



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Autonomous College)



Affiliated to
UNIVERSITY OF MUMBAI

Syllabus for the S.Y.B.Sc.

Program: B.Sc.

Course: Computer Science

*(Adapted from the Credit Based Semester and Grading System FYBSc Computer Science
Syllabus of University of Mumbai 2018-19)*

DISTRIBUTION OF TOPICS AND CREDITS**S.Y.B.Sc. Computer Science SEMESTER III**

Course	Nomenclature	Credits	Topics
RJSUCS301	Theory Of Computation	02	1. Automata Theory 2. Formal Language 3. Regular Set & Grm 4. Context Free Lang 5. Pushdown Automata 6. Linear Bound Automata 7. Turing Machine
RJSUCS302	Core Java	02	1. The Java Language 2. OOPS 3. String Manipulations 4. Packages 5. Exception Handling 6. Multithreading 7. I/O Streams 8. Networking 9. Wrapper Classes 10. Collection Framework 11. Inner Classes 12. AWT
RJSUCS303	Operating System	02	1. Introduction and Operating-Systems Structures 2. Operating-System Structures 3. Processes 4. Threads 5. Process Synchronization 6. CPU Scheduling 7. Deadlocks 8. Main Memory, Virtual Memory 9. Mass-Storage Structure 10. File-System Interface 11. File-System Implementation
RJSUCS304	Database Management Systems	02	1. Stored Procedures 2. Triggers 3. Sequences 4. File Organization and Indexing 5. Fundamentals of PL/SQL 6. Overview of PL/SQL Control Structures 7. Transaction Management 8. DCL Statements

S.Y.B.Sc Computer Science Syllabus Semester III & IV

			9. Crash Recovery
RJSUCS305	Combinatorics & Graph Theory	02	1. Introduction to Combinatorics 2. Graph Theory 3. Network Flows
RJSUCS306	Physical Computing & IOT	02	1. SoC and Raspberry Pi 2. Programming Raspberry Pi 3. Introduction to IoT
RJSUCS307	Skill Enhancement: Web Programming	02	1. HTML5 2. CSS 3. JavaScript 4. XML 5. AJAX 6. PHP 7. Introduction to jQuery
RJSUCS3P01	Practical of RJSUCS301 + RJSUCS302	02	
RJSUCS3P02	Practical of RJSUCS303+RJSUCS304	02	
RJSUCS3P03	Practical of RJSUCS305+RJSUCS306	02	

S.Y.B.Sc. Computer Science SEMESTER IV

Course	Nomenclature	Credits	Topics
RJSUCS401	Fundamentals of Algorithms	02	1. Introduction to algorithm 2. Graph Algorithms 3. Selection Algorithms 4. Algorithms Design Techniques 5. Greedy Algorithms 6. Divide and Conquer Algorithms 7. Dynamic Programming
RJSUCS402	Advanced JAVA	02	1. Swing 2. JDBC 3. Servlets 4. JSP 5. Java Beans 6. Struts 2 7. JSON
RJSUCS403	Computer Networks	02	1. Introduction to Networks 2. Introduction to OSI model 3. Physical Layer 4. Introduction to Physical Layer 5. Analog Transmission 6. Multiplexing 7. Transmission Media 8. Introduction to Data-Link Layer 9. Multiple Access 10. Connecting Devices and Virtual LANs 11. Introduction to Network Layer 12. Routing Protocols 13. Introduction to Transport Layer
RJSUCS404	Software Engineering	02	1. Introduction 2. System Design 3. Software Measurement and Metrics

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			<ol style="list-style-type: none"> 4. Software Project Management 5. Risk Management 6. Software Quality Assurance 7. Software Testing
RJSUCS405	Linear Algebra using Python	02	<ol style="list-style-type: none"> 1. Field 2. Matrix 3. Basis 4. Dimension 5. Gaussian elimination 6. Orthogonalization 7. Eigenvector
RJSUCS406	.Net Technologies	02	<ol style="list-style-type: none"> 1. The .NET Framework 2. C# Language Basics 3. ASP.NET 4. Web Controls 5. Validation 6. Rich Controls 7. Website Navigation 8. ADO.NET 9. Data Controls 10. Working with XML 11. LINQ 12. ASP.NET AJAX
RJSUCS407	Skill Enhancement: Android Developer Fundamentals	02	<ol style="list-style-type: none"> 1. Introduction to Android and tools 2. Web Services 3. Data
RJSUCS4P01	Practical of RJSUCS401 + RJSUCS402	02	
RJSUCS4P02	Practical of RJSUCS403+RJSUCS405	02	
RJSUCS4P03	Practical of RJSUCS406+RJSUCS407	02	

S.Y.B.Sc Computer Science Syllabus Semester III & IV

SEMESTER III (THEORY)		L	Cr
Paper-I: Theory of Computation		Paper Code: RJSUCS301	
		45	2
UNIT I		15	
Automata Theory & Formal Languages			
1	Automata Theory: Defining Automaton, Finite Automaton, Finite automata and Regular Expressions, Transitions and Its properties, Acceptability by Finite Automaton, Nondeterministic Finite State Machines, DFA and NFA equivalence, Minimizing Automata.		
2	Formal Languages: Defining Grammar, Derivations, Languages generated by Grammar, Chomsky Classification of Grammar and Language, Operations on Languages, Languages and Automata.		
UNIT II		15	
Regular Sets and Regular Grammar, Context Free Languages, Pushdown Automata, Linear Bound Automata			
1	Regular Sets and Regular Grammar: Regular Grammar, Pumping Lemma and its Applications, Closure Properties, Regular Sets and Regular Grammar.		
2	Context Free Languages: Context-free Languages, Derivation Tree, Ambiguity of Grammar, CFG simplification, Pumping Lemma for CFG		
3	Pushdown Automata: Definitions, Acceptance by PDA, PDA and CFG		
4	Linear Bound Automata: The Linear Bound Automata Model, Linear Bound Automata and Languages.		
UNIT III		15	
Turing Machines			
1	Turing Machines : Turing Machine Definition, Representations, Acceptability by Turing Machines, Designing and Description of Turing Machines, Turing Machine Construction, Variants of Turing Machine, Halting Problem in Turing machine.		

Tutorials :

1. Problems on generating languages for given simple grammar
2. Problems on DFA and NFA equivalence
3. Problems on generating Regular Expressions
4. Problems on drawing transition state diagrams for Regular Expressions
5. Problems on Regular Sets and Regular Grammar
6. Problems on Ambiguity of Grammar
7. Problems on working with PDA
8. Problems on working with Turing Machines
9. Problems on generating derivation trees
10. Problems on Linear Bound Automata/Universal Turing Machine

S.Y.BSc	Semester III Theory
RJSUCS301 Paper I Theory of Computation	<p>Course Objective 1.1 :</p> <ol style="list-style-type: none">1. To provide the comprehensive insight into theory of computation by understanding grammar, languages and other elements of modern language design.2. To develop capabilities to design and develop formulations for computing models and identify its applications in diverse areas. <p>Learning outcome:</p> <ol style="list-style-type: none">1. Understand Grammar and Languages2. Learn about Automata theory and its application in Language Design3. Learn about Turing Machines and Pushdown Automata4. Understand Linear Bound Automata and its applications

SEMESTER III (THEORY)		L	Cr
Paper-II: Core Java		45	2
UNIT I		15	
The Java Language, OOPS, String Manipulations, Packages			
1	The Java Language: Features of Java, Java programming format, Java Tokens, Java Statements, Java Data Types, Typecasting, Arrays		
2	OOPS: Introduction, Class, Object, Static Keywords, Constructors, this Key Word, Inheritance, super Key Word, Polymorphism (overloading and overriding), Abstraction, Encapsulation, Abstract Classes, Interfaces		
3	String Manipulations: String, String Buffer, String Tokenizer		
4	Packages: Introduction to predefined packages (java.lang, java.util, java.io, java.sql, java.swing), User Defined Packages, Access specifiers		
UNIT II		15	
Exception Handling, Multithreading, I/O Streams, Networking			
1	Exception Handling: Introduction, Pre-Defined Exceptions, Try-Catch-Finally, Throws, throw, User Defined Exception examples		
2	Multithreading: Thread Creations, Thread Life Cycle, Life Cycle Methods, Synchronization, Wait() notify() notify all() methods		
3	I/O Streams: Introduction, Byte-oriented streams, Character- oriented streams, File, Random access File, Serialization		
4	Networking: Introduction, Socket, Server socket, Client -Server Communication, RMI		
UNIT III		15	
Wrapper Classes, Collection Framework, Inner Classes, AWT			
1	Wrapper Classes: Introduction, Byte, Short, Integer, Long, Float, Double, Character, Boolean classes		
2	Collection Framework: Introduction, util Package interfaces, List, Set, Map, List interface & its classes, Set interface & its classes, Map interface & its classes		
3	Inner Classes: Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class		
4	AWT: Introduction, Components, Event-Delegation-Model, Listeners, Layouts, Individual components Label, Button, CheckBox, Radio Button, Choice, List, Menu,		

S.Y.BSc	Semester III Theory
RJSUCS302 Paper II Core Java	<p>Course Objective 1.1 :</p> <p>The objective of this course is to teach the learner how to use Object Oriented paradigm to develop code and understand the concepts of Core Java and to cover-up with the pre-requisites of Core java.</p> <p>Learning outcome:</p> <ol style="list-style-type: none">1. Object oriented programming concepts using Java.2. Knowledge of input, its processing and getting suitable output.3. Understand, design, implement and evaluate classes and applets.4. Knowledge and implementation of AWT package.

S.Y.B.Sc Computer Science Syllabus Semester III & IV

SEMESTER III (THEORY)		L	Cr
Paper-III: Operating System	Paper Code: RJSUCS303	45	2
UNIT I		15	
Introduction to Operating System			
1	Definition, Role, Functions and Operations of Operating System.		
2	OS structure: Services, User & OS interface, System Calls & its types.		
3	Processes: Process Concept, Scheduling, operations and interprocess communication.		
4	Threads: Overview, Multicore Programming, Multithreading Models		
UNIT II		15	
Process Synchronization, CPU Scheduling, Deadlocks			
1	Process Synchronization: General structure of a typical process, race condition, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors		
2	CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms (FCFS, SJF, SRTF, Priority, RR, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling), Thread Scheduling		
3	Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock		
UNIT III		15	
Main Memory, Virtual Memory, Mass-Storage Structure, File-System Interface, File-System Implementation			
1	Main Memory: Background, Logical address space, Physical address space, MMU, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table		
2	Virtual Memory: Background, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing		
3	Mass-Storage Structure: Overview, Disk Structure, Disk Scheduling, Disk Management		
	File-System Interface: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing		
	File-System Implementation: File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management		

S.Y.BSc	Semester III Theory
RJSUCS303 Paper III Operating System	<p>Course Objective 1.1 :</p> <p>Learners must understand proper working of operating system. To provide a sound understanding of Computer operating system, its structures, functioning and algorithms.</p> <p>Learning outcome:</p> <ol style="list-style-type: none">1. To provide a understanding of operating system, its structures and functioning2. Develop and master understanding of algorithms used by operating systems for various purposes.

S.Y.B.Sc Computer Science Syllabus Semester III & IV

SEMESTER III (THEORY)		L	Cr
Paper-IV: Database Management Systems	Paper Code: RJSUCS304	45	2
UNIT I		15	
Fundamentals of PL/SQL, Overview of PL/SQL Control Structures			
1	Fundamentals of PL/SQL: Defining variables and constants, PL/SQL expressions and comparisons: Logical Operators, Boolean Expressions, CASE Expressions Handling, Null Values in Comparisons and Conditional Statements, PL/SQL Datatypes: Number Types, Character Types, Boolean Type, Datetime and Interval Types.		
2	Overview of PL/SQL Control Structures: Conditional Control: IF and CASE Statements, IF-THEN Statement, IF-THEN-ELSE Statement, IFTHEN-ELSIF Statement, CASE Statement, Iterative Control: LOOP and EXIT Statements, WHILE-LOOP, FOR-LOOP, Sequential Control: GOTO and NULL Statements		
UNIT II		15	
Stored Procedures, Triggers, Sequences, File Organization and Indexing			
	Stored Procedures: Types and benefits of stored procedures, creating stored procedures, executing stored procedures, altering stored procedures, viewing stored procedures.		
	Triggers: Concept of triggers, Implementing triggers - creating triggers, Insert, delete, and update triggers, nested triggers, viewing, deleting and modifying triggers, and enforcing data integrity through triggers.		
	Sequences: creating sequences, referencing, altering and dropping a sequence.		
	File Organization and Indexing: Cluster, Primary and secondary indexing, Index data structure: hash and Tree based indexing, Comparison of file organization: cost model, Heap files, sorted files, clustered files. Creating, dropping and maintaining indexes.		
UNIT III		15	
Transaction Management, DCL Statements, Crash Recovery			
1	Transaction Management: ACID Properties, Serializability, Two-phase Commit Protocol, Concurrency Control, Lock Management, Lost Update Problem, Inconsistent Read Problem, Read-Write Locks, Deadlocks Handling, Two Phase Locking protocol.		
2	DCL Statements: Defining a transaction, Making Changes Permanent		

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	with COMMIT, Undoing Changes with ROLLBACK, Undoing Partial Changes with SAVEPOINT and ROLLBACK		
3	Crash Recovery: ARIES algorithm. The log based recovery, recovery related structures like transaction and dirty page table, Write-ahead log protocol, check points, recovery from a system crash, Redo and Undo phases.		

S.Y.BSc	Semester III Theory
RJSUCS304 Paper IV Database Management Systems	<p>Course Objective 1.1 :</p> <p>To develop understanding of concepts and techniques for data management and learn about widely used systems for implementation and usage.</p> <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. Master concepts of stored procedure and triggers and its use. 2. Learn about using PL/SQL for data management 3. Understand concepts and implementations of transaction management and crash Recovery

SEMESTER III (THEORY)		L	Cr	
Paper-V: Combinatorics and Graph Theory		Paper Code: RJSUCS305	45	2
UNIT I		15		
Introduction to Combinatorics				
1	Introduction to Combinatorics: Enumeration, Combinatorics and Graph Theory/ Number Theory/Geometry and Optimization, Sudoku Puzzles. Strings, Sets, and Binomial Coefficients: Strings- A First Look, Combinations, Combinatorial, The Ubiquitous Nature of Binomial Coefficients, The Binomial, Multinomial Coefficients. Induction: Introduction, The Positive Integers are Well Ordered, The Meaning of Statements, Binomial Coefficients Revisited, Solving Combinatorial Problems Recursively, Mathematical Induction, and Inductive Definitions Proofs by Induction. Strong Induction			
UNIT II		15		
Graph Theory				
1	Graph Theory: Basic Notation and Terminology, Multigraphs: Loops and Multiple Edges, Eulerian and Hamiltonian Graphs, Graph Coloring, Planar Counting, Labeled Trees, A Digression into Complexity Theory. Applying Probability to Combinatorics, Small Ramsey Numbers, Homogenous, Non-Homogenous, Exact & Non-Exact Differential Equation And its types.			
UNIT III		15		
Network Flows				
1	Network Flows: Basic Notation and Terminology, Flows and Cuts, Augmenting Paths, The Ford-Fulkerson Labeling Algorithm, A Concrete Example, Integer Solutions of Linear Programming Problems. Combinatorial Applications of Network Flows: Introduction, Matching in Bipartite Graphs, Chain partitioning, Polya's Enumeration Theorem: Coloring the Vertices of a Square.			

S.Y.BSc	Semester III Theory
RJSUCS305 Paper V Combinatorics and Graph Theory Programming	<p>Course Objective 1.1 :</p> <p>To give the learner a broad exposure of combinatorial Mathematics through applications especially the Computer Science applications.</p> <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. Appreciate beauty of combinatorics and how combinatorial problems naturally arise in many settings. 2. Understand the combinatorial features in real world situations and Computer Science applications. 3. Apply combinatorial and graph theoretical concepts to understand Computer Science concepts and apply them to solve problems

SEMESTER III (THEORY)		L	Cr
Paper-VI: Physical Computing and IoT Programming		45	2
Paper Code: RJSUCS306			
UNIT I		15	
SoC and Raspberry Pi			
1	System on Chip: What is System on chip? Structure of System on Chip.		
2	SoC products: FPGA, GPU, APU, Compute Units.		
3	ARM 8 Architecture: SoC on ARM 8. ARM 8 Architecture Introduction		
4	Introduction to Raspberry Pi: Introduction to Raspberry Pi, Raspberry Pi Hardware, Preparing your raspberry Pi.		
5	Raspberry Pi Boot: Learn how this small SoC boots without BIOS. Configuring boot sequences and hardware.		
UNIT II		15	
Programming Raspberry Pi			
1	Raspberry Pi and Linux: About Raspbian, Linux Commands, Configuring Raspberry Pi with Linux Commands		
2	Programing interfaces: Introduction to Node.js, Python.		
3	Raspberry Pi Interfaces: UART, GPIO, I2C, SPI		
4	Useful Implementations: Cross Compilation, Pulse Width Modulation, SPI for Camera.		
UNIT III		15	
Introduction to IoT			
1	Introduction to IoT: What is IoT? IoT examples, Simple IoT LED Program.		
2	IoT and Protocols		
3	IoT Security: HTTP, UPnp, CoAP, MQTT, XMPP.		
4	IoT Service as a Platform: Clayster, Thinger.io, SenseIoT, carriots and Node RED.		
5	IoT Security and Interoperability: Risks, Modes of Attacks, Tools for Security and Interoperability.		

S.Y.BSc	Semester III Theory
RJSUCS306 Paper VI Physical Computing and IoT Programming	Course Objective 1.1 : To learn about SoC architectures; Learn how Raspberry Pi. Learn to program Raspberry Pi. Implementation of internet of Things and Protocols. Learning outcome: <ol style="list-style-type: none">1. Enable learners to understand System On Chip Architectures.2. Introduction and preparing Raspberry Pi with hardware and installation.3. Learn physical interfaces and electronics of Raspberry Pi and program them using practical's4. Learn how to make consumer grade IoT safe and secure with proper use of protocols.

SEMESTER III (THEORY)		L	Cr
Paper-VII: Skill Enhancement: Web Programming	Paper Code: RJSUCS307	45	2
UNIT I		15	
HTML5, CSS			
1	HTML5: Fundamental Elements of HTML, Formatting Text in HTML, Organizing Text in HTML, Links and URLs in HTML, Tables in HTML, Images on a Web Page, Image Formats, Image Maps, Colors, FORMs in HTML, Interactive Elements, Working with Multimedia - Audio and Video File Formats, HTML elements for inserting Audio / Video on a web page		
2	CSS: Understanding the Syntax of CSS, CSS Selectors, Inserting CSS in an HTML Document, CSS properties to work with background of a Page, CSS properties to work with Fonts and Text Styles, CSS properties for positioning an element		
UNIT II		15	
JavaScript, XML			
1	JavaScript: Using JavaScript in an HTML Document, Programming Fundamentals of JavaScript - Variables, Operators, Control Flow Statements, Popup Boxes, Functions - Defining and Invoking a Function, Defining Function arguments, Defining a Return Statement, Calling Functions with Timer, JavaScript Objects - String, RegExp, Math, Date, Browser Objects - Window, Navigator, History, Location, Document, Cookies, Document Object Model, Form Validation using JavaScript		
2	XML: Comparing XML with HTML, Advantages and Disadvantages of XML, Structure of an XML Document, XML Entity References, DTD, XSLT: XSLT Elements and Attributes - xsl:template, xsl:apply-templates, xsl:import, xsl:call-template, xsl:include, xsl:element, xsl:attribute, e xsl:attribute-set, xsl:value-of		
UNIT III		15	
AJAX, PHP, Introduction to jQuery			
1	AJAX: AJAX Web Application Model, How AJAX Works, XMLHttpRequest Object - Properties and Methods, Handling asynchronous requests using AJAX		
2	PHP: Variables and Operators, Program Flow, Arrays, Working with		

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	Files and Directories, Working with Databases, Working with Cookies, Sessions and Headers		
3	Introduction to jQuery: Fundamentals, Selectors, methods to access HTML attributes, methods for traversing, manipulators, events, effects		

S.Y.BSc	Semester III Theory
RJSUCS307 Paper VII Skill Enhancement: Web Programming	<p>Course Objective 1.1 :</p> <p>To provide insight into emerging technologies to design and develop state of - the art web applications using client-side scripting, server-side scripting, and database connectivity.</p> <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. To design valid, well-formed, scalable, and meaningful pages using emerging technologies. 2. Understand the various platforms, devices, display resolutions, viewports, and browsers that render websites 3. To develop and implement client-side and server-side scripting language programs. 4. To develop and implement Database Driven Websites. 5. Design and apply XML to create a markup language for data and document centric applications.

SEMESTER IV (THEORY)		L	Cr
Paper-I: Fundamentals of Algorithms		45	2
Paper Code: RJSUCS401			
UNIT I		15	
Introduction			
1	Introduction to algorithm, Why to analysis algorithm, Running time analysis, How to Compare Algorithms, What kinds of problems are solved by algorithms? , Rate of Growth, Commonly Used Rates of Growth, Types of Analysis, Asymptotic Notation, Big-O Notation, Omega-Q Notation, Theta-0 Notation, Asymptotic Analysis, Properties of Notations, Performance characteristics of algorithms, Time complexity of sorting algorithms(Insertion sort, Merge sort, Quick sort)		
UNIT II		15	
Graph Algorithms, Selection Algorithms			
1	Graph Algorithms: Introduction, Glossary, Applications of Graphs, Graph Representation, Graph Traversals, Topological Sort, Shortest Path Algorithms, Minimal Spanning Tree		
2	Selection Algorithms: What are Selection Algorithms? Selection by Sorting, Partition-based Selection Algorithm, Linear Selection Algorithm - Median of Medians Algorithm, Finding the K Smallest Elements in Sorted Order.		
3	Algorithms Design Techniques: Introduction, Classification, Classification by Implementation Method, Classification by Design Method		
UNIT III		15	
Greedy Algorithms, Divide and Conquer Algorithms, Dynamic Programming			
1	Greedy Algorithms: Introduction, Greedy Strategy, Elements of Greedy Algorithms, Advantages and Disadvantages of Greedy Method, Greedy Applications, Understanding Greedy Technique with Huffman coding and Knapsack problem		
2	Divide and Conquer Algorithms: Introduction, What is Divide and Conquer Strategy? Divide and Conquer Visualization, Understanding Divide and Conquer, Advantages of Divide and Conquer, Disadvantages of Divide and Conquer, Divide and Conquer Applications like strassen's matrix multiplication.		
3	Dynamic Programming: Introduction, What is Dynamic Programming Strategy? Properties of Dynamic Programming Strategy, Problems which can be solved		

using Dynamic Programming, Dynamic Programming Approaches, Examples of Dynamic Programming Algorithms, Understanding Dynamic Programming, Longest Common Subsequence		
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S.Y.BSc	Semester III Theory
RJSUCS401 Paper I Fundamentals of Algorithms	<p>Course Objective 1.1 :</p> <ol style="list-style-type: none"> 1. To understand basic principles of algorithm design and why algorithm analysis is important 2. To understand how to implement algorithms in Python 3. To understand how to transform new problems into algorithmic problems with efficient solutions 4. To understand algorithm design techniques for solving different problems <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. Understand the concepts of algorithms for designing good program 2. Implement algorithms using Python

SEMESTER IV (THEORY)		L	Cr
Paper-II: Advanced Java		Paper Code: RJSUCS402	45
UNIT I		15	
Swing, JDBC			
1	Swing: Need for swing components, Difference between AWT and swing, Components hierarchy, Panes, Swing components: JLabel, JTextField and JPasswordField, JTextAres, JButton, JCheckBox, JRadioButton, JComboBox, JList, JScrollPane, JTable, JTabbedPane, JMenu, JTree		
2	JDBC: Introduction, JDBC Architecture, Types of Drivers, Statement, ResultSet, Read Only ResultSet, Updatable ResultSet, Forward Only ResultSet, Scrollable ResultSet, PreparedStatement, Connection Modes, SavePoint, Batch Updations, CallableStatement, BLOB & CLOB		
UNIT II		15	
Servlets, JSP, Java Beans			
1	Servlets: Introduction, Web application Architecture, Http Protocol & Http Methods, Web Server & Web Container, Servlet Interface, GenericServlet, HttpServlet, Servlet Life Cycle, ServletConfig, ServletContext, Servlet Communication, Session Tracking Mechanisms		
2	JSP: Introduction, JSP LifeCycle, JSP Implicit Objects & Scopes, JSP Directives, JSP Scripting Elements, JSP Actions: Standard actions and customized actions,		
3	Java Beans: Introduction, JavaBeans Properties, Examples		
UNIT III		15	
Struts 2, JSON			
1	Struts 2: Basic MVC Architecture, Struts 2 framework features, Struts 2 MVC pattern, Request life cycle, Examples, Configuration Files, Actions, Interceptors, Results & Result Types, Value Stack/OGNL		
2	JSON: Overview, Syntax, DataTypes, Objects, Schema, Comparison with XML, JSON with Java		

S.Y.B.Sc	Semester III Theory
RJSUCS402	Course Objective 1.1 :
Paper II	Explore advanced topic of Java programming for solving problems.
Advanced	Learning outcome:
JAVA	<ol style="list-style-type: none"> 1. Understand the concepts related to Java Technology 2. Explore and understand use of Java Server Programming

SEMESTER IV (THEORY)		L	Cr
Paper III: Computer Networks	Paper Code: RJSUCS403	45	2
UNIT I		15	
Introduction			
1	Introduction to Networks : Introduction to data communication, Components, Data Representation, Data Flow, Networks, Network Criteria, Physical Structures, Network types, Local Area Network, Wide Area Network, Switching, The Internet, Accessing the Internet, standards and administration Internet Standards.		
2	Introduction to OSI model: Network Models, Protocol layering, Scenarios, Principles of Protocol Layering, Logical Connections, TCP/IP Protocol Suite, Layered Architecture, Layers in the TCP/IP Protocol Suite, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing. Detailed introduction to Physical Layer, Detailed introduction to Data-Link Layer, Detailed introduction to Network Layer, Detailed introduction to Transport Layer, Detailed introduction to Application Layer.		
	Physical Layer: Data and Signals, Analog and Digital Data, Analog and Digital Signals, Sine Wave Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signal, Bit Rate, Bit Length, Transmission of Digital Signals, Transmission Impairments, Attenuation, Distortion, Noise, Data Rate Limits, Performance, Bandwidth, Throughput, Latency (Delay)		
UNIT II		15	
Introduction to Physical Layer, Analog Transmission, Multiplexing, Transmission Media, Introduction to Data-Link Layer			
1	Introduction to Physical Layer: Digital Transmission digital-to-digital conversion, Line Coding, Line Coding Schemes, analog-to-digital conversion, Pulse Code Modulation (PCM), Transmission Modes, Parallel Transmission, Serial Transmission.		
2	Analog Transmission: Analog Transmission, digital-to-analog Conversion, Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, analog-to-analog Conversion- Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM),		
	Multiplexing – Frequency-Division Multiplexing, Wavelength-Division Multiplexing, Time-Division Multiplexing.		
	Transmission Media -Guided Media, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable.		
	Introduction to Data-Link Layer- Nodes and Links, Services, Two Sub-layers, Three Types of addresses, Address Resolution Protocol (ARP). Error Detection and Correction, introduction, Types of Errors,		

	Redundancy, Detection versus Correction.		
UNIT III		15	
Multiple Access, Connecting Devices and Virtual LANs, Introduction to Network Layer, Routing Protocol, Introduction to Transport Layer			
1	Multiple Access – Media Access Control (MAC), random access, CSMA, CSMA/CD, CSMA/CA, controlled access, Reservation, Polling, Token Passing, channelization, FDMA, TDMA, CDMA.		
2	Connecting Devices and Virtual LANs - connecting devices, Hubs, Link-Layer Switches, Routers.		
3	Introduction to Network Layer - network layer services, Packetizing, Routing and Forwarding, Other Services, IPv4 addresses, Address Space, Classful Addressing.		
4	Routing Protocols - Unicast Routing, General Idea, Least-Cost Routing, Routing Algorithms, Distance-Vector Routing, Link-State Routing, Path-Vector Routing.		
5	Introduction to Transport Layer - Transport-Layer Services, Connectionless and Connection-Oriented Protocols. Transport-Layer Protocols, Service, Port Numbers, User Datagram Protocol, User Datagram, UDP Services, UDP Applications, Transmission Control Protocol, TCP Services, TCP Features, Segment.		

S.Y.BSc	Semester III Theory
RJSUCS403 Paper III Computer Networks	<p>Course Objective 1.1 :</p> <p>In this era of Information, its computation and its exchange techniques, Learner should be able to conceptualize and understand the framework and working of communication networks. And on completion, will be able to have a firm grip over this very important segment of Internet.</p> <p>Learning outcome:</p> <ol style="list-style-type: none"> 1. Learner will be able to understand the concepts of networking, which are important for them to be known as a '<i>networking professionals</i>'. 2. Useful to proceed with industrial requirements and International vendor certifications.

SEMESTER IV (THEORY)		L	Cr
Paper-IV: Software Engineering		45	2
Paper Code: RJSUCS404			
UNIT I		15	
Introduction			
1	Introduction: The Nature of Software, Software Engineering, The Software Process, Generic Process Model, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Component-Based Development, The Unified Process Phases, Agile Development- Agility, Agile Process, Extreme Programming Requirement Analysis and System Modeling: Requirements Engineering, Eliciting Requirements, SRS Validation, Components of SRS, Characteristics of SRS , Object-oriented design using the UML - Class diagram, Object diagram, Use case diagram, Sequence diagram, Collaboration diagram, State chart diagram, Activity diagram, Component diagram, Deployment diagram		
UNIT II		15	
System Design, Software Measurement and Metrics, Software Project Management			
1	System Design: System/Software Design, Architectural Design, Low-Level Design Coupling and Cohesion, Functional-Oriented Versus The Object-Oriented Approach, Design Specifications, Verification for Design, Monitoring and Control for Design		
2	Software Measurement and Metrics: Product Metrics - Measures, Metrics, and Indicators, Function-Based Metrics, Metrics for Object-Oriented Design, Operation-Oriented Metrics, User Interface Design Metrics, Metrics for Source Code, Halstead Metrics Applied to Testing, Metrics for Maintenance, Cyclomatic Complexity, Software Measurement - Size-Oriented, Function-Oriented Metrics, Metrics for Software Quality		
3	Software Project Management: Estimation in Project Planning Process -Software Scope And Feasibility, Resource Estimation, Empirical Estimation Models - COCOMO II, Estimation for Agile Development, The Make/Buy Decision, Project Scheduling - Basic Principles, Relationship Between People and Effort, Effort Distribution, Time-Line Charts		
UNIT III		15	
Risk Management, Software Quality Assurance, Software Testing			
1	Risk Management - Software Risks, Risk Identification, Risk Projection and Risk Refinement, RMMM Plan		
2	Software Quality Assurance: Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Six Sigma, Software Reliability, The ISO 9000 Quality Standards, Capability Maturity Model		
3	Software Testing : Verification and Validation, Introduction to Testing,		

	Testing Principles, Testing Objectives, Test Oracles, Levels of Testing, White-Box Testing/Structural Testing, Functional/Black-Box Testing, Test Plan, Test-Case Design		
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SEMESTER IV (THEORY)		L	Cr
Paper-V: Linear Algebra using Python		45	2
Paper Code: RJSUCS405			
UNIT I		15	
Introduction			
1	Field: Introduction to complex numbers, numbers in Python , Abstracting over fields, Playing with GF(2), Vector Space: Vectors are functions, Vector addition, Scalar-vector multiplication, Combining vector addition and scalar multiplication, Dictionary-based representations of vectors, Dot-product, Solving a triangular system of linear equations. Linear combination, Span, The geometry of sets of vectors, Vector spaces, Linear systems, homogeneous and otherwise		
UNIT II		15	
Matrix, Basis, Dimension			
1	Matrix: Matrices as vectors, Transpose, Matrix-vector and vector-matrix multiplication in terms of linear combinations, Matrix-vector multiplication in terms of dot-products, Null space, Computing sparse matrix-vector product, Linear functions, Matrix-matrix multiplication, Inner product and outer product, From function inverse to matrix inverse		
2	Basis: Coordinate systems, Two greedy algorithms for finding a set of generators, Minimum Spanning Forest and GF(2), Linear dependence, Basis , Unique representation, Change of basis, first look, Computational problems involving finding a basis		
	Dimension: Dimension and rank, Direct sum, Dimension and linear functions, The annihilator		
UNIT III		15	
Gaussian elimination, Orthogonalization, Eigenvector			
1	Gaussian elimination : Echelon form, Gaussian elimination over GF(2), Solving a matrix-vector equation using Gaussian elimination, Finding a basis for the null space, Factoring integers, Inner Product: The inner product for vectors over the reals, Orthogonality,		
2	Orthogonalization : Projection orthogonal to multiple vectors, Projecting orthogonal to mutually orthogonal vectors		
3	Eigenvector: Modeling discrete dynamic processes, Diagonalization of the Fibonacci matrix, Eigenvalues and eigenvectors, Coordinate representation in terms of eigenvector		

S.Y.BSc	Semester III Theory
RJSUCS405 Paper V Linear Algebra using Python	Course Objective 1.1 : To offer the learner the relevant linear algebra concepts through computer science applications. Learning outcome: <ol style="list-style-type: none">1. Appreciate the relevance of linear algebra in the field of computer science.2. Understand the concepts through program implementation3. Instill a computational thinking while learning linear algebra.

SEMESTER IV (THEORY)		L	Cr
Paper-VI: .Net Technologies		45	2
Paper Code: RJSUCS406			
UNIT I		15	
The .NET Framework, C# Language Basics ,ASP.NET			
1	The .NET Framework: .NET Languages, Common Language Runtime, .NET Class Library		
2	C# Language Basics: Comments, Variables and Data Types, Variable Operations, Object-Based Manipulation, Conditional Logic, Loops, Methods, Classes, Value Types and Reference Types, Namespaces and Assemblies, Inheritance, Static Members, Casting Objects, Partial Classes		
3	ASP.NET: Creating Websites, Anatomy of a Web Form - Page Directive, Doctype, Writing Code - Code-Behind Class, Adding Event Handlers, Anatomy of an ASP.NET Application - ASP.NET File Types, ASP.NET Web Folders,		
4	HTML Server Controls - View State, HTML Control Classes, HTML Control Events, HtmlControl Base Class, HtmlContainerControl Class, HtmlInputControl Class, Page Class, global.asax File, web.config File		
UNIT II		15	
Web Controls, State Management, Validation, Rich Controls			
1	Web Controls: Web Control Classes, WebControl Base Class, List Controls, Table Controls, Web Control Events and AutoPostBack, Page Life Cycle		
2	State Management: ViewState, Cross-Page Posting, Query String, Cookies, Session State, Configuring Session State, Application State		
3	Validation: Validation Controls, Server-Side Validation, Client-Side Validation, HTML5 Validation, Manual Validation, Validation with Regular Expressions		
4	Rich Controls: Calendar Control, AdRotator Control, MultiView Control Themes and Master Pages: How Themes Work, Applying a Simple Theme, Handling Theme Conflicts, Simple Master Page and Content Page, Connecting Master pages and Content Pages, Master Page with Multiple Content Regions, Master Pages and Relative Paths Website Navigation: Site Maps, URL Mapping and Routing, SiteMapPath Control, TreeView Control, Menu Control		
UNIT III		15	
ADO.NET, Data Binding, Data Controls, Working with XML, LINQ			
1	ADO.NET: Data Provider Model, Direct Data Access - Creating a Connection,		

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	Select Command, DataReader, Disconnected Data Access		
2	Data Binding: Introduction, Single-Value Data Binding, Repeated-Value Data Binding, Data Source Controls - SqlDataSource		
3	Data Controls: GridView, DetailsView, FormView		
4	Working with XML: XML Classes - XMLTextWriter, XMLTextReader		
5	Caching: When to Use Caching, Output Caching, Data Caching		
6	LINQ: Understanding LINQ, LINQ Basics,		
7	ASP.NET AJAX: ScriptManager, Partial Refreshes, Progress Notification, Timed Refreshes		

S.Y.BSc	Semester III Theory
RJSUCS406 Paper VI .Net Technologies	<p>Course Objective 1.1 :</p> <p>To explore .NET technologies for designing and developing dynamic, interactive and responsive web applications.</p> <p>Learning outcome:</p> <p>Understand the .NET framework</p> <ol style="list-style-type: none"> 1. Develop a proficiency in the C# programming language 2. Proficiently develop ASP.NET web applications using C# 3. Use ADO.NET for data persistence in a web application

SEMESTER IV (THEORY)		L	Cr
Paper-VII: Skill Enhancement: Android Developer Fundamentals	Paper Code: RJSUCS407	45	2
UNIT I		15	
Introduction			
1	What is Android? Obtaining the required tools, creating first android app, understanding the components of screen, adapting display orientation, action bar, Activities and Intents, Activity Lifecycle and Saving State, Basic Views: TextView, Button, ImageButton, EditText, CheckBox, ToggleButton, RadioButton, and RadioGroup Views, ProgressBar AutoCompleteTextView, TimePicker View, DatePicker View, ListView View, Spinner View. User Input Controls, Menus, Drawables.		
UNIT II		15	
Web Services			
1	AsyncTask and AsyncTaskLoader, Connecting to the Internet, Broadcast receivers, Services, Notifications, Alarm managers, Transferring data efficiently		
2	Web Services: Characteristics, Architecture, Components ,Examples, Security.		
UNIT III		15	
Data,			
1	Data - saving, retrieving, and loading: Overview to storing data, Shared preferences, SQLite primer, store data using SQLite database, ContentProviders, loaders to load and display data, Permissions, performance and security, Firebase and AdMob, Publish your app		

S.Y.BSc	Semester III Theory
RJSUCS307 Paper VII Skill Enhancement: Android Developer Fundamentals	<p>Course Objective 1.1 :</p> <p>To provide the comprehensive insight into developing applications running on smart mobile devices and demonstrate programming skills for managing task on mobile. To provide systematic approach for studying definition, methods and its applications for Mobile-App development.</p> <p>Learning outcome:</p> <ol style="list-style-type: none"> 1) Understand the requirements of Mobile programming environment. 2) Learn about basic methods, tools and techniques for developing Apps 3) Explore and practice App development on Android Platform 4) Develop working prototypes of working systems for various uses in daily lives.

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Semester III (PRACTICALS)		L/W	Cr
Practical-II: Core Java		Paper Code: RJSUCS302	03 1
1	Write a program to create a class in java.		
2	Demonstrate Java inheritance using extends keyword.		
3	Demonstrate method overloading and method overriding in Java.		
4	Demonstrate String handling in Java.		
5	Create a package: Animals. In package animals create interface Animal with suitable behaviors. Implement the interface Animal in the same package animals.		
6	Demonstrate creating your own exception in Java.		
7	Demonstrate the concept of multithreading in Java.		
8	Demonstrate the concept of networking (client-server communication) in Java.		
9	Demonstrate the concept of RMI in Java.		
10	Demonstrate the concept of I/O streams in Java.		
11	Write a Java List example and demonstrate methods of Java List interface.		
12	Using various swing components design Java application to accept a student's resume.(Design form).		
13	Design simple calculator GUI application using AWT components.		
Practical-III: Operating System		Paper Code RJSUCS303	03 1
<i>Practical can be implemented either in JAVA or any other programming language.</i>			
1	Practical based on Process Communication.		
2	Practical based on Threads.		
3	Practical based on Synchronization.		
4	Implement FCFS scheduling algorithm in Java.		
5	Implement SJF (with no preemption) scheduling algorithm in Java.		
6	Implement RR scheduling algorithm in Java.		
7	Write a Java program that implements the banker's algorithm.		
8	Write a Java program that implements the FIFO page-replacement algorithm.		
9	Write a Java program that implements the LRU page-replacement algorithm.		
Practical-IV: Database Management System		Paper Code: RJSUCS304	03 1
<i>Practical can be implemented either in JAVA or any other programming language.</i>			
1	Creating and working with Insert/Update/Delete Trigger using Before/After clause.		
2	Writing PL/SQL Blocks with basic programming constructs by including following: a. Sequential Statements b. unconstrained loop		

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3	Sequences: a. Creating simple Sequences with clauses like START WITH, INCREMENT BY, MAXVALUE, MINVALUE, CYCLE NOCYCLE, CACHE NOCACHE, ORDER NOORDER. b. Creating and using Sequences for tables.		
4	Writing PL/SQL Blocks with basic programming constructs by including following: a. If...then...Else, IF...ELSIF...ELSE... END IF b. Case statement		
5	Writing PL/SQL Blocks with basic programming constructs for following Iterative Structure: a. While-loop Statements b. For-loop Statements.		
6	Writing PL/SQL Blocks with basic programming constructs by including a GoTO to jump out of a loop and NULL as a statement inside IF		
7	Writing Procedures in PL/SQL Block a. Create an empty procedure, replace a procedure and call procedure b. Create a stored procedure and call it c. Define procedure to insert data d. A forward declaration of procedure		
8	Writing Functions in PL/SQL Block. a. Define and call a function b. Define and use function in select clause, c. Call function in dbms_output.put_line d. Recursive function e. Count Employee from a function and return value back		
Practical-V: : Combinatorics and Graph Theory		Paper Code: RJSUCS305	03 1
(Practicals in python except last practical)			
1	Solving problems on strings, sets and binomial coefficients.		
2	Solving problems using induction.		
3	Solving problems on Eulerian and Hamiltonian graphs.		
4	Solving problems on Chromatic number and coloring.		
5	Solving problems using Kruskal's Algorithm		
6	Solving problems using Prim's Algorithm.		
7	Solving problems using Dijkstra's Algorithm		
8	Solving problems of finding augmenting paths in network flows.		
9	Solving problems on network flows using Ford-Fulkerson Labeling Algorithm		
10	Solving problems on posets and their associated networks.		
Practical-VI: Physical Computing and IoT Programming		Paper Code: RJSUCS306	03 1
1	Preparing Raspberry Pi: Hardware preparation and Installation		
2	Linux Commands: Exploring the Raspbian		
3	GPIO : Light the LED with Python		
4	GPIO: LED Grid Module: Program the 8X8 Grid with Different Formulas		
5	SPI: Camera Connection and capturing Images using SPI		
6	Real Time Clock display using PWM.		

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7	Stepper Motor Control: PWM to manage stepper motor speed.		
8	Node RED: Connect LED to Internet of Things		
9	Create a simple Web server using Raspberry Pi		
Practical-VII: Web Programming		Paper Code: RJSUCS307	03 1
1	Design a webpage that makes use of a. Document Structure Tags b. Various Text Formatting Tags c. List Tags d. Image and Image Maps		
2	Design a webpage that makes use of a. Table tags b. Form Tags (forms with various form elements) c. Navigation across multiple pages d. Embedded Multimedia elements		
3	Design a webpage that make use of Cascading Style Sheets with a. CSS properties to change the background of a Page b. CSS properties to change Fonts and Text Styles c. CSS properties for positioning an element		
4	Write JavaScript code for a. Performing various mathematical operations such as calculating factorial / finding Fibonacci Series / Displaying Prime Numbers in a given range / Evaluating Expressions / Calculating reverse of a number b. Validating the various Form Elements		
5	Write JavaScript code for a. Demonstrating different JavaScript Objects such as String, RegExp, Math, Date b. Demonstrating different JavaScript Objects such as Window, Navigator, History, Location, Document, c. Storing and Retrieving Cookies		
6	Create a XML file with Internal / External DTD and display it using a. CSS b. XSL		
7	Design a webpage to handle asynchronous requests using AJAX on a. Mouseover b. button click		
8	Write PHP scripts for a. Retrieving data from HTML forms b. Performing certain mathematical operations such as calculating factorial / finding Fibonacci Series / Displaying Prime Numbers in a given range / Evaluating Expressions / Calculating reverse of a number c. Working with Arrays d. Working with Files (Reading / Writing)		
9	Write PHP scripts for a. Working with Databases (Storing Records / Reprieving Records and Display them) b. Storing and Retrieving Cookies c. Storing and Retrieving Sessions		
10	Design a webpage with some jQuery animation effects.		

S.Y.B.Sc Computer Science (Practical) Semester III & IV		L/W	Cr
Practical-I: Fundamentals of Algorithms		Paper Code: RJSUCS401	03
1	Write Python program to perform matrix multiplication. Discuss the complexity of algorithm used.		
2	Write Python program to sort n names using Quick sort algorithm. Discuss the complexity of algorithm used.		
3	Write Python program to sort n numbers using Merge sort algorithm. Discuss the complexity of algorithm used.		
4	Write Python program for inserting an element into binary tree.		
5	Write Python program for deleting an element (assuming data is given) from binary tree and traversing through tree.		
6	Write Python program for checking whether a given graph G has simple path from source s to destination d. Assume the graph G is represented using adjacent matrix.		
7	Write Python program for finding the smallest and largest elements in an array A of size n using Selection algorithm. Discuss Time complexity.		
8	Write Python program for finding the second largest element in an array A of size n using Tournament Method. Discuss Time complexity.		
9	Write Python program for implementing Huffman Coding Algorithm. Discuss the complexity of algorithm.		
10	Write Python program for implementing Strassen's Matrix multiplication using Divide and Conquer method. Discuss the complexity of algorithm.		
Practical-II: Advanced JAVA		Paper Code : RJSUCS402	03
1	Design applications in java by using Swing Controls :- a. JLabel, JTextField, JComboBox, JRadioButton, JButton b. JTable c. JScrollPane, JTabbedPane d. JMenu e. JTree		
2	Write a jdbc program to implement ResultSet by accepting query by command line.		
3	Write a jdbc program to insert and show records in a database using Swing controls.		
4	Write a program to implement Servlet Life Cycle.		
5	Write a Servlet program a. to calculate product of two numbers. b. to calculate Net Salary.		
6	Write a Servlet & jdbc program to design login form.		
7	Write a jsp program a. to insert record in a database. b. to display date.		
8	Write a JavaBean program to display date.		
9	Write a JavaBean program to display student information.		
10	Write a JSON program to display data.		
11	Write a JSON program with HTML to display data.		

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Practical-III: Computer Networks		Paper Code: : RJSUCS403	03	1
1	Understanding the working of NIC cards, Ethernet/Fast Ethernet/Gigabit Ethernet.			
2	Crimping of Twisted-Pair Cable with RJ45connector for Straight-Through, Cross-Over, Roll-Over.			
3	To understand their respective role in networks/internet.			
4	Problem solving with IPv4, which will include concept of Classful addressing. (supportive Hint: use Cisco Binary Game)			
5	Using, linux-terminal or Windows-cmd, execute following networking commands and note the output: <i>ping, traceroute, netstat, arp, ipconfig</i> .			
6	Using Packet Tracer, create a basic network of two computers using appropriate network wire.			
7	Using Packet Tracer, connect multiple (min.6) computers using layer 2 switch.			
8	Using Packet Tracer, connect a network in triangular shape with three layer two switches and every switch will have four computer. Verify their connectivity with each other.			
9	Using Packet Tracer, create a wireless network of multiple PCs using appropriate access point.			
10	Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the network analyzer is working.			
Practical-V: Linear Algebra using Python		Paper Code: : RJSUCS405	03	1
(Practicals in python except last practical)				
1	Write a program which demonstrates the following: <ul style="list-style-type: none"> • Addition of two complex numbers • Displaying the conjugate of a complex number • Plotting a set of complex numbers • dCreating a new plot by rotating the given number by a degree 90, 180, 270 degrees and also by scaling by a number $a=1/2$, $a=1/3$, $a=2$ etc. 			
2	Write a program to do the following: <ul style="list-style-type: none"> • Enter a vector u as a n-list • Enter another vector v as a n-list • Find the vector $au+bv$ for different values of a and b • Find the dot product of u and v 			
3	Write a program to do the following: <ul style="list-style-type: none"> • Enter two distinct faces as vectors u and v. • Find a new face as a linear combination of u and v i.e. $au+bv$ for a and b in R. • Find the average face of the original faces. 			
4	Write a program to do the following: <ul style="list-style-type: none"> • Enter an r by c matrix M (r and c being positive integers) • Display M in matrix format • Display the rows and columns of the matrix M • Find the scalar multiplication of M for a given scalar. 			

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	<ul style="list-style-type: none"> Find the transpose of the matrix M. 		
5	<p>Write a program to do the following:</p> <ul style="list-style-type: none"> Find the vector -matrix multiplication of a r by c matrix M with an c-vector u. Find the matrix-matrix product of M with a c by p matrix N. 		
6	Write a program to enter a matrix and check if it is invertible. If the inverse exists, find the inverse.		
7	Write a program to convert a matrix into its row echelon form.		
8	<p>Write a program to do the following:</p> <ul style="list-style-type: none"> Enter a positive number N and find numbers a and b such that $a - b = N$ Find the gcd of two numbers using Euclid's algorithm. 		
9	<p>Write a program to do the following:</p> <ul style="list-style-type: none"> Enter a vector b and find the projection of b orthogonal to a given vector u. Find the projection of b orthogonal to a set of given vectors 		
10	Write a program to enter a given matrix and an eigen value of the same. Find its eigen vector.		
Practical-VI: .NET Technologies		Paper Code: : RJSUCS406	03 1
1	Write C# programs for understanding C# basics involving <ol style="list-style-type: none"> Variables and Data Types Object-Based Manipulation Conditional Logic Loops Methods 		
2	Write C# programs for Object oriented concepts of C# such as: <ol style="list-style-type: none"> Program using classes Constructor and Function Overloading Inheritance Namespaces 		
3	Design ASP.NET Pages with <ol style="list-style-type: none"> Server controls. Web controls and demonstrate the use of AutoPostBack Rich Controls (Calendar / Ad Rotator) 		
4	Design ASP.NET Pages for State Management using <ol style="list-style-type: none"> Cookies Session State Application State 		
5	Perform the following activities <ol style="list-style-type: none"> Design ASP.NET page and perform validation using various Validation Controls Design an APS.NET master web page and use it other (at least 2-3) content pages. Design ASP.NET Pages with various Navigation Controls 		
6	Performing ADO.NET data access in ASP.NET for <ol style="list-style-type: none"> Simple Data Binding Repeated Value Data Binding 		
7	Design ASP.NET Pages for Performance improvement using Caching		
8	Design ASP.NET application to query a Database using LINQ		
9	Design and use AJAX based ASP.NET pages.		

Practical-VII: Andriod Developer Fundamentals		Paper Code: : RJSUCS407	03	1
1	Install Android Studio and Run Hello World Program.			
2	Create an android app with Interactive User Interface using Layouts.			
3	Create an android app that demonstrates working with TextView Elements.			
4	Create an android app that demonstrates Activity Lifecycle and Instance State.			
5	Create an android app that demonstrates the use of Keyboards, Input Controls, Alerts, and Pickers.			
6	Create an android app that demonstrates the use of an Options Menu.			
7	Create an android app that demonstrate Screen Navigation Using the App Bar and Tabs.			
8	Create an android app to Connect to the Internet and use BroadcastReceiver.			
9	Create an android app to show Notifications and Alarm manager.			
10	Create an android app to save user data in a database and use of different queries.			

References	
Semester III	
Paper-I: Theory Of Computation	Paper Code RJSUCS301
<p>Textbook(s):</p> <p style="text-align: right;">rd</p> <ol style="list-style-type: none"> 1) Theory of Computer Science, K. L. P Mishra, Chandrasekharan, PHI, 3rd Edition 2) Introduction to Computer Theory, Daniel Cohen, Wiley, 2nd Edition 3) Introductory Theory of Computer Science, E.V. Krishnamurthy, Affiliated East-West Press. <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1) Theory of Computation, Kavi Mahesh, Wiley India 2) Elements of The Theory of Computation, Lewis, Papadimitriou, PHI 3) Introduction to Languages and the Theory of Computation, John E Martin, McGraw-Hill Education Introduction to Theory of Computation, Michel Sipser, Thomson 	
Paper-II: Core Java	Paper Code RJSUCS302
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1) Herbert Schildt, Java The Complete Reference, Ninth Edition, McGraw-Hill Education, 2014 <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1) E. Balagurusamy, Programming with Java, Tata McGraw-Hill Education India, 2014 2) Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press 3) The Java Tutorials: http://docs.oracle.com/javase/tutorial/ 	
Paper-III: Operating System	Paper Code RJSUCS303
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Abraham Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts, Wiley, 8th Edition <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1. Achyut S. Godbole, Atul Kahate, Operating Systems, Tata McGraw Hill 2. Naresh Chauhan, Principles of Operating Systems, Oxford Press 3. Andrew S Tanenbaum, Herbert Bos, Modern Operating Systems, 4e Fourth Edition, Pearson Education, 2016 	
Paper-IV: Database Management Systems	Paper Code RJSUCS304
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1) Ramakrishnam, Gehrke, Database Management Systems, Bayross, McGraw-Hill, 3rd Edition 2) Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, 6th Edition 3) Ivan Bayross, "SQL, PL/SQL - The Programming language of Oracle", B.P.B. Publications <p>Additional Reference(s):</p>	

S.Y.B.Sc Computer Science Syllabus Semester III & IV

1) Ramez Elmasri & Shamkant B.Navathe, Fundamentals of Database Systems, Pearson Education 2) Robert Sheldon, Geoff Moes, Begning MySQL, Wrox Press. Joel Murach, Murach's MySQL, Murach	
Paper-V: Combinatorics & Graph Theory	Paper Code RJSUCS305
Textbook(s): 1) Applied Combinatorics, Mitchel T. Keller and William T. Trotter, 2016, http://www.rellek.net/appcomb . Additional Reference(s): 1) Applied Combinatorics, sixth.edition, Alan Tucker, Wiley; (2016) 2) Graph Theory and Combinatorics, Ralph P. Grimaldi, Pearson Education; Fifth edition (2012) 3) Combinatorics and Graph Theory, John Harris, Jeffrey L. Hirst, Springer(2010). 4) Graph Theory: Modeling, Applications and Algorithms, Agnarsson, Pearson Education India (2008).	
Paper-VI: Physical Computing & IOT	Paper Code RJSUCS306
Textbook(s): 1) Learning Internet of Things, Peter Waher, Packt Publishing(2015) 2) Mastering the Raspberry Pi, Warren Gay, Apress(2014) Additional Reference(s): 1) Abusing the Internet of Things, Nitesh Dhanjani, O'Reilly	
Paper-VII: Skill Enhancement: Web Programming	Paper Code RJUSCS307
Text Book(s): 1) HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Dreamtech Press 2) Web Programming and Interactive Technologies, scriptDemics, StarEdu Solutions India. 3) PHP: A Beginners Guide, Vikram Vaswani, TMH Additional Reference(s): 1) HTML, XHTML, and CSS Bible Fifth Edition, Steven M. Schafer, WILEY 2) Learn to Master HTML 5, scriptDemics, StarEdu Solutions Pvt Ltd. 3) Learning PHP, MySQL, JavaScript, CSS & HTML5, Robin Nixon, O'Reilly 4) PHP, MySQL, JavaScript & HTML5 All-in-one for Dummies, Steve Suehring, Janet Valade Wiley	

Semester IV	
Paper-I: Fundamentals of Algorithms	Paper Code RJSUCS401
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1. Data Structure and Algorithmic Thinking with Python, Narasimha Karumanchi , CareerMonk Publications, 2016 2. Introduction to Algorithm, Thomas H Cormen, PHI <p>Additional References(s):</p> <ol style="list-style-type: none"> 1. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, 2016, Wiley 2. Fundamentals of Computer Algorithms, Sartaj Sahni and Sanguthevar Rajasekaran Ellis Horowitz, Universities Press 	
Paper-II: Advanced Java	Paper Code RJSUCS402
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1) Cay S. Horstmann, Gary Cornell, Core Java™ 2: Volume II-Advanced Features Prentice Hall PTR,9th Edition 2) Herbert Schildt, Java2: The Complete Reference, Tata McGraw-Hill,5th Edition 3) Joe Wigglesworth and Paula McMillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD) ,3rd Edition <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1) Advanced Java Programming, Uttam K. Roy, Oxford University Press 2) The Java Tutorials: http://docs.oracle.com/javase/tutorial/ 3) The Java Tutorials of Sun Microsystems Inc 	
Paper-III: Computer Networks	Paper Code RJSUCS403
<p>Textbook(s):</p> <ol style="list-style-type: none"> 1) Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, TMH, 2013. 2) Computer Network, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson Education, 2011. <p>Additional Reference(s):</p> <ol style="list-style-type: none"> 1) Computer Network, Bhushan Trivedi, Oxford University Press <p>Data and Computer Communication, William Stallings, PHI</p>	
Paper-IV: Software Engineering	Paper Code RJSUCS404

Text book(s): 1) Software Engineering, A Practitioner's Approach, Roger S, Pressman.(2014)	
Additional Reference(s): 1) Software Engineering, Ian Sommerville, Pearson Education 2) Software Engineering: Principles and Practices",Deepak Jain,OXFORD University Press, 3) Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI 4) Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons A Concise Introduction to Software Engineering, Pankaj Jalote, Springer	
Paper-V: Linear Algebra using Python	Paper Code RJSUCS405
Textbook(s): 1) Coding the Matrix Linear Algebra through Applications to Computer Science Edition 1, PHILIP N. KLEIN, Newtonian Press (2013)	
Additional References: 1) Linear Algebra and Probability for Computer Science Applications, Ernest Davis, A K Peters/CRC Press (2012). 2) Linear Algebra and Its Applications, Gilbert Strang, Cengage Learning, 4 th Edition (2007). Linear Algebra and Its Applications, David C Lay, Pearson Education India; 3 Edition (2002)	
Paper-VI: .Net Technologies	Paper Code RJSUCS3406
Textbook(s): 1) Beginning ASP.NET 4.5 in C#, Matthew MacDonald, Apress(2012)	
Additional Reference(s): 1) The Complete Reference ASP .NET, MacDonald, Tata McGraw Hill Beginning ASP.NET 4 in C# and VB Imar Spanjaars, WROX	
Paper-VII: Skill Enhancement: Android Developer Fundamentals	Paper Code RJSUCS407
Textbook(s): 1) "Beginning Android 4 Application Development", Wei-Meng Lee, March 2012, WROX.	
Additional Reference(s): 1) https://developers.google.com/training/courses/android-fundamentals https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-practicals/details	

Scheme of Examinations

1. Two Internals of 20 marks each. Duration 30min for each.
2. One External (Semester End Examination) of 60 marks. Duration 2 hours.
3. One Practical at the end of Semester consisting of practical I (Paper I and II)-100 marks and Practical II (Paper III and IV) - 100 marks.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. Student must appear for at least one of the two Internal Tests to be eligible for the Semester End Examination.
6. For any KT examinations, there shall be ODD-ODD/EVEN-EVEN pattern followed.
7. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of S.Y.B.Sc. Computer Science or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of S.Y.B.Sc. Computer Science as per the minimum requirements.
8. In case of loss of journal, a candidate must produce a certificate from the Head of the department /Institute that the practicals for the academic year were completed by the student. However, such a candidate will be allowed to appear for the practical examination, but the marks allotted for the journal will not be granted.
9. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.