



Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum

M. Sc. I - Computer Applications

With effect from June 2019

Programme Structure

Semester	Course Code	Course Title	Course	No. of Credits
I	CSA4101	Mathematical Foundation	TCore-1	04
	CSA4102	Operating Systems	TCore-2	04
	CSA4103	Python Programming	TCore-3	04
	CSA4104	Database Management Systems	TCore-4	04
	CSA4105	Computer Applications Practical - I (Lab Based on Python Programming and Databases)	PCore-1	04
	CSA4106	Computer Applications Practical - II (Lab Based on Operating Systems)	PCore-2	04
II	CSA4201	Data Mining and Data Warehousing	TCore-5	04
	CSA4202	Core Java	TCore-6	04
	CSA4203	Web Technologies	D Elect-1	04
	CSA4204	Networking Concepts	D Elect-2	04
	CSA4205	Better Spoken English (MOOC-I)	M Elect-1	04
	CSA4206	Problem solving through programming in C (General Elective-I)	D Elect-3	04
	CSA4207	Software Testing	D Elect-4	04
	CSA4208	Bigdata Analytics	D Elect-5	04
	CSA4209	Computer organization and architecture (MOOC-II)	M Elect-2	04
	CSA4210	Advanced 'C' (General Elective-II)	D Elect-6	04
	CSA4211	Computer Applications Practical - III Lab Based on Data mining and Core Java)	PCore-3	04
	CSA4212	Computer Applications Project - I	PCore-4	04

Semester	Course Code	Course Title	Course	No. of Credits
III	CSA5301	Advanced Java	TCore-7	04
	CSA5302	Software Engineering & UML	TCore-8	04
	CSA5303	Advanced Web Technologies	D Elect-7	04
		Mobile Technology	D Elect-8	04

		MOOC – III	M Elect-3	04
		Programming in C++ (General Elective-III)	D Elect-9	04
	CSA5304	Full Stack	D Elect-10	04
		Internet of Things	D Elect-11	04
		Programming, data structures and algorithms using python (MOOC-IV)	M Elect-3	04
		Data Structures (General Elective-IV)	D Elect-12	04
	CSA5305	Practical - III (Lab Based on Advanced Java)	PCore-5	04
	CSA5306	Project	PCore-6	04
IV	CSA5401	Industrial Training/ Institutional Project	PCore-7	08

Programme learning outcomes

PO1	Knowledge and Application of computing environment for domain specific solutions.
PO2	Apply knowledge of Mathematics, Computer Science in practice.
PO3	Proficiency in Designing, Analyzing and Developing Computer Applications.
PO4	Expertise in Modern Computing Tools & Techniques and using them with agility.
PO5	Understanding the impact of system solutions in a contemporary, global, economical, and societal context for sustainable development.
PO6	Develop Understanding of cross technological issues.
PO7	Display professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.
PO8	Showing continuous improvement in their professional career through life-long learning, appreciating human values and ethics.
PO9	Express familiarity and understanding of the computing principles by relating these to one's individual work, as a member and leader in a team, to supervise projects in multidisciplinary environments.
PO10	Utilizing strong technical aptitude and domain knowledge to develop smart software solutions for the upliftment of society.
PO11	Study real life problems, design computing systems appropriate to its solutions that are technically sound, economically feasible and socially acceptable.
PO12	Applying research and entrepreneurial skills augmented with a rich set of communication, teamwork and leadership skills to excel in their profession.

CSA4101 Mathematical Foundation
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Understand sets and their associated operations.	Discuss various concepts and operations of sets on Blackboard with examples. Explain various problems on sets using Venn diagrams.
Analyze various binary relations, characteristic function and Recursive functions.	Discuss various concepts and operations of relations and functions on Blackboard with examples. Represent the given relation in matrix, digraph and vice versa.
Learn principles of Counting, The Pigeon-Hole Principle, and Solving Recurrence Relations and Non-homogeneous Recurrence relations.	Discuss principles of Counting, The Pigeon-Hole Principle, forming and solving of recurrence relations and non homogeneous recurrence relations using different methods on the Blackboard with examples.
Understand logical operators, Implications, Tautologies, validity of arguments, and quantifiers	Discuss various ways of writing arguments using logical notations. Explain different ways of expressing the statements using propositional and predicate logic techniques.
Model problems using Graphs, connectivity, Minimum Spanning Trees.	Discuss various concepts of Graphs and Trees on Blackboard with examples. Explain different traversal methods for trees and graphs with examples.
Apply probability theory via Bayes' Rule.	Explain concepts of probability on Blackboard with examples. Discuss about Bayes' Rule.
Understand basic statistical concepts such as measures of central tendency, dispersion, and correlation and regression analysis.	Explain about basic statistical concepts such as measures of central tendency, dispersion, and correlation and regression analysis on Blackboard with examples.
Learn basics of vector spaces.	Explain about basics of vector spaces Blackboard with examples.

Unit No.	Title of Unit and Contents
I	Sets, Relations and Functions 1.1 Sets 1.2 Relations and functions 1.3 Methods of proof 1.4 Equivalence relations 1.5 Cardinality
II	Introductory Logic 2.1 Fundamentals of Logic 2.2 Logic operators such as AND, OR etc., Truth tables 2.3 Logical inferences 2.4 Methods of proofs of an implication 2.5 First order logic 2.6 Predicate calculus Predicates and Quantifiers 2.7 Rules of inference for quantified propositions
III	Recurrence Relations 3.1 Recursion 3.2 Forming and solving recurrence relations by substitution method and generating function 3.3 Method of characteristic roots 3.4 Solving non homogeneous recurrence relations
IV	Theory of Graphs 4.1 Graphs 4.2 Subgraphs 4.3 Isomorphism Proofs 4.4 Types of graphs 4.5 Paths and cycles 4.6 Adjacency matrices 4.7 Transitive closure 4.8 Connectivity 4.9 Directed acyclic graphs 4.10 Planar graphs and Euler's formula 4.11 Dual of a graph 4.12 Hamiltonian and Eulerian graphs 4.13 Applications like matching and colouring graphs 4.14 Graph traversals (BFS and DFS) 4.15 Trees 4.16 Spanning trees
V	Probability and Random Vectors 5.1 Introduction to regular expression to finite automata 5.2 Random vectors 5.3 Conditional Probability 5.4 Bayes Rule 5.5 Random Processes
VI	Basics of statistics 6.1 Introduction to statistics 6.2 Measure of central tendency 6.3 Measure of dispersion 6.4 Best linear unbiased estimator and weighted least-squares, maximum likelihood 6.5 Computing estimates: stochastic gradient descent

	6.6 Bayesian estimation 6.7 Hypothesis testing
VII	Basics of Vector spaces 7.1 Linear Vector spaces 7.2 Linear independence 7.3 Norms and Inner products 7.4 Bases and Orthobases

Learning Resources

1. J. L. Mott, A. Kandel, T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians , PHI, 2008
2. John Truss, Discrete Mathematics for Computer Science, Pearson International, 2009
3. Jean-Paul Tremblay, R Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2017
4. Liu, Introduction to Combinatorial Mathematics (Computer Science Series), First Edition, 1968

CSA4102 Operating Systems
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Understand basic functions and concepts of Operating system.	Discuss various concepts and operations of Operating System using PowerPoint presentation.
Able to learn Architecture of Operating System, process management and memory management.	Explain the architecture of Operating system by drawing a figure on the Blackboard. Explain about concepts, algorithms related to process management and memory management with examples on the Blackboard.
Gain knowledge of process synchronization, CPU scheduling and deadlock.	Explain various concepts and algorithms related to process synchronization, CPU scheduling and deadlock with examples on the Blackboard.
Get familiarity with the concept of I/O and File management.	Explain various concepts and operations of I/O and File management with examples on the Blackboard.
Able to get familiarity with various Memory management techniques and related algorithms.	Explain various concepts and algorithms related to Memory management techniques.

Unit No.	Title of Unit and Contents
I	Introduction to Operating System 1.1 Definition of operating system 1.2 Services provided by OS 1.3 System Calls: definition, implementation
II	Process Management 2.1 Introduction and definition of process 2.2 Process state transition 2.3 Process Control Block 2.4 Process scheduling 2.5 Scheduling queues 2.6 Types of schedulers: Long Term Schedulers, Middle Term Schedulers, Short Term Schedulers, IO Scheduler 2.7 Context Switch
III	CPU Scheduling 3.1 Introduction 3.2 Scheduling Concepts: CPU- I/O Burst Cycle, CPU Scheduler, Pre-emptive and Non-Pre-emptive scheduling, Dispatcher 3.3 Scheduling criteria(terminologies used in scheduling): CPU Utilization, Throughput, Turnaround time, Waiting time, Response time 3.4 Scheduling Algorithms: FCFS,SJF (Preemptive & Nonpreemptive), Priority Scheduling (Preemptive & Nonpreemptive), Round Robin Scheduling 3.5 Multilevel Queues, Multilevel Feedback queues
IV	Process Synchronization 4.1 Introduction 4.2 Critical section problem

	<p>4.3 Semaphores: Concept, Implementation, Deadlock & Starvation</p> <p>4.4 Classic Problems of synchronization: Bounded buffer problem, Readers & writers problem, Dining Philosophers problem</p> <p>4.5 Monitors</p>
V	<p>Deadlocks</p> <p>5.1 Introduction</p> <p>5.2 Deadlock characterization: Necessary Conditions, Resource-Allocation Graph</p> <p>5.3 Methods for handling deadlocks: Deadlock Avoidance</p> <p>5.4 Deadlock Prevention: Mutual Exclusion, Hold and Wait, No Preemption, Circular Wait</p> <p>5.5 Deadlock Avoidance: Safe state, Resource Allocation Graph Algorithm, Banker's Algorithm</p> <p>5.6 Deadlock Detection</p> <p>5.7 Recovery from Deadlock</p>
VI	<p>Memory Management</p> <p>6.1 Introduction to memory management</p> <p>6.2 Problems with memory management</p> <p>6.3 Logical vs. physical addresses</p> <p>6.4 Dynamic vs. Static linking</p> <p>6.5 Swapping</p> <p>6.6 Paging</p> <p>6.7 Structure of Page Table</p> <p>6.8 Segmentation</p> <p>6.9 Virtual memory</p> <p>6.10 Demand paging</p> <p>6.11 Page Replacement: Page replacement Algorithms: FIFO, MRU, LRU, MFU, LFU, Second Chance algorithm, Optimal replacement</p>
VII	<p>File System</p> <p>7.1 Introduction</p> <p>7.2 File concepts : File attributes, File operations, File types, File structure</p> <p>7.3 Access Methods: Sequential Access, Direct Access, Other Access Methods</p> <p>7.4 Directory and Disk Structure</p> <p>7.5 File Protection</p> <p>7.6 Allocation methods: Contiguous allocation, Linked Allocation, Indexed Allocation</p> <p>7.7 Free space management: Bit map or Bit vector, Linked list, Grouping, Counting</p>
VIII	<p>Device Management & I/O System</p> <p>8.1 Introduction</p> <p>8.2 I/O Hardware: Polling, Interrupt (Maskable and Non-maskable)</p> <p>8.3 Kernel I/O Subsystem: I/O Scheduling, Buffering, Caching, Spooling and device Reservation, Error Handling, Kernel Data Structures</p> <p>8.4 Disk Scheduling: First Come First Served (FCFS), Shortest Seek Time First (SSTF), Scan, C-Scan, LOOK, C-LOOK</p>

Learning Resources

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating Systems, – Willey Publication (8th Edition), 2009
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating Systems, – Willey Publication (9th Edition), 2015
3. Pabitra Pal Choudhary, Operating Systems : Principles and Design – (PHI Learning Pvt. Ltd), Paperback, 2009
4. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall (7th Edition), 2017

CSA4103 Python Programming
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Basic understanding of concept of variable, operators, keyword control structure etc.	Presentation method will be applied along with hand on method is preferred
Acquire the knowledge of functions.	Discuss the concepts of functions and their usage with syntax and examples.
Get familiarity with the concepts of strings.	Classroom discussion about concepts of strings and the operators with examples.
Learn the concepts of Data structures using Python.	Explain the concepts and operations of Data structures.
Understand the concepts of Modules.	Explain the concepts of various modules.
Gain the knowledge about functionalities of error and exception handling.	Power point presentation will be used to show the concepts of Error and Exceptional handling. Demo method to show the functionality of error and exceptional handling.
Get familiarity with Standard Library.	Discuss about concepts of Standard Library.
Get familiarity with the concepts of GUI development.	Power point presentation will be used to show the concepts of GUI development. Demo method will be used to show effective way of developing a good GUI.

Unit No.	Title of Unit and Contents
I	Introduction to Python 1.1 History of Python 1.2 Need of Python Programming 1.3 Applications of Python Programming 1.4 Values 1.5 Variables and Keywords 1.6 Operators in Python 1.7 Operator Precedence 1.8 Expressions and Statements 1.9 Accepting Input and Displaying Output 1.10 Putting Comments
II	Conditional Constructs and Looping 2.1 if, if..else statement 2.2 while, for (range function) 2.3 break, continue, else, pass 2.4 Nested Loops 2.5 Use of Compound expression in conditional constructs and looping
III	Functions : Importing Modules 3.1 Invoking built-in functions 3.2 Functions from math module 3.3 Using random() and randint() functions of random module to generate random numbers 3.4 Composition 3.5 Invoking User-defined functions

	<p>3.6 Passing Parameters (Default parameter values, keyword arguments)</p> <p>3.7 Scope of Variables</p> <p>3.8 Void functions and function returning values</p> <p>3.9 Flow of execution</p>
IV	<p>Strings</p> <p>4.1 Creating, Initializing and Accessing Elements</p> <p>4.2 String Operators: +, *, in, not in, range, slice [n:m]</p> <p>4.3 Comparing strings using relational operators</p> <p>4.4 String functions and methods</p> <p>4.5 Pattern matching</p>
V	<p>Data Structures</p> <p>5.1 Concepts of Mutable lists: Creating, Initializing and Accessing elements in lists, Traversing, Updating and Deleting elements</p> <p>5.2 List Operations: Joining, List slices, List functions and methods</p> <p>5.3 Dictionaries: Concept of key-value pair, Creating, Initializing and Accessing elements in a Dictionary, Traversing, Updating and Deleting elements, Dictionary functions and methods</p> <p>5.4 Tuples: Immutable Concept, Creating, Initializing and Accessing elements in a Tuple, Tuple functions</p>
VI	<p>Modules</p> <p>6.1 Executing modules as scripts</p> <p>6.2 The Module Search Path</p> <p>6.3 “Compiled” Python files</p> <p>6.4 Standard Modules</p> <p>6.5 The dir() function</p> <p>6.6 Packages: Importing * from a Package, Intra-Package References, Packages in Multiple Directories</p>
VII	<p>Input and Output</p> <p>7.1 Output Formatting</p> <p>7.2 Reading and Writing Files</p>
VIII	<p>Errors and Exceptions</p> <p>8.1 Syntax Errors</p> <p>8.2 Exceptions: Handling Exceptions, Raising Exceptions User-defined Exceptions</p> <p>8.3 Defining Clean-Up Actions</p> <p>8.4 Predefined Clean-Up Actions</p>
IX	<p>Standard Library</p> <p>9.1 String Pattern Matching</p> <p>9.2 Mathematics</p> <p>9.3 Date and Time</p> <p>9.4 Output Formatting</p>
X	<p>GUI Development</p> <p>10.1 The simple GUI program in Python</p> <p>10.2 Event-driven programming</p> <p>10.3 Changing the layout</p> <p>10.4 Getting input from the user</p> <p>10.5 Examples on GUI: Designing a GUI</p>

Learning Resources

1. Bruce J. MacLennan, Functional Programming: Practice and Theory, 1990
2. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus (Dover Books on Mathematics) Paperback, 2011
3. Kenneth C. Loudon, Programming Languages: Principles and Practice, 3rd Edition, 2013
4. Michael Dawson, Python Programming for the Absolute Beginner, 3rd Edition, Cengage Learning, 2011
5. David Beazley, Python Essential Reference, Third Edition, 2006
6. E-Books: python_tutorial.pdf, python_book_01.pdf
7. Mark Lutz, Learning Python, O'Reilly, 2009
8. <https://docs.python.org>
9. <https://docs.python.org/3/tutorial/index.html>

CSA4104 Database Management Systems

Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Gain a good understanding of the database architecture and functioning of database management systems.	Discuss about database architecture, functioning of database management systems and their associated tools and techniques on the Black board.
Learn the concepts of entity relationship and able to draw entity relationship diagrams.	Discuss about principles of data modeling by using entity relationship and demonstration of entity relationship diagrams by giving various examples of various systems on the Black board.
Develop a good database design by using normalization techniques to normalize a database.	Discuss about normalization and its techniques to normalize a database on the Black board
Able to know the use of structured query language and its syntax.	Discuss various concepts and constructs of Structured query language and their syntax on Blackboard. Demonstration of various constructs on Terminal.
Know the use of transactions, database recovery and techniques for query optimization.	Discuss about the use of transactions, database recovery and various techniques for query optimization with examples on Blackboard.
Obtain a good understanding of database systems concepts and to be in a position to use and design databases for different applications.	Discuss about concepts of database systems and design of databases by giving various examples on the Blackboard.
Understand the need of database processing and learn techniques for controlling the consequences of concurrent data access and recovery of database systems.	Discuss about concepts of concurrency control and database recovery by giving examples on Black board.

Unit No.	Title of Unit and Contents
I	<p>Introduction to Database Systems</p> <p>1.1 Introduction</p> <p>1.2 Basic Concepts and Definition: Data, Information, Data versus Information, Data Warehouse, Metadata, Data Item or Field, Records, Data Dictionary, Database, Database System</p> <p>1.3 Database Users and Database Administrator</p> <p>1.4 Functions and Responsibilities of DBA</p> <p>1.5 File System versus Database System</p> <p>1.6 View of Data</p> <p>1.7 Database Languages</p> <p>1.8 Schemas, Sub-schemas and Instance</p> <p>1.9 3-Level Architecture: Internal Level, Conceptual Level, External Level</p> <p>1.10 Data Independence: Physical Data Independence, Logical Data Independence</p> <p>1.11 Structure of a DBMS</p>

	<p>1.12 Functions of DBMS</p> <p>1.13 Data Models</p>
II	<p>Relational Model</p> <p>2.1 Introduction</p> <p>2.2 Structure of Relational Database</p> <p>2.3 Relational Algebra: Selection Operation, Projection Operation, Union Operation, Cartesian Product Operation, Difference Operation, Intersection Operation, Division Operation, Rename Operation, Join Operation</p>
III	<p>Database and Relational Database Design</p> <p>3.1 Introduction</p> <p>3.2 Basic E-R Concepts</p> <p>3.3 Keys</p> <p>3.4 Constraints</p> <p>3.5 Entity Set</p> <p>3.6 Strong Entity Set</p> <p>3.7 Weak Entity Set</p> <p>3.8 E-R Diagram Symbol</p> <p>3.9 E-R Diagram</p> <p>3.10 Extended E-R features</p> <p>3.11 Conversion of E-R Model into Relations</p> <p>3.12 Functional Dependency</p> <p>3.13 Full Functional Dependency</p> <p>3.14 Armstrong's Axioms</p> <p>3.15 Redundant Functional Dependencies</p> <p>3.16 Closure of a set of Functional Dependencies</p> <p>3.17 Decomposition</p> <p>3.18 Normalization</p> <p>3.19 Normal Forms: First Normal Form, Second Normal Form, Third Normal Form, Boyce - Codd Normal Form (BCNF), Fourth Normal Form, Fifth Normal Form</p>
IV	<p>SQL</p> <p>4.1 Introduction</p> <p>4.2 Data definition</p> <p>4.3 Basic structure of SQL queries</p> <p>4.4 Data types</p> <p>4.5 Integrity constraints</p> <p>4.6 Set operations</p> <p>4.7 Aggregate Functions</p> <p>4.8 Null values</p> <p>4.9 Nested sub-queries</p> <p>4.10 Complex queries</p> <p>4.11 Modification of database</p> <p>4.12 Integrity and Security Constraints</p> <p>4.13 Join relations</p> <p>4.14 Stored Functions</p> <p>4.15 Cursors</p> <p>4.16 Triggers</p> <p>4.17 Views</p> <p>4.18 Security and Authorization</p> <p>4.19 Embedded SQL</p>

	4.20 Dynamic SQL
V	Transaction Management 5.1 Transaction Concepts 5.2 Transaction Properties 5.3 Transaction States 5.4 Concurrent Execution 5.5 Serializability 5.6 Recoverability
VI	Concurrency Control & Database Recovery System 6.1 Introduction 6.2 Lock Based Protocols 6.3 Locks 6.4 Granting of Locks 6.5 Two Phase Locking Protocol 6.6 Time Stamp-Based Protocol 6.7 Thomas Write Rule 6.8 Multiple Granularity 6.9 Deadlock Handling 6.10 Database Recovery Concepts 6.11 Types of Database Recovery 6.12 Recovery Technique 6.13 Deferred Update 6.14 Immediate Update 6.15 Buffer Management

Learning Resources

1. Abraham Silberschatz, Henry Korth, S. Sudarshan, ISBN: 9780071244763, Database Systems Concepts, Tata McGraw Hill,(6th Ed.), 2011
2. Raghu Ramakrishnan, Johannes Gehrke, ISBN: 9780072465631, Database Management Systems, Tata McGraw Hill, (3rd Ed.), 2003
3. Date / Kanna, ISBN, 9788177585568, An Introduction to Database Systems, Pearson, (7th Ed.), 2005
4. Elmasri, Navathe, Fundamentals of Database Systems, Pearson Education, (7th Ed.), 2001
5. Singh, Database Systems: Concepts, Design and Applications, ISBN: 9788131760925, Pearson, (2nd Ed.), 2013
6. Chakrabarti, Advanced Database Management system, ISBN: 9788177228021, Wiley India, 1st Ed., 2014
7. O'Neil, Database-Principles, Programming and Performance, ISBN:9789380501284, Elsevier, 1st Ed., 1998
8. Russell Dyer, MySQL in a Nutshell, 1st Ed., 2009
9. Paul DuBois, MySQL Cookbook 3rd Edition, O'Reilly
10. Paul DuBois, MySQL 4th Edition, O'Reilly
11. Seyed Tahaghoghi, Hugh Williams, Learning MySQL, O'Reilly

CSA4105 Computer Applications Practical - I
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Able to learn different concepts of Python Programming.	Discussion on various concepts of Python programming with the syntax and examples.
Able to understand Database Management System, different aspects of database implementation for the real life problems according to the software industry needs.	Discussion on MySQL commands for the creation of database and queries to handle and manipulate the database, perform different case studies based on the concepts of the syllabus.

Unit No.	Title of Unit and Contents
Assignments based on Python Programming	
1.	To find all prime numbers within a given range.
2.	To print 'n' terms of Fibonacci Series using Iteration.
3.	To demonstrate the use of slicing in string.
4.	Accept a sequence of whitespace separated words as input and prints the words after removing all duplicate words and sorting them alphanumerically.
5.	To demonstrate the use of list & related functions.
6.	To demonstrate the use of Dictionary& related functions.
7.	To demonstrate the use of tuple.
8.	To read and write from a file.
9.	To demonstrate Exception Handling mechanism.
10.	To demonstrate the working of classes and objects.
11.	To demonstrate the use of Composition.
12.	To create a small GUI application for insert, update and delete in a table using MySQL as backend and front end for creating form.
Assignments based on Databases	
1.	Database Creation
2.	Queries
3.	Stored Functions
4.	Cursors
5.	Triggers
6.	Views

Learning Resources

1. Bruce J. MacLennan, Functional Programming: Practice and Theory, 1990
2. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus (Dover Books on Mathematics) Paperback, 2011
3. Kenneth C. Loudon, Programming Languages: Principles and Practice, 3rd Edition, 2013
4. Michael Dawson, Python Programming for the Absolute Beginner, 3rd Edition, Cengage Learning, 2011
5. David Beazley, Python Essential Reference, Third Edition, 2006
6. E-Books: python_tutorial. pdf, python_book_01.pdf
7. Mark Lutz, Learning Python, O'Reilly, 2009
8. <https://docs.python.org>

9. <https://docs.python.org/3/tutorial/index.html>
10. Abraham Silberschatz, Henry Korth, S. Sudarshan, ISBN: 9780071244763, Database Systems Concepts, Tata McGraw Hill,(6th Ed.), 2011
11. Raghu Ramakrishnan, Johannes Gehrke, ISBN: 9780072465631, Database Management Systems, Tata McGraw Hill, (3rd Ed.), 2003
12. Russell Dyer, MySQL Nutshell, 1st Ed., 2009
13. Paul DuBois, MySQL Cookbook 3rd Edition, O'Reilly
14. Paul DuBois, MySQL 4th Edition, O'Reilly
15. Seyed Tahaghoghi, Hugh Williams, Learning MySQL, O'Reilly
16. www.mysql.com

CSA4106 Computer Applications Practical - II
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Choose the best CPU scheduling algorithm for a given problem instance.	Discussion on various concepts of Operating systems such as CPU Scheduling, Paging, Deadlock avoidance, Deadlock detection, File allocations strategies with the syntax and examples.
Identify the performance of various page replacement algorithms.	
Understand the concepts of deadlock avoidance, detection and file allocation methods.	

Unit No.	Title of Unit and Contents
1.	CPU Scheduling
2.	Deadlock – Banker’s Algorithm
3.	Paging
4.	File Allocation Methods

Learning Resources

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating Systems, – Willey Publication (8th Edition), 2009
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating Systems, – Willey Publication (9th Edition), 2015
3. Pabitra Pal Choudhary, Operating Systems : Principles and Design – (PHI Learning Pvt. Ltd), Paperback, 2009
4. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall (7th Edition), 2017

CSA4201 Data Mining and Data Warehousing
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Students will be well aware of structure of Data Warehouse and the ETL process.	Power point presentation for structure of data warehouse and for ETL process the case study should be presented.
Students will get know about different pre processing methodologies.	With the help of various free tools students will be asked to smooth the data. For the same sake different data sets will be used.
Students should able to do some basic descriptive and predictive data mining. And able to compare and contrast different concepts.	Power point presentation to describe the working of the technique and show R code to understand the working of the algorithms.
Students should able to evaluate supervised and unsupervised models based on the accuracy.	Statistical approaches to find the accuracy, various case studies will be presented to evaluate the accuracy.
Students should able to analyse the given problem and using their skills able to solve the practical problem.	Different tools and various readymade datasets will be presented, so that students could able to find out some trends in the data. Classroom discussions and learning by communicating interest will be applied.

Unit No.	Title of Unit and Contents
I	Introduction to Data Mining 1.1 Definition of Data Mining and Data Warehousing 1.2 DM versus Knowledge 1.3 Discovery in Databases 1.4 Data to be mined 1.5 Basic mining techniques 1.6 Data Mining Issues 1.7 Data Mining Metrics 1.8 Social Implications of Data Mining 1.9 Overview of Applications of Data Mining
II	Data Pre-processing 2.1 Data Processing prerequisites 2.2 Attributes and Data types 2.3 Statistical descriptions of data 2.4 Distance and similarity measures 2.5 Need for Preprocessing 2.6 Handling Missing data 2.7 Data Cleaning 2.8 Data Integration 2.9 Data Reduction 2.10 Data Transformation and Data Discretization
III	Introduction to Data Warehousing 3.1 Architecture of DW 3.2 OLAP and Data Cubes 3.3 Dimensional Data Modeling-star, snowflake schemas

	3.4 Concept of data mart
IV	Association Rule Mining 4.1 Market Basket analysis 4.2 Frequent item-sets 4.3 Association rule mining: Apriori algorithm, FP growth algorithm, Sampling Algorithms
V	Classification & Prediction 5.1 Definition of classification 5.2 Model construction 5.3 Model Usage 5.4 Choosing algorithm 5.5 K-nearest neighbor algorithm 5.6 Decision tree Induction 5.7 Information gain 5.8 gain ratio 5.9 gini index 5.10 Bayesian Classification 5.11 Bayes Theorem 5.12 Naïve Bayes classifier 5.13 Measuring performance of classifiers 5.14 Precision 5.15 Recall 5.16 F-measure 5.17 confusion matrix 5.18 cross-validation 5.19 Bootstrap 5.20 Linear Regression 5.21 Non-linear Regression 5.22 Logistic Regression
VI	Clustering 6.1 Definitions 6.2 Partitioning methods 6.3 Hierarchical clustering 6.4 Density Based methods
VII	Data Mining Tool 7.1 Weka 7.2 Performance measures TP, FP, ROC 7.3 Baseline algorithms zeroR, oneR

Learning Resources

1. Tom Mitchell, Machine Learning, McGraw Hill, 1997
2. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, Second edition, 2011
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, ISBN:9789380931913, Elsevier Morgan Kaufmann Publishers, 3rd Ed., 2012
4. Margaret H. Dunham, S. Sridhar, Data Mining - Introductory and Advanced Topics, Pearson Education, 2012
5. George Marak, Modern Data warehousing and mining and visualization, Pearson Publication

CSA4202 Core Java

Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Able to understand the concept of object oriented programming. Have a strong understanding of the concept of byte code, virtual machine	Classroom discussion will be preferred to discuss the characteristics. Power point presentation can be used.
Basic understanding of concept of variable, operators, keyword control structure etc.	Presentation method will be applied along with hand on method is preferred
Understand and can use various library package in java.	Demonstrations with the help of small code snippets will be preferred.
Will able to choose various classes for the effective use of file handling operations. Can use different methods	Power point presentations along with interactions with students with the help of case studies.
Can design interactive GUI with the help of AWT and Swing.	Power point presentation will be used to show the class hierarchy. Demo method will be used to show effective way of using various layouts.

Unit No.	Title of Unit and Contents
I	Introduction to Java Language 1.1 History and Evolution of Java 1.2 OOP Principles 1.3 Java Platform 1.4 JDK Environment 1.5 Java Tools 1.6 Java Byte Code services to Protocol
II	Basic Programming Concepts 2.1 Keywords 2.2 Data Types 2.3 Variables 2.4 Operators 2.5 Naming Conventions 2.6 Type Casting 2.7 Control Statements 2.8 Arrays
III	Object Oriented Concepts of Java 3.1 Introducing classes and objects 3.2 Constructors (All types) 3.3 Garbage Collection and finalize() method 3.4 Inheritance Basics 3.5 Types of Inheritance 3.6 Implementation of polymorphism : Method Overloading and Method Overriding 3.7 Nested and Inner classes 3.8 Modifiers and Access Control Specifiers 3.9 Final variables, methods and classes 3.10 Abstract methods and classes 3.11 Interfaces 3.12 Creating and Importing Packages

	3.13 Exception Handling
IV	Java Library 4.1 String Handling: String Constructors, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, valueOf(), StringBuffer 4.2 Primitive Type Wrappers: Number, Double and Float, Byte, Short, Integer and Long, Character Boolean, Void 4.3 Utility Classes (Only listed below): Math, StringTokenizer, Date, Calendar, GregorianCalendar, Random
V	Files and Streams 5.1 Exploring java.io package, File, Byte Streams 5.2 InputStream & OutputStream: FileInputStream & FileOutputStream, ByteArrayInputStream and ByteArrayOutputStream, DataInputStream & DataOutputStream 5.3 PrintStream 5.4 RandomAccessFile 5.5 Character Streams 5.6 Reader & Writer: FileReader & FileWriter, BufferedReader & BufferedWriter, CharArrayReader & CharArrayWriter 5.7 PrintWriter 5.8 Serialization 5.9 Serializable 5.10 ObjectInput & ObjectOutput: ObjectInputStream & ObjectOutputStream
VI	Applets, AWT and Event Handling 6.1 Applet Programming 6.2 Applet Basics 6.3 Applet Architecture 6.4 Applet Skeleton 6.5 update() and repaint() 6.6 HTML Applet Tag 6.7 Passing Parameters to an Applet Using Status Window 6.8 Introducing AWT: AWT classes, Windows Fundamentals, Working with Frame Windows Working with Graphics, Working with Colors and Fonts, AWT Controls, Layout Managers, Menus 6.9 Event Handling: Event Handling Mechanism, Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter Classes 6.10 Anonymous Inner Classes
VII	Swing 7.1 Swing Features 7.2 Model View Controller Architecture for Swing, Components & Containers 7.3 Swing Controls: JApplet, JFrame, JButton, JCheckBox, JTextField, JTabbedPane, JInternalFrame, JScrollPane, JLabel, JList, JTree, JTable, JDialog, JFileChooser, JProgressBar

Learning Resources

1. Herbert Schildt, The Complete Reference JAVA - Eighth Edition, 2011
2. Horstman & Cornell, Core Java (Volume 1 - Fundamentals) Ninth Edition, 2015
3. Horstman & Cornell, Core Java (Volume 2 - Advanced Features) Ninth Edition, 2014
4. Balaguruswamy, Programming with Java, 4th Ed., 2010
5. Java 7 Programming - Black Book, Kogent Learning Solutions Inc., 2014

CSA4203 Web Technologies

Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Get concepts of basics of the HTML and CSS.	Discuss various concepts of HTML and CSS using Blackboard with examples. Notepad application is used to create the script and demo is shown using Web Browser.
Obtain the knowledge of various concepts of PHP scripting language.	Discuss various concepts of PHP scripting language on the Blackboard with examples. Notepad application is used to create the script and demo is shown using Web Browser and Web Server.
Able to understand the concept of object oriented programming.	Discuss various object oriented concepts of PHP scripting language on the Blackboard with examples. Notepad application is used to create the script and demo is shown using Web Browser and Web Server.
Acquire the knowledge and skills for creation of website by considering both client- and server-side programming to build up responsive web applications. Gain the knowledge of using PHP to access database.	PowerPoint presentation to demonstrate the process of constructing website using client-side programming and server-side programming with the help of Database connectivity. Demonstration of PHP and Database connectivity is shown using Web Browser and Web Server.
Able to create XML documents.	Discuss the structure of XML document using Blackboard. Demonstration of creating an XML document using PHP with the help of Web Browser and Web Server.
Gain familiarity with the object oriented concepts of PHP.	Classroom discussion about revision of object oriented concepts using PHP. Demonstration of object oriented concepts in PHP using Web Browser and Web Server.
Able to create graphic objects using PHP.	Classroom discussion about graphics concepts using PHP. Demonstration of creating various graphic objects in PHP using Web Browser and Web Server.

Unit No.	Title of Unit and Contents
I	Introduction to Internet Programming 1.1 Client-Server model 1.2 Browsers - Graphical and Hypertext Access to the Internet 1.3 HTTP - HyperText Transfer Protocol (how it actually works)
II	Overview of Language Essentials 2.1 Data Types 2.2 Variables 2.3 Embedding PHP into web pages

	<ul style="list-style-type: none"> 2.4 Functions 2.5 Arrays 2.6 Objects 2.7 Strings
III	<p>HTML forms processing</p> <ul style="list-style-type: none"> 3.1 Building a form 3.2 Text fields and value, size, maxlength, 3.3 HTML buttons 3.4 Radio buttons 3.5 Checkboxes 3.6 Selection lists 3.7 Introduction to CGI scripting Action and Method - GET and 3.8 POST 3.9 Global variables 3.10 Reading files 3.11 File permissions 3.12 Uploading files 3.13 Reading from other Servers 3.14 Security: Filtering Input and Escaping Output
IV	<p>Web Techniques</p> <ul style="list-style-type: none"> 4.1 Server Information 4.2 Cookies 4.3 Sessions 4.4 Maintaining state
V	<p>Object Oriented Programming</p> <ul style="list-style-type: none"> 5.1 Introduction 5.2 Defining PHP Classes 5.3 Creating Objects in PHP 5.4 Calling Member Functions 5.5 Constructor, Destructor 5.6 Inheritance 5.7 Function Overriding 5.8 Access Specifiers: Private, Public, Protected 5.9 Interfaces 5.10 Abstract classes
VI	<p>Databases</p> <ul style="list-style-type: none"> 6.1 Relational databases and SQL 6.2 Using PHP to access a database 6.3 Accessing Databases 6.4 PEAR DB Basic
VII	<p>XML</p> <ul style="list-style-type: none"> 7.1 Introduction 7.2 PHP and XML 7.3 Functions in XML 7.4 The Simple XML extension 7.5 Loading XML Document into a SimpleXML Object 7.6 Looping through an Element 7.7 Use SimpleXML Element Constructor 7.8 Looping over all Elements and its Attributes 7.9 Recursively processing XML Document 7.10 Parsing XML

VIII	Graphics 8.1 Basic concepts 8.2 GD extensions 8.3 Creating and drawing images 8.4 Images with text 8.5 Scaling images 8.6 Color handling 8.7 Embedding an image into page
IX	E-mail via scripts 9.1 Email Background 9.2 Internet Mail Protocols 9.3 Structure of an Email message 9.4 Sending Email with PHP 9.5 Email-Id Validation and Email-Id Verification

Learning Resources

1. Rasmus Lerdorf and Kevin Tatroe, Programming PHP, O'Reilly Publication, 3rd Edition, 2013
2. Matt, Doyle, Beginning PHP 5.3, Wrox Publication, 2014
3. Pratiyush Guleria, PHP – Beginner's Practical Guide, BPB Publications, 2018
4. PHP cookbook, O'Reilly Publication, 2014
5. Learning PHP and MYSQL, O'Reilly Publication, 4th Edition, 2016
6. PHP for Beginners, SPD Publication
7. Robert W. Sebesta , Programming the World Wide Web, Pearson, (4th Edition), 2009
8. www.php.net.in
9. www.w3schools.com
10. www.wrox.com

CSA4204 Networking Concepts
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Able to discuss the physical and logical as well as the electrical characteristics of digital signals and the basic methods of data transmission.	Classroom discussion will be preferred to discuss the characteristics. Field visit to server room and networking lab to practically see the components.
Can identify the importance of the ISO 7-layer reference model. Capable of compare and contrast TCP/IP and OSI model	Presentation method will be applied to see the architecture and its role. Animated slides will be preferred.
Understand the functions and architectures of LAN and WAN.	Simulation method will be used to understand the architecture and working of LAN and MAN
Explore basic protocols involved in wired/wireless communications.	Power point presentations along with interactions with students to understand the functionality of the different layers.
Discuss the design principles of wired and wireless communication networks	Class discussion along with power point presentation will be used.
Understand the concepts of Presentation Layer.	Class discussion along with power point presentation will be used.
Analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.	Animated power point presentation will be used to demonstrate the working of the different protocols.

Unit No.	Title of Unit and Contents
I	<p>Introduction to Computer Networks</p> <p>1.1 Data Communication: Characteristics of data communication, Components, Data representation, Data flow</p> <p>1.2 Computer Networks: Distributed processing, Physical structure-Point to Point, Broadcast, Categories of topology (mesh, star, ring, bus, etc.)</p> <p>1.3 Categories of network: LAN, WAN, MAN, INTERNET etc.</p> <p>1.4 Protocols and Standards: Definition of protocol, Key elements, Defacto & Dejure standard, Standards organizations</p> <p>1.5 Network Software: Protocol Hierarchies –layers, protocols, peers, interfaces, network architecture - protocol stack, design issues of the layers - addressing, error control, flow control, multiplexing and demultiplexing, routing, Connection-oriented and connectionless service, Service Primitives - listen, connect, receive, send, disconnect, The relationships of services to Protocol</p>
II	<p>Network Models</p> <p>2.1 OSI Reference model- Functionality of each layer</p> <p>2.2 TCP/IP model - Introduction to IP,TCP & UDP, TCP/IP Protocol Suite</p> <p>2.3 Addressing - Physical, Logical & Port addresses</p>
III	<p>The Physical Layer</p> <p>3.1 The Basic Concepts of analog & digital data and signals</p> <p>3.2 Line Coding digital to digital conversion : Characteristics, Line Coding Schemes: Unipolar, NRZ, RZ, Manchester and Differential Manchester</p> <p>3.3 Transmission Modes: Parallel Transmission, Serial Transmission –</p>

	<p>Asynchronous and Synchronous</p> <p>3.4 Multiplexing: FDM, TDM, WDM</p> <p>3.5 Switching: Circuit Switching, Message Switching, Packet Switching</p>
IV	<p>The Data Link Layer</p> <p>4.1 Framing: Character Count, Byte Stuffing, Bit Stuffing, Physical Layer Coding Violations</p> <p>4.2 Error Control: Hamming Code and CRC Elementary data link protocols: Simplex ,stop & wait protocol, Simplex protocol for noisy channel</p> <p>4.3 Sliding Window Protocols: 1- bit sliding window protocols, Pipelining, Go-Back N, Selective Repeat</p>
V	<p>Medium Access Control layer</p> <p>5.1 Random Access Protocols: ALOHA – pure and slotted, CSMA: 1-persistent, p- persistent and non-persistent, CSMA/CD, CSMA/CA</p> <p>5.2 Controlled Access: Reservation, Polling Token Passing</p> <p>5.3 Channelization: FDMA, TDMA, CDMA</p>
VI	<p>Wired & wireless LANs</p> <p>6.1 Ethernet Standard: Frame Format, Access Method , Physical Layer, Changes In The Standard: Bridged Ethernet, Switched Ethernet and Full Duplex Ethernet, Fast Ethernet: Goals and MAC Sub layer Specifications, Gigabit Ethernet: Goals, MAC Sub layer Specifications</p> <p>6.2 Wireless LAN: Architecture, BSS & ESS, Bluetooth</p>
VII	<p>The Network layer</p> <p>7.1 Design Issues: Store-and-forward packet switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram</p> <p>7.2 Logical Addressing : IPV4 Addresses- Address Space, Notations, Classful Addressing, Classless Addressing, Network Address Translation(NAT), IPV6 Addresses -Addressing Structure, Address Space</p> <p>7.3 IPV4 Protocol: Datagram Format, Fragmentation, Checksum, Options</p> <p>7.4 Routing Concepts: Properties of routing algorithm, Comparison of Adaptive and Non-Adaptive Routing Algorithms</p> <p>7.5 Congestion Control: General Principles of Congestion Control, Congestion Prevention Policies</p>
VIII	<p>The Transport layer</p> <p>8.1 Process-to-Process Delivery : Client Server Paradigm, Multiplexing and De-multiplexing, Connectionless Vs Connection-Oriented Service, Reliable Vs Unreliable</p> <p>8.2 User Datagram Protocol UDP : Datagram Format, Checksum, UDP operations, Use of UDP</p> <p>8.3 Transmission Control Protocol (TCP) : TCP Services, TCP Features, TCP Segment, TCP Connection, Flow Control, Error Control</p> <p>8.4 TCP Congestion Control : Slow Start Mechanism, Introduction to SCTP</p>
IX	<p>The Application Layer</p> <p>9.1 Domain Name System (DNS): Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Name – Address Resolution</p> <p>9.2 TELNET: Timesharing Environment, Logging, NVT, Embedding,</p>

	Options, Mode of Operations
9.3	E-MAIL: Architecture, User Agent, Message Transfer Agent-SMTP, Message Access Agent-POP, IMAP, Web Based Mail
9.4	File Transfer Protocol (FTP): Communication over control connection, Communication over Data Connection, Anonymous FTP
9.5	WWW: Architecture, WEB Documents
9.6	HTTP: HTTP Transaction, Persistent and Non-persistent Connection, Proxy Server

Learning Resources

1. Tanenbaum, Computer Networks, ISBN:788177581652, Pearson, 4th Edition, 2007
2. Behrouz Forouzan, Data Communication and Networking, TATA McGraw Hill, Fourth Edition, 2011
3. Halsall / Kulkarni, Computer Networking and the Internet, ISBN:9788177584752, Pearson, 5th Edition, 2007
4. Irvine, Data Communications and Networks: An Engineering Approach, ISBN:9788126507658, Wiley India, 2007
5. Gouda, Elements of Network Protocol Design, ISBN:9788126516476, Wiley India, 2009
6. Peterson, Computer Networks-A Systems Approach, 5e, ISBN :9789380501932, Elsevier, 2012

CSA4205 Better Spoken English
Credits: 4C

CSA4206 Problem Solving through Programming in C
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Learn about algorithms, flowcharts, various programming languages and their features.	Presentation method will be applied along with hand on method is preferred.
Understand the structure of C Program, C program development life cycle.	Explain the structure of C Program, C program development life cycle.
Understand the concept of keywords, variable, constants, data types, operators etc.	Discussion on various concepts such as keywords, variable, constants, data types, operators etc.
Learn how to use different types of input and output.	Explain how to use different types of input and output with syntax and examples.
Understand the concepts and implementation of different control structures.	Explain the concepts and implementation of different control structures with syntax and examples.
Able to learn the concept of functions, recursion and how to use for the given problem.	Explain the concepts of functions, recursion, storage classes with syntax and examples.
Ability to work with arrays and implementing different Operations on arrays.	Explain the concepts and implementation of arrays with syntax and examples.

Unit No.	Title of Unit and Contents
I	Introduction to Programming 1.1 Problem Solving : Algorithms, Flowcharts 1.2 Programming Languages: Machine language, Assembly language, Assembler, Higher level language 1.3 Compiler and Interpreter
II	Introduction to C 2.1 Structure of a C program 2.2 Functions as Building Blocks 2.3 C Program development life cycle
III	C Tokens 3.1 Keywords 3.2 Identifiers 3.3 Variables 3.4 Constants – character, numeric, string, escape sequences 3.5 Data types – built-in and user defined 3.6 Operators and expressions - types (arithmetic, relational, logical, assignment, bitwise, Conditional, other operators), precedence and associativity rules.
IV	Input and Output 4.1 Character input and output 4.2 String input and output 4.3 Formatted input and output
V	Control Structures 5.1 Decision making structures: if, if-else, switch

	5.2 Loop Control structures: while, do-while, for 5.3 Nested structures 5.4 break and continue
VI	Functions in C 6.1 Functions, advantages 6.2 Standard library functions 6.3 User defined functions: declaration, definition, function call, parameter passing, return Keyword 6.4 Scope of variables, storage classes 6.5 Recursion
VII	Arrays 7.1 Declaration, initialization 7.2 One, two and multidimensional arrays 7.3 Passing arrays to functions

Learning Resources

1. R.G. Dromey, How to Solve it by Computer, ISBN:9788131705629, Pearson Education, 2013
2. Harrow, Problem Solving with C, ISBN:9788131734391, Pearson Education, 1996
3. E. Balaguruswamy, Programming in ANSI C, ISBN:9781259004612, Tata Mc-Graw Hill Publishing Co.Ltd.-New Delhi, 6th Edition, 2012
4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, ISBN:9788120305960, PHI Learning, 2nd Edition, 2017
5. Behrouz A. Forouzan, Richard F. Gilberg, A Structured Programming Approach Using C, ISBN:9788131500941, Cengage Learning India, 2008
6. Ashok Kamthane, Programming in C (2nd Edition), Pearson, 2011
7. Yashwant Kanitkar, C Programming, BPB Publication, 1994

CSA4207 Software Testing
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Learn the basic concepts and the processes that lead to software quality and testing.	Discuss various concepts of software quality and testing using Blackboard.
Design test cases from the given requirements using Black box testing techniques	Explain various black box testing techniques with different test cases.
Identify the test cases from Source code by means of white box testing techniques	Explain various white box testing techniques with different test cases.
Know about user acceptance testing and generate test cases for it	Explain user acceptance testing with different test cases.
Examine the test adequacy criteria to complete the testing process	Discuss about the testing process.
Develop test cases and test suite using automated testing tools	Demo on various test cases and test suite using with the help of automated testing tools.
Ability to evaluate software quality	Explain how to evaluate software quality.

Unit No.	Title of Unit and Contents
I	<p>Introduction</p> <p>1.1 Testing as an Engineering Activity</p> <p>1.2 Role of Process in Software Quality, Testing as a Process, Basic Definitions</p> <p>1.3 Software Testing Principles</p> <p>1.4 The Tester's Role in a Software Development Organization</p> <p>1.5 Origins of Defects ,Defect Classes</p> <p>1.6 The Defect Repository and Test Design, Defect Examples, Developer/Tester Support for Developing a Defect Repository</p>
II	<p>Test Case Design</p> <p>2.1 Introduction to Testing Design Strategies, The Smarter Tester</p> <p>2.2 Test Case Design Strategies: Using Black Box Approach to Test Case Design, Random Testing, Requirements based testing , Positive & Negative testing, Boundary Value Analysis, Decision tables Equivalence, Class Partitioning state-based testing, cause effect graphing, error guessing, compatibility testing, user documentation testing, domain testing, Using White –Box Approach to Test design</p> <p>2.3 Test Adequacy Criteria,static testing vs.structural testing, code functional testing</p> <p>2.4 Coverage and Control Flow Graphs</p> <p>2.5 Covering Code Logic Paths, Their Role in White–box based Test</p>
III	<p>Levels of Testing</p> <p>3.1 The Need for Levels of Testing</p> <p>3.2 Unit Test, Unit Test Planning, Designing the Unit Tests</p> <p>3.3 The Test Harness</p> <p>3.4 Running the Unit tests and Recording results</p> <p>3.5 Integration tests: Designing Integration Tests, Integration Test Planning, Scenario testing,</p>

	<p>Defect bash elimination</p> <p>3.6 System Testing , Types of system testing, Acceptance testing, performance testing, Regression Testing, internationalization testing, Ad-hoc testing, Alpha - Beta Tests, Testing OO systems, Usability and Accessibility testing</p>
IV	<p>Test Management</p> <p>4.1 People and organizational issues in testing, Organization structures for testing teams, Testing Services Test Planning: Test Plan Components, Test Plan Attachments, Locating Test Items, Test Management, Test process, Reporting Test Results</p> <p>4.2 The role of three groups in Test Planning and Policy Development</p> <p>4.3 Introducing the test specialist: Skills needed by a test specialist, building a Testing Group</p>
V	<p>Controlling and Monitoring</p> <p>5.1 Software test automation: Skills needed for automation, Scope of automation, design and architecture for automation, Requirements for a test tool, challenges in automation</p> <p>5.2 Test metrics and measurements, Project, Progress and Productivity metrics</p> <p>5.3 Status Meetings</p> <p>5.4 Reports and Control Issues</p> <p>5.5 Criteria for Test Completion: SCM, Types of reviews, Developing a review program, Components of Review Plans, Reporting Review Results, Evaluating software quality, Defect Prevention, Testing maturity model</p>

Learning Resources

1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing –Principles and Practices”, Pearson Education, 2006
2. Aditya P.Mathur, “Foundations of Software Testing”, Pearson Education, 2008
3. Boris Beizer, “Software Testing Techniques”, Second Edition, Dreamtech, 2003
4. Elfriede Dustin, “Effective Software Testing”, First Edition, Pearson Education, 2003
5. Renu Rajani, Pradeep Oak, “Software Testing – Effective Methods, Tools and Techniques”, Tata McGraw Hill, 2004

CSA4208 Bigdata Analytics
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Understand the concept and challenge of big data and why existing technology is inadequate to analyze the big data.	Explain the concepts and challenges of Big data.
Collect, manage, store, query and analyze various form of big data.	Discuss about various forms of big data.
Learn the concepts, architecture of Hadoop.	Explain the concepts, architecture of Hadoop using black board and powerpoint presentation.
Acquire the concepts, architecture of NoSQL.	Explain the concepts, architecture of NoSQL using black board and PowerPoint presentation.
Learn about the concepts and algorithms of Map Reduce.	Discuss the concepts and various algorithms of Map Reduce.
Get familiarity with Mining data streams.	Explain how to mine data streams with different data sets.
Understand the concepts of Link Analysis.	Explain the concepts of Link Analysis.
Attain the knowledge of Clustering.	Explain the concepts of Clustering.

Unit No.	Title of Unit and Contents
I	<p>Introduction to Big Data</p> <p>1.1 Introduction about distributed file system, Big Data and its importance</p> <p>1.2 Four Vs, Drivers for Big data</p> <p>1.3 Big data analytics</p> <p>1.4 Big data applications</p> <p>1.5 Algorithms using map reduce</p> <p>1.6 Algorithms Matrix-Vector Multiplication by Map Reduce</p>
II	<p>Introduction to Hadoop</p> <p>2.1 What is Hadoop?</p> <p>2.2 Core Hadoop Components</p> <p>2.3 Hadoop Ecosystem</p> <p>2.4 Physical Architecture</p> <p>2.5 Hadoop limitations</p>
III	<p>NoSQL</p> <p>3.1 Introduction to NoSQL</p> <p>3.2 NoSQL business drivers</p> <p>3.3 NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores</p> <p>3.4 Variations of NoSQL architectural patterns</p> <p>3.5 Using NoSQL to manage big data: What is a big data NoSQL solution?, Understanding the types of big data problems, Analyzing big data with a shared-nothing architecture, Choosing distribution models: master-slave versus peer-to-peer, Four ways that NoSQL systems handle big data problems</p>
IV	Map Reduce and the New Software Stack

	<p>4.1 Distributed File Systems: Physical Organization of Compute Nodes, Large Scale File-System Organization</p> <p>4.2 Map Reduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of Map Reduce Execution, Coping With Node Failures</p> <p>4.3 Algorithms using Map Reduce: Matrix-Vector Multiplication by Map Reduce, Relational-Algebra Operations, Computing Selections by Map Reduce, Computing Projections by Map Reduce, Union, Intersection, and Difference by Map Reduce, Computing Natural Join by Map Reduce, Grouping and Aggregation by Map Reduce, Matrix Multiplication, Matrix Multiplication with One Map Reduce Step</p>
V	<p>Mining Data Streams</p> <p>5.1 The Stream Data Model: A Data-Stream- Management System, Examples of Stream Sources, Stream Query, Issues in Stream Processing</p> <p>5.2 Sampling Data in a Stream: Obtaining a Representative Sample, The General Sampling Problem, Varying the Sample Size</p> <p>5.3 Filtering Streams: The Bloom Filter, Analysis</p>
VI	<p>Link Analysis</p> <p>6.1 Efficient computation of Page Rank: Page Rank Iteration Using Map Reduce, Use of Combiners to Consolidate the Result Vector</p> <p>6.2 Topic sensitive Page Rank, link Spam</p>
VII	<p>Clustering</p> <p>7.1 Page Rank Definition, Structure of the Web, Dead Ends</p> <p>7.2 Using Page Rank in a Search Engine</p> <p>7.3 Hubs and Authorities</p> <p>7.4 CURE Algorithm</p> <p>7.5 Stream-Computing</p> <p>7.6 A Stream-Clustering Algorithm</p> <p>7.7 Initializing and Merging Buckets</p> <p>7.8 Answering Queries</p>

Learning Resources

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, ISBN: 9788126551071, Wiley, 2015
2. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012
3. Tom White, “HADOOP: The definitive Guide”, O Reilly 2012
4. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packet Publishing, 2013
5. Jy Liebowitz, “Big Data and Business analytics”,CRC Press, 2013
6. Ullman, Rajaraman, Mining of Massive Datasets, 2014

CSA4209 Computer organization and Architecture
Credits: 4C

CSA4210 Advanced ‘C’
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Understand the concepts of Pointers and Dynamic memory allocation.	Explain the concepts of Pointers, Dynamic memory allocation.
Get familiarity with String handling, Command line arguments.	Explain the concept and implementation of string handling and command line arguments.
Learn the concepts of Structures, Unions and their operations.	Discuss the concepts of Structures, Unions and their operations.
Know the features of Preprocessor directives.	Explain the features of Preprocessor directives.
Implement various file handling operations in C programming for a given application.	Explain various file handling operations in C Programming.
Learn how to draw simple geometrical figures.	Explain basics of graphics concepts and how to draw simple geometrical figures.

Unit No.	Title of Unit and Contents
I	Pointers 1.1 Declaration, initialization 1.2 Dereferencing pointers 1.3 Pointer arithmetic 1.4 Pointer to pointer 1.5 Arrays and pointers 1.6 Functions and pointers – passing pointers to functions, functions returning pointers. 1.7 Dynamic memory allocation
II	Strings 2.1 Declaration and initialization 2.2 Standard library functions for String handling 2.3 Strings and pointers 2.4 Array of strings 2.5 Command line Arguments
III	Structures and Unions 3.1 Creating Structures 3.2 Accessing structure members (dot Operator) 3.3 Structure initialization 3.4 Array of structures 3.5 Passing structures to functions 3.6 Nested structures 3.7 Pointers and structures 3.8 Self referencing structure 3.9 Unions

	3.10 Difference between Structures and Unions
IV	C PreProcessor 4.1 Format of Preprocessor directive 4.2 File Inclusion directive 4.3 Macro substitution, nested macro, augmented macro
V	File Handling 5.1 Streams 5.2 Types of Files 5.3 Operations on Files 5.4 Random Access to files 5.5 Program using Command Line Arguments
VI	Introduction to Graphics 6.1 Initialization Graphics 6.2 Graphics Library function – putpixel, getpixel, functions to draw simple geometrical figures.

Learning Resources

1. R.G. Dromey, How to Solve it by Computer, ISBN:9788131705629, Pearson Education, 2013
2. Harrow, Problem Solving with C, ISBN:9788131734391, Pearson Education
3. E. Balaguruswamy, Programming in ANSI C, ISBN:9781259004612, Tata Mc-Graw Hill Publishing Co.Ltd.-New Delhi, 6th Edition, 2012
4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, ISBN:9788120305960, PHI Learning, 2nd Edition, 2017
5. Behrouz A. Forouzan, Richard F. Gilberg, A Structured Programming Approach Using C, ISBN:9788131500941, Cengage Learning India, 2008
6. Ashok Kamthane, Programming in C, 2nd Edition, Pearson, 2011
7. Yashwant Kanitkar, C Programming, BPB Publication, 1994

CSA4211 Computer Applications Practical - III
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Able to understand Data mining concepts, tools of data mining and implementation for the real life problems according to the software industry needs.	Discussion on concepts of data mining and tools and commands to perform different case studies based on the concepts of the syllabus.
Able to learn different packages of Java and implementation of different concepts and pure object oriented paradigms.	Discussion on the syntax and packages required for each concept.

Unit No.	Title of Unit and Contents
Data Mining Assignments	
1.	Cleansing of data
2.	Association mining
3.	Decision tree
4.	Naïve Bayes
5.	Linear Regression
6.	Logistic regression
7.	Measuring performance of a classifier
8.	Clustering : K means
9.	Clustering: DBSCAN
10.	Different data mining tools
Core Java Assignments	
1.	Constructor and static function/variable
2.	Packages.
3.	Abstract class and Inheritance
4.	Interface and Inheritance
5.	File handling
6.	Applets
7.	AWT interface
8.	Swing interface
9.	Event Listeners
10.	Applet/Swing interface/ adapter class

Learning Resources

1. Tom Mitchell, Machine Learning, McGraw Hill, 1997
2. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2nd Edition, 2011
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, ISBN:9789380931913, Elsevier Morgan Kaufmann Publishers, 3rd Edition, 2012
4. Margaret H. Dunham, S. Sridhar, Data Mining - Introductory and Advanced Topics, Pearson Education, 2012
5. George Marak, Modern Data warehousing and mining and visualization, Pearson Publication
6. Herbert Schildt, The Complete Reference JAVA - 8th Edition, 2011
7. Horstman & Cornell, Core Java (Volume 1 - Fundamentals) 9th Edition, 2015
8. Horstman & Cornell, Core Java (Volume 2 - Advanced Features) 9th Edition, 2014
9. Balaguruswamy, Programming with Java, 4th Edition, 2010
10. Java 7 Programming - Black Book, Kogent Learning Solutions Inc., 2014

CSA4212 Computer Applications Project - I
Credits: 4C

Learning Outcomes	Suggested Pedagogical Processes
Understand different software development lifecycle and different approaches to solve the problem of a project.	Identifying the interesting problem Discussion on the solution of a problem and selection of technology Guide the student at various stages for the completion of the project
Understand the difference between literature writing and technical writing and importance of different UML diagrams of the concerned problem.	Helping the students to write a technical report and draw UML diagrams of their project

Unit No.	Title of Unit and Contents
1.	Selection of a problem statement
2.	Collection of Synopsis
3.	Design the problem solution
4.	Implementation of design and refinement if needed
5.	Working Progress Report - I
6.	Working Progress Report – II
7.	Working Progress Report – III
8.	Final report writing and presentation

Course Learning Outcomes (Course / paper wise)

Mathematical Foundation

- Understand Sets and their operations
- Analyze various binary relations, characteristic function and Recursive functions
- Learn principles of Counting, The Pigeon-Hole Principle, and Solving Recurrence Relations
- Understand logical operators, Implications, Tautologies, validity of arguments, and quantifiers
- Model problems using Graphs, connectivity, Minimum Spanning Trees
- Represent the given relation in matrix, digraph and vice versa
- Apply probability theory via Bayes' Rule
- Understand basic statistical concepts such as measures of central tendency, dispersion, correlation and regression analysis
- Understand basics of vector spaces

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓								
CO6	✓	✓	✓	✓								
CO7	✓	✓	✓	✓					✓		✓	
CO8	✓	✓	✓	✓					✓		✓	
CO9	✓	✓	✓	✓								

Operating Systems

- Understand basic functions and concepts of Operating system
- Learn Architecture of Operating System, process management and memory management
- Gain knowledge of process synchronization, CPU scheduling and deadlock
- Get familiarity with the concept of I/O and File management
- Learn various Memory management techniques and related algorithms

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓				✓			

Python Programming

- Basic understanding of concept of variable, keywords, operators, control structures etc
- Acquire the knowledge of functions
- Get familiarity with the concepts of strings
- Learn the concepts of Data structures using Python
- Understand the concepts of Modules
- Gain the knowledge about functionalities of error and exception handling
- Get familiarity with Standard Library
- Get familiarity with the concepts of GUI development

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓					✓			
CO6	✓	✓	✓	✓								
CO7	✓	✓	✓	✓								
CO8	✓	✓	✓	✓					✓	✓	✓	✓

Database Management Systems

- Gain a good understanding of the database architecture and functioning of Database Management systems
- Learn the concepts of entity relationship and able to draw entity relationship diagrams
- Develop a good database design by using normalization techniques to normalize a Database
- Ability to know the use of structured query language and its syntax
- Know the use of transactions, database recovery and techniques for query Optimization
- Obtain a good understanding of database systems concepts and to be in a position to use and design databases for different applications
- Understand the need of database processing and learn techniques for controlling the consequences of concurrent data access and recovery of database systems

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓					✓	✓	✓	
CO5	✓	✓	✓	✓					✓	✓	✓	✓
CO6	✓	✓	✓	✓					✓	✓	✓	✓
CO7	✓	✓	✓	✓					✓	✓	✓	✓

Practical - I (Lab Based on Python Programming and Databases)

- Able to learn different concepts of Python Programming.
- Able to understand Database Management System, different aspects of database implementation for the real life problems according to the software industry needs.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓	✓	✓	
CO2	✓	✓	✓	✓					✓	✓	✓	

Practical - II (Lab Based on Operating Systems)

- Choose the best CPU scheduling algorithm for a given problem instance.
- Identify the performance of various page replacement algorithms.
- Develop algorithm for deadlock avoidance, detection and file allocation methods.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓	✓	✓	
CO2	✓	✓	✓	✓					✓	✓	✓	
CO3	✓	✓	✓	✓					✓	✓	✓	

Data Mining and Data Warehousing

- Students will be well aware of structure of Data Warehouse and the ETL process.
- Students will get know about different pre processing methodologies.
- Students should able to do some basic descriptive and predictive data mining. And able to compare and contrast different concepts.
- Students should able to evaluate supervised and unsupervised models based on the accuracy.
- Students should able to analyze the given problem and using their skills able to solve the practical problem.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓			✓				✓			✓	✓

Core Java

- Able to understand the concept of object oriented programming. Have a strong understanding of the concept of byte code, virtual machine.
- Understand the concept of variable, operators, keyword, control structures etc.
- Understand and can use various library package in java.
- Able to choose various classes for the effective use of file handling operations by using different methods.
- Design interactive GUI with the help of AWT and Swing.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	✓	✓	✓	✓								
C02	✓	✓	✓	✓								
C03	✓	✓	✓	✓								
C04	✓	✓	✓	✓					✓		✓	
C05	✓	✓	✓	✓					✓		✓	

Web Technologies

- Get concepts of basics of the HTML and CSS.
- Obtain the knowledge of various concepts of PHP scripting language.
- Acquire the knowledge and skills for creation of website by considering both client and server-side programming to build up responsive web applications.
- Gain the knowledge of using PHP to access database.
- Able to create XML documents.
- Gain familiarity with the object oriented concepts of PHP.
- Able to create graphic objects using PHP.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	✓	✓	✓	✓								
C02	✓	✓	✓	✓								
C03	✓	✓	✓	✓					✓		✓	
C04	✓	✓	✓	✓					✓		✓	
C05	✓	✓	✓	✓								
C06	✓	✓	✓	✓								
C07	✓	✓	✓	✓								

Networking Concepts

- Able to discuss the physical and logical as well as the electrical characteristics of digital signals and the basic methods of data transmission.
- Can identify the importance of the ISO 7-layer reference model. Capable of compare and contrast TCP/IP and OSI model.
- Understand the functions and architectures of LAN and WAN.
- Explore basic protocols involved in wired/wireless communications.
- Explore basic protocols in wired/wireless communications.
- Discuss the design principles of wired and wireless communication networks.
- Understand the concepts of Presentation Layer.
- Analyze the features and operations of various application layer protocols such as Http, DNS, and SMTP.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓			✓					
CO6	✓	✓	✓	✓			✓					
CO7	✓	✓	✓	✓			✓					
CO8	✓	✓	✓	✓			✓					

MOOC – I - Better Spoken English

(General Elective – I) Problem Solving through Programming in C

- Develop Problem Solving abilities using computers.
- Understand the fundamentals of C programming.
- Understand the concept of variable, operators, keyword, control structures etc.
- Able to learn the concept of functions and how to use for the given problem.
- Ability to work with arrays and implementing different Operations on arrays.

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓					✓		✓	
CO5	✓	✓	✓	✓								

Software Testing

- Learn the basic concepts and the processes that lead to software quality and testing
- Design test cases from the given requirements using Black box testing techniques
- Identify the test cases from Source code by means of white box testing techniques
- Know about user acceptance testing and generate test cases for it
- Examine the test adequacy criteria to complete the testing process
- Develop test cases and test suite using automated testing tools
- Ability to evaluate software quality

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓					✓		✓	
CO5	✓	✓	✓	✓					✓		✓	
CO6	✓	✓	✓	✓					✓		✓	
CO7	✓	✓	✓	✓					✓		✓	

Bigdata Analytics

- Understand the concept and challenge of big data and why existing technology is inadequate to analyze the big data.
- Collect, manage, store, query, and analyze various form of big data.
- Learn the concepts, architecture of Hadoop.
- Acquire the concepts, architecture of NoSQL.
- Learn about the concepts and algorithms of Map.
- Get familiarity with mining data streams.
- Understand the concepts of Link Analysis.
- Attain the knowledge of Clustering.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								

CO5	✓	✓	✓	✓								
CO6	✓	✓	✓	✓					✓		✓	✓
CO7	✓	✓	✓	✓								
CO8	✓	✓	✓	✓					✓		✓	✓

MOOC – II - Computer organization and Architecture

(General Elective – II) Advanced ‘C’

- Understand concepts Pointers and dynamic memory allocation.
- Get familiarity with String handling operations.
- Acquire the concepts of Structures and Unions and its operations.
- Know the features of Preprocessor directives.
- Implement file Operations in C programming for a given application.
- Learn how to draw simple geometrical figures.

CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓					✓		✓	
CO6	✓	✓	✓	✓								

Practical - III (Lab Based on Data Mining and Core Java)

- Able to understand Data mining concepts, tools of data mining and implementation for the real life problems according to the software industry needs.
- Able to learn different packages of Java and Implementation of different concepts and pure object oriented paradigms.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓	✓	✓	
CO2	✓	✓	✓	✓					✓	✓	✓	

Project

- Understand different software development lifecycle and different approaches to solve the problem of a project.
- Understand the difference between literature writing and technical writing and Importance of different UML diagrams of the concerned problem.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓					✓	✓	✓	✓
CO2	✓	✓	✓	✓					✓	✓	✓	✓