of Technology – Forms of Parallelism – Case Studies.	18
	Activities – Apply Pipeline scheduling, Loop unrolling, Register renaming. Compare Static vs Dynamic Scheduling.	
VI	**Current Trends (For CIA only) –** 32-bit Advanced RISC Machine, 32-bit Intel Architecture, PowerPC Architecture	

Text Book(s):
Kai Hwang, "Advanced Computer Architecture, "Tata McGraw-Hill International Edition Singapore, 2003.
Reference Book(s):
1. Kai Hwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, Singapore, 1985. 2. 2. Michael J.Quinn, "Parallel Computing, Theory and Practice", McGrawHill, International Edition, Singapore, 1994.
Web Resource(s):
1. https://www.pdfdrive.com/advanced-computer-architecture-e5799174.html 2. https://www.researchgate.net/publication/255178777_UNIT_1_Advanced_Computer_Architecture Introduction 3. https://onlinecourses.nptel.ac.in/noc23_cs07/preview

Course Outcomes		
Upon successful completion of this course, the students will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the different parallel computer models and compare the program flow mechanisms with network properties.	K2
CO2	Identify the advanced processor technologies like super scalar, vector, pipeline processors and make use of bus, cache and superscalar techniques.	K3
CO3	Analyze multiprocessor system concepts with message passing mechanism and examine the concepts of SIMD computers.	K4
CO4	Evaluate the parallel programming models, languages, compilers and estimate the Parallel Program Development and Environments	K5
CO5	Adapt the Instruction level Parallelism and estimate the recent trends in Parallel System	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	2	3	2	3	3	2	2	2.5
CO2	3	3	3	2	2	3	2	2	2	2	2.4
CO3	3	2	2	3	2	3	2	3	3	2	2.5
CO4	2	3	2	2	2	3	2	2	2	2	2.2
CO5	3	2	3	2	3	3	2	3	2	2	2.5
										Mean Overall Score	2.42
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. K. Syed Kousar Niasi **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1CP04A	Core -IV(a)	3	2	10	40	50
Course Title	Java Programming - Practical						

Using NetBeans IDE, develop the Java application to:

1. Prepare a student report using class and objects.
2. Implement single inheritance to find area & perimeter of a Rectangle.
3. Display an Employee Salary using abstract class
4. Demonstrate Exceptions handling (atleast three).
5. Create two threads using Runnable interface for displaying factorials of first five natural numbers.
6. Arrange the given set of names in alphabetical order using String handling methods.
7. Demonstrate various operations on Vector and ArrayList classes.
8. Demonstrate UDP Sockets.
9. Send a text message from one system to another using TCP/IP Sockets.
10. Send and receive value between client and server using RMI technique.
11. Prepare an invoice using Swing controls and to store the details in a database using JDBC.
12. Create three buttons with caption Red, Green and Blue using Swing and set the background color by clicking the relevant buttons.

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Apply the Operators and various control statements	K2
CO2	Compare and contrast the three types of looping statements	K3
CO3	Apply the concept of class, inheritance, interfaces and packages in a problem domain	K4
CO4	Distinguish between method overloading and method overriding	K5
CO5	Formulate the power of Multithreading, Exception handling and Event handling techniques using Java Swing	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	3	3	2	2.8
CO2	3	3	2	2	3	3	3	3	3	2	2.7
CO3	3	3	2	2	2	3	3	3	2	2	2.5
CO4	3	3	3	3	3	3	2	3	3	3	2.9
CO5	3	2	2	2	3	3	3	3	3	3	2.7
Mean Overall Score											2.72
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Abdul Saleem **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1CP04B	Core – IV(b)	3	2	10	40	50

Course Title	Web Programming Lab – Practical

Develop a ASP.NET programs to

1. a) Demonstrate String Object.

b) Display first N Fibonocci numbers.

c) Find the eligibility of admission for a professional course based on the following criteria:

Marks in Mathematics >=65, Marks in Physics>=55, Marks in Chemistry>=50 ,
Total in all three subject >=180,total in Mathematics and Subjects >=140
Test Data :
Input the marks obtained in Physics :65
Input the marks obtained in Chemistry :51
Input the marks obtained in Mathematics :72

2. Web Forms Program:

a) To Make use of Currency Changes.

b) To create a table dynamically.

c) To generate a Greeting Card Automatically.

3. Make use of AdRotator control.

4. Creation of Bio- data using Validation Controls.

5. Implement state management techniques.

6. Implement view state and session state.

7. Manipulate student details using DML Commands through connected approach.

8. Access the data in DataList and DataGrid.

9. Update and delete few records using Disconnected Access for student information system.

10. Perform basic mathematical operations using web services.

11. Client for web service.

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Apply basic programming concepts and develop simple C programs using strings, loops, and conditional statements.	K3
CO2	Demonstrate the ability to design and implement web forms using standard ASP.NET server controls.	K3
CO3	Analyze and apply state management techniques such as View State, Session State, and Cookies in ASP.NET applications.	K4
CO4	Determine database-driven web applications using connected and disconnected approaches with DML operations.	K5
CO5	Construct and use ASP.NET web services to perform basic mathematical operations and client-server communication.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	2	3	2	2	2	2	2.4
CO2	3	3	3	3	2	3	2	2	2	2	2.5
CO3	3	2	3	2	3	2	3	2	3	2	2.5
CO4	3	3	3	2	2	3	2	3	3	2	2.6
CO5	3	3	3	2	3	3	3	3	3	3	2.9
Mean Overall Score											2.56
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: P. Shaik Abdulla **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1DE01:1	Discipline Specific Elective – I	6	4	25	75	100
Course Title	Parallel and Distributed Systems						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Fundamentals of Parallel Computing:** Introduction to Parallel Computing – Motivation and Scope – Parallel vs Distributed Systems – Flynn's Taxonomy – Types of Parallelism (Data, Task, Pipeline) – Performance Metrics: Speedup, Efficiency, Scalability – Amdahl's Law and Gustafson's Law.	18
	Activities – Case study discussion on performance gain using parallelism - Worksheet on speedup and efficiency calculations - Seminar on real-world parallel applications	
II	**Parallel Architectures:** Shared Memory Architectures – Distributed Memory Architectures – Hybrid Architectures – SIMD, MIMD Systems – Multicore and Manycore Processors – Cache Coherence – NUMA Architectures.	18
	Activities – Architecture comparison chart preparation - Group presentation on multicore processors - Diagrammatic assignment on memory architectures	
III	**Parallel Programming Models:** Parallel Programming Paradigms – Shared Memory Programming (OpenMP concepts) – Message Passing Programming (MPI concepts) – Data Parallel Programming – Thread Models – Synchronization and Communication.	18
	Activities – Hands-on pseudocode writing for OpenMP/MPI - Debugging discussion on race conditions - Mini project proposal on parallel algorithms	
IV	**Distributed Systems Concepts:** Distributed System Models – Communication in Distributed Systems – RPC and RMI – Time and Global State – Logical Clocks – Mutual Exclusion – Deadlocks – Election Algorithms.	18
	Activities – Algorithm dry-run sessions - Role-play activity for mutual exclusion - Quiz on distributed algorithms	
V	**Distributed File Systems and Scheduling:** Distributed File Systems – Naming and Synchronization – Load Balancing – Scheduling Algorithms – Fault Tolerance – Consistency Models – Introduction to Cluster and Grid Computing.	18
	Activities – Case study on Google File System - Scheduling algorithm comparison table - Assignment on fault tolerance techniques	
VI	**Current Trends (For CIA only) –Contemporary developments related to the course during the semester concerned:** Cloud-based Parallel Processing - MapReduce and Big Data Processing Frameworks	

Text Book(s):

1. Ananth Grama Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Pearson, 2nd Edition, 2003, Chapters 1–4.
2. Andrew S. Tanenbaum & Maarten van Steen, Distributed Systems: Principles and Paradigms, Pearson, 2nd Edition, 2007, Chapters 1–6.

Reference Book(s):

1. Kai Hwang, Advanced Computer Architecture, McGraw Hill, 2nd Edition, 2015.
2. George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Distributed Systems: Concepts and Design, Pearson, 5th Edition, 2012.

Web Resource(s):
1. https://nptel.ac.in/courses/106106107 2. https://www.geeksforgeeks.org/parallel-computing/ 3. https://developer.nvidia.com/cuda-zone

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Explain the fundamentals and architectures of parallel systems	K2
CO2	Compute performance metrics of parallel algorithms	K3
CO3	Analyze parallel programming models to solve problems	K4
CO4	Determine distributed system concepts and algorithms	K5
CO5	Formulate current trends in parallel and distributed computing	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	2	2	3	2	2	2	2	2.2
CO2	2	3	2	2	2	2	3	2	2	2	2.2
CO3	2	2	3	2	2	2	2	3	2	2	2.2
CO4	2	2	2	3	2	2	2	2	3	2	2.2
CO5	2	2	2	2	3	2	2	2	2	3	2.2
										Mean Overall Score	2.20
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S.A. Jameel **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	26PCS1DE01:2	Discipline Specific Elective – I	6	4	25	75	100

Course Title	Big Data Analytics

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction to Big Data:** Characteristics of Big Data (5 V's)-Architecture of big data systems-Traditional data systems- Core layers of Big Data systems- Service layers- Difference between traditional and big data systems - Roles of data science team- Big Data Use Cases and Applications-Advantages of big data-Challenges faced by Big Data systems.	18
	Activities: Learn to clearly articulate the business problem or question that the analytics project aims to solve.	
II	**Introduction to NoSQL:** Key features of NoSQL Databases- Challenges of NoSQL databases-SQL vs NoSQL,Use of NoSQL -Principle of NoSQLdata models –CAP - Base- Consistency - Availability- Partioning – NoSQL data models - NoSQL comparison - Case study.	18
	Activities: Master the gathering of data from various sources (internal databases, external APIs, social media, IoT sensors, etc.) and then explain preprocessing techniques.	
III	**Big Data Technologies and Frameworks:** Introduction to Hadoop-Hadoop Architecture- MapReduce Architecture - MapReduce Programming –optimizing map reduce tasks- Hadoop Ecosystem Components-hdfs-YARN- Pig-Hive-HBase-Oozie	18
	Activities: Install hadoop in windows platform and execute either word count or line count programs.	
IV	**Big Data Analytics and Data Processing:** Data Analytics Life Cycle-issues in applying SDLC for data centric projects -Life cycle for Data centric projects –Big data life cycle -Introduction to processing – Measures of central tendency-Dispersion of data- Feature selection- Principal component analysis-Importance of feature selection in machine learning. Introduction to Data streams – Processing data streams- Data streaming architecture using kafka and spark – The role of Big Data Analytics in Decision Making.	18
	Activities: Select appropriate models and analytical techniques (e.g., statistical analysis, machine learning algorithms) and then explain the patterns and trends within the data.	
V	**Big data technology and tools:** Overview of spark- Spark architecture - Job execution in spark - Storm architecture- Working with Rstorm- Big data infrastructure– Architecture for data intensive computing- Clusters-Parallel database architecture- Sharing and replication-Big data management in clouds – Characteristics of cloud environment- Cloud models- Big data virtualization	18
	Activities: Popular big data visualization tools include interactive platforms like Tableau, Power BI for business intelligence and compare the features in each case.	
VI	**Current Trends (For CIA only) –** Agentic and Generative AI, Augmented Analytics and Data Democratization	

Text Book(s):
G. Sudha Sadasivam and R Thirumahal , “Big Data Analytics”, oxford university press, New Delhi,
Reference Book(s):
Judith Hurwitz, Alan Nugent, Dr. Fern Halper and Marcia Kaufman , Big Data for Dummies, Wiley India Private Ltd.
Web Resource(s)
1. https://www.anodot.com/blogtop-12-analytics-websites 2. https://www.ibm.com/think/topics/nosql-databases 3. https://www.geeksforgeeks.org/dbms/introduction-to-nosql (Unit-II)

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand Big Data concepts and their characteristics	K2
CO2	Analyze Big Data frameworks and tools	K3
CO3	Discuss NoSQL databases for large-scale data	K4
CO4	Evaluate analytics on structured and unstructured data	K5
CO5	Explain real-world Big Data applications	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	3	3	2	2	2	3	2.5
CO2	3	3	2	2	3	2	3	2	3	2	2.5
CO3	3	2	3	2	3	2	3	2	3	2	2.5
CO4	2	3	2	3	2	2	3	2	2	2	2.3
CO5	3	2	2	3	3	2	2	2	2	3	2.4
									Mean Overall Score		2.44
									Correlation		Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. Mozibur Raheman Khan **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	26PCS2CC05	Core – V	6	5	25	75	100

Course Title	Design and Analysis of Algorithms

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction:** Algorithm Definition – Algorithm Specification – Performance Analysis. Elementary Data Structures: Stacks and Queues – Trees – Dictionaries – Priority Queues – Sets and Disjoint Set Union – Graphs.	18
	Activities: Perform algorithm definition, specification, and performance analysis through hands-on problem solving. apply elementary data structures in practical scenarios.	
II	**Divide and Conquer:** The General Method – Defective Chessboard – Binary Search – Finding the Maximum and Minimum – Merge Sort – Quick Sort – Selection - Strassen's Matrix Multiplication.	18
	Activities: Apply the General Method (Divide and Conquer) to classic problems and understand recursive thinking. Compare classical vs optimized algorithms and understand when advanced algorithms are beneficial.	
III	**The Greedy Method:** The General Method - Container Loading - Knapsack Problem - Tree Vertex Splitting – Job Sequencing with Deadlines - Minimum Cost Spanning Trees - Optimal Storage on Tapes – Optimal Merge Patterns - Single Source Shortest Paths.	18
	Activities: Apply how greedy choice strategies work and where they succeed or fail. Analyze and apply graph algorithms for optimization and shortest-path problems.	
IV	**Dynamic Programming:** The General Method – Multistage Graphs – All-Pairs Shortest Paths – Single-Source Shortest Paths - Optimal Binary Search Trees - String Editing - 0/1Knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Biconnected Components and DFS.	18
	Activities: Apply the General Method of Dynamic Programming to solve optimization problems efficiently. Implement basic traversal and search techniques for trees and graphs.	
V	**Backtracking:** The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack Problem- Branch and Bound: The Method - 0/1 Knapsack Problem .	18
	Activities: Perform the General Method of Backtracking by exploring solution spaces and pruning invalid paths. Apply how Branch and Bound improves efficiency by eliminating non-promising solutions.	
VI	Current Trends (For CIA only): Randomization, Incremental improvement	

Text Book(s):
Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, Second Edition, Reprint 2009
Reference Book(s):
Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Second Edition, 2011.

Web Resource(s):
1. https://www.javatpoint.com/daa-algorithm-design-techniques/ 2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf 3. https://onlinecourses.nptel.ac.in/noc22_cs92/preview

Course Outcomes		
Upon successful completion of this course, the students will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Select appropriate data structures for any specified problem	K1
CO2	Implement the various operations such as Traverse, Search, Insert and Delete	K2
CO3	Apply the proper algorithm in the design of new method for problem solving	K3
CO4	learn mathematical background for analyzing algorithm	K4
CO5	Evaluate the algorithms and data structures used in the problem to determine the time and memory consumption	K5& K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	3	3	2	3	3	2	2.7
CO2	3	3	2	3	2	3	3	2	2	3	2.6
CO3	3	3	3	3	2	3	3	3	2	2	2.7
CO4	3	3	3	3	2	3	2	3	3	2	2.7
CO5	3	3	3	2	3	3	3	3	3	2	2.8
										Mean Overall Score	2.70
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. O. S. Abdul Qadir **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	26PCS2CC06	Core – VI	6	5	25	75	100

Course Title	Database Systems

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction:** Database System Applications – Purpose of Database Systems – Views of Data – Database Languages – Data Storage and Querying – Database Users and Administrator – Structure of Relational Database – Keys – Schema Diagrams – Formal Relational Query Languages – Relational Algebra – The Tuple Relational Calculus – The Domain Relational Calculus	18
	Activities: Case Study Scenario: A College Library System wants to store information about Books, Students, and Borrowing details in a database. Tasks: Identify Database Components. A. List at least three applications of database systems used in a college. B. State the purpose of using a database instead of a file system for the library.	
II	**Introduction to SQL:** Overview of SQL – SQL Definition – Basic Structure of SQL Queries – Additional Basic Operations – Set Operations – Null Values – Aggregate Functions – Nested Sub-queries – Modification of the database - Intermediate SQL: Join Expression – Views. Database Design: Entity Relationship Model – Constraints – Entity-Relationship Diagram	18
	Activities: Students will design a simple database, create tables using SQL, and perform various SQL operations based on a given real-world scenario.	
III	**Normalization:** Purpose of Normalization – How Normalization Support Database Design – Data Redundancy and Update Anomalies – Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form. Advanced Normalization: More on Functional Dependencies – BCNF – 4NF – 5NF.	18
	Activities: Students will analyze an unnormalized relation, identify functional dependencies, detect anomalies**,** and convert the relation step-by-step into higher normal forms**.**	
IV	**Transaction:** Transaction Concept – A simple Transaction Model – Storage Structure – Transaction Atomicity and Durability – Transaction Isolation – Serializability – Concurrency Control: Lock-Based Protocol – Timestamp-Based Protocol – Validation-Based Protocol – Recovery Systems: Failure Classification – Recovery and Atomicity.	18
	Activities: Students will analyze transaction schedules, identify conflicts, determine serializability, and study failure and recovery scenarios.Case Study Scenario: A Banking System performs multiple transactions on customer accounts simultaneously.	
V	**Database-System Architectures:** Centralized and Client-Server Architectures – Server System Architecture. Distributed Databases: Homogeneous and Heterogeneous Databases – Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control in Distributed Database.	18
	Activities: Students will analyze a real-world distributed database scenario, identify architectural components, and explain how data is stored and transactions are managed across multiple sites. Case Study Scenario: A University has multiple campuses located in different cities. Each campus maintains its own database, but the central administration needs integrated access to student and examination data.	
VI	Current Trends(For CIA only): MongoDB, Parallel Database Systems and Cloud Databases.	

Text Book(s):

1. Abraham Silberschatz, Hendry F. Korth and S. Sudarshan, Database System Concepts, 7 th Edition, McGraw- Hill International Edition, 2019.
2. Thomas M.Connolly, Carolyn E.Begg, Database Systems A Practical Approach to Design, Implementation, and Management, 4th Edition, Pearson Education, Fifth Impression, 2012.

Reference Book(s):
1. C.J. Date, A. Kannan and S. Swaminathan, An Introduction to Database Systems, 8th Edition, Pearson Education Asia, 2000. 2. Fundamentals of Database Systems, 5th Edition by Ramez Elmasri, Shamkant B. Navathe, Pearson Education Ltd, 2016.
Web Resource(s)
1. https://www.db-book.com/db6/slide-dir/ 2. https://www.geeksforgeeks.org/basic-database-concepts 3. https://onlinecourses.nptel.ac.in/noc23_cs29/preview

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the features of RDBMS and compare them with file system.	K1, K2
CO2	Apply SQL queries on created tables in Relational Databases	K3
CO3	Examine techniques pertaining to Database design practices	K4
CO4	Explain the working principle of commit protocols and concurrency control.	K5
CO5	Create various advanced SQL queries related to Transaction Processing & Locking.	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	3	3	2	3	3	2	2.5
CO2	3	3	2	3	2	3	3	3	2	2	2.5
CO3	3	2	2	3	3	2	3	2	3	2	2.6
CO4	2	3	2	2	2	3	3	3	3	2	2.5
CO5	3	2	2	3	3	3	2	3	3	3	2.6
									Mean Overall Score		2.54
									Correlation		High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. Mozibur Raheman Khan **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	26PCS2CC07	Core - VII	6	5	25	75	100
Course Title	Python for Data Science						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction:** Using Python - Displaying Output with the print Function – Variables - Reading Input from the Keyboard - Simple Functions: Introduction to Functions - Defining and Calling a Function - Decision Structures and Boolean Logic: The if Statement - The if-else Statement - Comparing Strings – Nested Decision Structures and the if-elif-else Statement - Logical Operators - Boolean Variables - Repetition Structures: The while Loop: a Condition- Controlled Loop - The for Loop: a Count-Controlled Loop - Sentinels – Input Validation Loops - Nested Loops. **Activities** – Display multiple outputs using print, Grade calculator using if-elif-else, Function to calculate area of rectangle, Nested loops to print triangle of stars.	18
II	**Lists and Tuples:** Sequences - Introduction to Lists - List Slicing - Finding Items in Lists with the in Operator - List Methods and Useful Built-in Functions - Copying Lists - Processing Lists - Two-Dimensional Lists - Tuples - More About Strings: Basic String Operations - String Slicing - Testing, Searching and Manipulating Strings - Dictionaries and Sets: Dictionaries - Sets - Serializing Objects - Classes and Object-Oriented Programming: - Classes - Inheritance: Introduction to Inheritance - Polymorphism - Getting MySQL for Python -import MySQL for Python - MySQLDb - Connecting with a Database. **Activities** – Create and slice lists, Create tuples and demonstrate immutability, Define a class and create objects, Demonstrate inheritance and polymorphism, Connect to MySQL database using MySQLdb.	18
III	**Making Sense of Data through Advanced Visualization:** Controlling the line properties of a chart – Creating multiple plots – Playing with text – Styling your plots – Box plots – Heatmaps – Scatter plots with histograms – A scatter plot matrix – Area plots – Bubble charts – Hexagon bin plots – Trellis plots – A 3D plot of a surface. **Activities** – Create multiple plots in one figure, Scatter plots with histograms, Trellis plots, 3D surface plot.	18
IV	**Getting Started with Raw Data**: The world of arrays with NumPy – Creating an array – Mathematical Operations – Squaring an array – Indexing and Slicing – Shape manipulation – Empowering data analysis with Pandas – The data structure of pandas – Inserting and Exporting data – Data cleansing – Data Operations – Joins.. **Activities** – Create arrays with NumPy, Cleanse data (handle missing values), Insert and export data with pandas, Perform data operations (grouping, filtering)	18
V	**Inferential Statistics:** Various forms of distribution – A normal distribution – A Poisson distribution – A Bernoulli distribution – A z-score – A p-value – One- tailed and two-tailed tests – Type 1 and Type 2 errors – A confidence interval – Correlation – Z-test vs T-test – The F distribution – The chi-square distribution – The chi-square test of independence. **Activities** - Plot and analyze normal distribution, Perform one-tailed and two-tailed tests, Perform correlation analysis, Perform chi-square distribution and test of independence.	18
VI	**Current Trends (For CIA only) –** AI**,** Web Development and Analysis of Variance (ANOVA) **(**Contemporary developments related to the course during the semester concerned.)	

Text Book(s):

1. Tony Gaddis, Starting Out with Python, Addison-Wesley Pearson Education, 2nd Edition, 2012
2. Albert Lukaszewski, MySQL for Python, [PACKT] Publishing, 1st Edition, 2010
3. Samir Madhavan, Mastering Python for Data Science, PACKT Publishing, 2015

Reference Book(s):

1. Jake VanderPlas, Python data Science Hand book, O'Reilly Publications, 2016
2. Samuel Burns , Fundamentals of Data Science, Independently Published, 2019

Web Resource(s):

1. https://www.geeksforgeeks.org/data-science-tutorial/
2. https://www.w3schools.com/datascience/
3. https://onlinecourses.nptel.ac.in/noc23_cs21/preview
4. https://www.youtube.com/watch?v=LHBE6Q9XlzI

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Interpret the fundamental concepts of Python Programming	K1, K2
CO2	Apply inferential statistical methods for distribution of data and decision making	K3
CO3	Analyze the sense of data through data visualization techniques	K4
CO4	Influence Python library for working with data sets.	K5
CO5	Develop database application in Python for solving real-time problems	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	3	3	3	2	2.8
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	2	3	2	3	2	3	2	3	3	2.6
CO4	3	3	2	3	3	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	3	3	3	2	2.8
										Mean Overall Score	2.78
										Correlation	High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A. Jainulabudeen **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	26PCS2CP08A	Core – VIII (a)	3	2	10	40	50
Course Title	RDBMS – Practical						

I. Data Definition Languages

1. Create the following relations

Customer (customer-Id (Primary key), customer-name, address)
Account (account-number (Primary key), branch-name, and balance)
Loan (loan-number (Primary key), branch-name, and amount)
Branch (branch-name, branch-city, assets)
Depositor (customer-name, account-number)
Borrower (customer-name, loan-number)
Supplier (supplier-number, part-number, color, quantity) use the candidate key

2. Unique and Check constraints
3. Write a DDL query to perform the foreign key with on delete cascade
4. Alter with three options

Add – add columns in the existing table
Add – constraints
Modify – modify the data type and size in the existing table
Drop – delete column from existing table

II. Data Manipulation Language

1. Arithmetic, Logical, Comparison operations
2. String Operations

(a) Finds any values that start with "a"
(b) Finds any values that end with "a"
(c) Finds any values that have “ar" in any position
(d) Finds any values that have "r" in the second position
(e) Finds any values that start with "a" and are at least 2 characters in length
(f) Finds any values that start with "a" and are at least 3 characters in length
(g) Finds any values that start with “J" and end with “y"

4. Tuple Variables

Using the branch relation, to find the names of all branches that have assets greater than at least one branch located in a city (any city)

5. Ordering of Tuples

(a) To list in alphabetic order all customers who have loan at a branch
(b) To list customer names in descending order.

6. Set Operations – (union, intersection, minus)

(a) Find all customers having a loan, an account or both at the bank.
(b) Find all customers who have both a loan and account at the bank.
(c) Find all customers who have an account but no loan at the bank.

7. Aggregate functions with group by and having clause)

(a) Find the average account balance at each branch.
(b) Find branch names those branches where the total balance is more than Rs.100000
(c) Find the branches those branch where the total accounts are more than 3.

8. Nested sub-queries.

Membership (in and not in)
(a) Find all customers who have both a loan and account at the bank.
(b) Find all customers who have an account but no loan at the bank.
Set Comparison (some, all)
(c) Using branch relation, Find the names of all branches that have asset value greater than at least one branch located in a city (any city)
(d) Find the names of all branches that have asset value greater than that of each branch located in a city (any city)

9. Views

Create the view consisting of names of customers and branch-names who have either loan or an account at the branch.

10. Deletion

(a) Delete the tuples of all accounts with balances below the average at the bank

(b) Delete all account tuples at every branch located in a city (any city)

11. Updates

(a) All balances are to be increased by 5 percent.

(b) Update with case statements all accounts with balances over 10000 receives 10 percent interest where as others receive 5 percent

12. Join Operations

(a) Inner join – Find the names of customers who have loan from a branch

(b) Left outer join – Show the loans that were not buy by any customers

(c) Right outer join – Show customers who bought loans for which no corresponding loan record exists.

(d) Full outer join

(e) Natural join

IV. PL/SQL Procedure

1. Reverse the string.
2. Student Mark Sheet Preparation
3. Pay-Roll preparation
4. Find the factorial number using the recursive function.
5. Program using Implicit and Explicit Cursor
6. Exception Handling

V. SQL Forms

1. Student Mark System
2. EB bill Preparation
3. Income Tax Calculation

Course Outcomes		
Upon successful completion of this course, the students will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Learn how to retrieve and manipulate data from one or more tables	K1
CO2	Understand how the relationship between tables affect the SQL	K2
CO3	Apply the PL/SQL procedures for implementing tasks	K3
CO4	Compare the various join operations	K5
CO5	Develop simple applications using SQL Forms	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	3	3	2	2.8
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	2	3	2	3	2	3	2	3	3	2.6
CO4	3	3	2	3	3	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	3	3	3	2	2.8
Mean Overall Score											2.78
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Co-ordinator: Dr. S. Syed Ibrahim **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	MarksforEvaluation		
					CIA	ESE	Total
II	26PCS2CP08B	Core - VIII (b)	3	2	10	40	50
Course Title	Data Science Lab – Practical						

1. a) Program to create an numpy array, rank1 array, rank2 array and create an array from tuple.
   b) Program to demonstrate indexing in numpy array.

2. a) Program to demonstrate basic operations, unary and binary operations in numpy array.
   b) Program to demonstrate vertical and horizontal (stacking and splitting)

3. Program to create a date, array of dates in a month, arithmetic operations on dates and sorting on dates.

4. a) Program that uses various methods to apply linear algebra on any numpy array.
   b) Program to create array with all zeroes and ones.

5. a) Python program to create pandas series with scalar values, default index values and predefined index values.
   b) Python program to create Dictionary series, ndarray series.
   c) Program to create data frame with two dictionaries
   d) Program to create data frame of three series and from 2D array.

6. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.

7. Use the diabetes data set from UCI and Pima Indians Diabetes data set for performing the following:
   a. Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation
   b. Bivariate analysis: Linear and logistic regression modeling
   c. Multiple Regression analysis
   d. Also compare the results of the above analysis for the two data sets.

Course Outcomes		
Upon successful completion of this course, the students will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Demonstrate operations on Numpy array in Python Programming	K1
CO2	Apply inferential statistical methods for distribution of data and decision making	K3
CO3	Create data frames for using Dictionaries and 2D Arrays	K4
CO4	Invoke Python library modules for working with data sets	K5
CO5	Develop database application in Python for solving real-time problems	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	2	3	3	3	3	2	2.8
CO2	3	3	2	3	3	3	3	3	2	3	2.8
CO3	3	2	3	2	3	2	3	2	3	3	2.6
CO4	3	3	2	3	3	3	3	3	3	3	2.9
CO5	3	3	3	3	2	3	3	3	3	2	2.8
Mean Overall Score											2.78
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A. Jainulabudeen **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	26PCS2DE02:1	Discipline Specific Elective – II	6	4	25	75	100
Course Title	Embedded Systems and IoT						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction to Embedded systems:** Embedded Systems – Processor embedded into a system – software embedded in a system – Embedded hardware units and devices in a system – Embedded system on chip (SoC) – Complex system design and processors – Design process in embedded system - Challenges in Embedded system – Design examples in Embedded System – Classification in Embedded System .	18
	Activities – Identify the Processor used (Microcontroller / DSP / ARM core), Sensors and actuators, Memory components, Communication interfaces, Type of embedded system (Real-time / Networked / Standalone). Create Embedded System Design Process Simulation	
II	**Devices and Communication buses for Devices Network:** I/O types and examples – Serial communication devices – Parallel device ports – Interfacing features in device ports – Wireless devices – Timer and counting devices – Watchdog timer – Network embedded systems – Serial bus communication protocols – Parallel bus device protocols – Internet enabled systems.	18
	Activities – Identify and classify Digital Input: Push button, Digital Output: LED, Analog Input: Temperature sensor, Serial Device: UART module, Parallel Device: LCD display. Create an Internet-enabled embedded system for wireless device.	
III	**Device Drivers**: Interrupt service mechanism – Interrupt sources – Multiple interrupts – Direct memory access – Direct Memory Access - Device driver programming. Interprocess communication and synchronization of processes, threads and tasks – Multiple process in an application – Multiple threads in an application – Tasks – Task states – Semaphores – Semaphore functions – Message queue functions – Pipe functions – Socket functions – RPC functions .	18
	Activities – Create Interrupt & DMA Based Device Driver Simulation. Develop small application using producer-consumer problem, reader-writer problem.	
IV	**Introduction:** Definition and Characteristics of IoT - Things in IoT-IoT Protocols-IoT Functional Blocks-IoT Communication Models-IoT Communication APIs - IoT Enabling Technologies: Wireless Sensor Networks-Cloud Computing- Big Data Analytics - Communication Protocols-Embedded System.	18
	Activities – Identify Devices (Things), Sensors & Actuators, Gateway, Cloud platform, Data analytics engine, User interface. Use ESP32 and Arduino Uno for temperature sensor.	
V	**Domain Specific IoTs:** Introduction – Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health & Lifestyle. IoT & M2M: Machine to Machine-Difference between IoT and M2M-SDN and NFV for IoT.	18
	Activities – Compare IoT-based approach and traditional M2M based solution. Explore control plane, data plane and SDN controller.	
VI	**Current Trends (For CIA only) –** Embedded security by design, advanced hardware integration**,** IoT supply chain issues, AI support for IoT data analytics, New chip design and standards	

Text Book:
1. Embedded systems – Architecture, Programming and Design by Raj Kamal, Second Edition – TMH, 2008. 2,Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press (India) Private Limited, 1st Edition, 2015.
Reference Book(s):
1. Mohamed Ali Maszidi & Janice Gillispie Maszidi, "The 8051 Microcontroller and Embedded System", Pearson Publishers, 2007. 2.Cuno Pfister, "Getting started with the internet of things", O'Rielly Publication.
Web Resource(s):
1. https://www.tutorialspoint.com/embedded_systems/index.htm 2. http://www.internet-of-things-book.com 3. https://www.tutorialspoint.com/internet_of_things/index.htm

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the fundamental concepts, characteristics, and components of embedded systems.	K2
CO2	Identify and describe interfacing features of serial ports, parallel ports, and wireless devices used in embedded systems.	K3
CO3	Analyze multiple interrupt handling techniques and the operation of Direct Memory Access (DMA) in improving system performance.	K4
CO4	Determine on the underlying concepts of Internet of Things.	K5
CO5	Design the various IoT enabling technologies and comprehend the idea of M2M.	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	2	2	3	2	3	2	2	3	2.4
CO2	3	2	2	3	3	3	3	2	2	3	2.6
CO3	2	3	3	2	2	3	2	2	2	3	2.4
CO4	3	2	3	2	3	3	2	2	2	2	2.2
CO5	3	3	3	2	2	2	2	3	2	3	2.4
										Mean Overall Score	2.40
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. K. Syed Kousar Niasi **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	MarksforEvaluation		
					CIA	ESE	Total
II	26PCS2DE02:2	Discipline Specific Elective – II	6	4	25	75	100
Course Title	Computer Networks & Cryptography						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Introduction**: Uses of Computer Networks – Network Technology, From Local To Global - Network Protocols: Design Goals, Protocol Layering, Connections and Reliability Service Primitives. Reference Models: The OSI Reference Model–- The TCP/IP Reference Model. The Physical Layer: Guided Transmission Media – Twisted Pair, Coaxial Cable, and Fiber Optics - The Public Switched Telephone Network: Structure of the Telephone System – Switching	18
	Activities – Scale and usage of each network, why protocols are necessary	
II	**The Data Link Layer:** Data Link Layer Design Issues: Framing - Error Control - Flow Control. Error Detection and Correction – Elementary Data Link Protocols – Improving Efficiency. The Medium Access Control Sub-Layer Multiple Access Protocols: Carrier Sense Multiple Access Protocols – Collision-Free Protocols – Ethernet: Switched Ethernet – Fast Ethernet – Giga Ethernet - BLUETOOTH	18
	Activities – Identify and correct a single-bit error, understanding the frame methods	
III	**The Network Layer:** Design Issues – Routing Algorithms: The Optimality Principle– Shortest Path Algorithm– Distance Vector Routing– Link State Routing– Hierarchical Routing – Broadcast Routing – Congestion - Traffic-Aware Routing - Load Shedding – Choke Packets - Hop-by-Hop Backpressure. The IPv4 Protocol– IP Addresses– IPv6	18
	Activities – Observe the count-to-infinity problem, identify Multiple hosts sending traffic to a single router causing congestion	
IV	**The Transport Layer:** The Transport Service: Services Provided to the Upper Layers – Transport Service Primitives – Berkeley Sockets – Elements of Transport Protocols – The Internet Transport Protocols: UDP – Introduction to UDP –Remote Procedure Call – TCP: Introduction to TCP – The TCP Service Model – The TCP Protocol – The TCP Segment Header.	18
	Activities – Demonstrate TCP three-way handshake using diagrams, implement TCP Server (listens on a port) TCP Client (connect and exchanges messages)	
V	**The Application Layer:** DNS – The DNS Name Space – Domain Resource Records – Electronic Mail: Architecture and Services – The User Agent – Network Security: Cryptography – Introduction – Substitution & Transposition Ciphers – DES – RSA– Symmetric-Key Signatures – Public- Key Signatures – Communication Security: Firewalls– VPN– Authentication Protocols– Authentication Based on a Shared Secret Key – Establishing a Shared Key: The Diffie-Hellman Key Exchange.	18
	Activities – Practice a small challenge-response example with a shared key. Analyze DNS Name Space hierarchy.	
VI	**Current Trends (For CIA only) –** AI and Machine Learning in Networks	

Text Book(s):
Andrew S. Tanenbaum, Nick Feamster, and David J. Wetherall, Computer Networks, PHI, Sixth Edition, 2021

Reference Book(s):
1. William Stallings, Data and Computer Communication, PHI, Tenth Edition, 2021. 2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition, Tata McGraw-Hill, 2022.
Web Resource(s):
https://unidel.edu.ng/focelibrary/books/103computer%20networks.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Analyze the different types of computer networks, such as PAN, LAN, MAN, and WAN, as well as different types of transmission media. (Analysis)	K1
CO2	Evaluate and compare various network software protocols and their hierarchies, such as the OSI and TCP/IP reference models. (Evaluation)	K2
CO3	Apply knowledge of data link layer design issues and implement error detection and correction methods, MAC protocols, and data link layer switching techniques (synthesis)	K2, K3
CO4	Evaluate and Analyze network layer design issues, including routing algorithms, congestion control algorithms, and IPv4 and IPv6 protocols (Evaluation)	K4, K5
CO5	Evaluate and compare different transport layer services and protocols, including UDP, TCP, and RPC. Also, design and implement secure network applications using cryptographic techniques, firewalls, VPN, and authentication protocols (Evaluation and Synthesis.	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	2	3	2	3	2	2	2.4
CO2	3	3	2	3	2	3	2	3	3	3	2.7
CO3	3	3	2	2	3	3	3	2	3	2	2.6
CO4	2	3	3	2	3	3	3	3	3	2	2.7
CO5	3	2	3	3	2	3	2	2	3	3	2.6
									Mean Overall Score		2.60
									Correlation		High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. S. Syed Ibrahim **HOD**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	26PCS3SL01	Self-Paced Learning Course	-	2	-	100	100
Course Title	Cyber Security & Ethical Hacking						

SYLLABUS	
Unit	**Contents**
I	**Introduction to Cyber Crime:** Introduction – Cybercrime : definition and origins of the word – Cyber Crime and information security – who are cyber criminals? – classifications of cybercrimes – cybercrime : the legal perspectives – Cybercrimes: An Indian perspective – Cyber Crime and the Indian ITA 2000 – A global perspective on cybercrimes
II	**Cyber offences:** How criminals Plan them: Introduction – How criminals plan the attacks – Social Engineering – cyberstalking – cybercafes and cybercrimes – Bot-nets: the fuels for cybercrime – attack vector – cloud computing
III	**Cybercrime:** Mobile and wireless devices: Introduction – Proliferation of mobile and wireless devices– credit card frauds in mobile and wireless computing era – Attacks on Mobiles/Cell phones – Tools and Methods used in Cybercrime: Introduction – Proxy servers and Anonymizers – Phishing – Password cracking – Keyloggers and spywares virus and worms – Trojan horses and backdoors – Steganography – DoS and DDoS Attacks – Attacks on wireless networks
IV	**Ethical Hacking Overviews:** Principles of Ethical hacking – Hacking Methodologies – Role of Ethical Hacker – Scope & Limitations of Hacking – Cyber Threats and Attacks Vectors – Hacking Tools and Techniques – Policies and Controls.
V	**Footprinting and Reconnaissance** – System Hacking – Sniffers - Trojans, Backdoors, Viruses and Worms – Session Hijacking – Social Engineering – Denial of Service.

Text Book(s):

1. A. Nina GodBole, Sunit Belapure, “Cyber Security Understanding Cybercrimes, Computer Forensics and Legal perspectives”, Wiley Publications, 2011
2. Mayank Bhusan, Rajumar Singh Rathore, Aatif Jamshed, “Fundamental of Cyber Security (Principles, Theory and Practices), 2017
3. Nabie Y Conteh, “Ethical Hacking Techniques and Countermeasures for Cybercrime Prevention”, IGI Global, 2021

Reference Book(s):

1. James Graham, Richard Howard, Ryan Olson, “Cyber Security Essesntials”, CRC Press, 2011
2. Jon Erickson, “Hacking The Art Of Exploitation”, William Pollock, 2008

Web Resource(s):

1. https://www.scribd.com/document/820803159/Cyber-Security-by-Nina-Godbole-TEXT-BOOK
2. https://archive.org/details/hackingtheartofexploitation_202003/page/n39/mode/2up
3. https://github.com/imrk51/hacking-books/blob/master/Jon%20Erickson%20-%20Hacking%20Art%20of%20Exploitation.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Understand the underlying motivations behind cybercrime, such as financial gain, espionage, activism, and disruption.	K1&K2
CO2	Apply the knowledge of mobile devices security principles to assess and mitigate risks associated with credit card frauds.	K3
CO3	Analyze the knowledge of cybercriminal behavior, identify key factors that contribute to the success or failure of cyber offenses	K4
CO4	Evaluate the various types of hacking and its principles	K5
CO5	Explain the tools and techniques for hacking and also their limitations	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	3	2	3	2	2	2	2	2.4
CO2	3	3	3	3	2	3	2	2	2	2	2.5
CO3	3	3	2	3	2	3	2	2	2	2	2.4
CO4	3	3	3	2	2	3	2	2	2	2	2.4
CO5	3	3	3	3	2	3	3	3	3	3	2.9
Mean Overall Score											2.52
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: J. Shahitha Banu **HOD**