Hindi Vidya Prachar Samiti's

Ramniranjan Jhunjhunwala College

of Arts, Science & Commerce

(Autonomous College)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.Sc.

Program: B.Sc. COMPUTER-SCIENCE

Program Code: RJSUCS

(CBCS 2021-2022)

THE PREAMBLE

Why Computer Science ?

Computer Science(CS) has been evolving as an important branch of science and engineering throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer science is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Science can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of computer science also has strong connections to other disciplines. Many problems in science, engineering, healthcare, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular application domain. The B.Sc. Computer Science course structure therefore needed a fresh outlook and complete overhaul.

Why Computer Science at R J College?

The Computer Science department was established in the year 1999 with strength of 60 Students and M.Sc CS with strength of 40 Seats was introduced in the year 2001. Today the strength has reached to 120 at UG level and 48 at PG level. The department offers both UG and PG programs in the subject of CS and is affiliated to, and recognized by the University of Mumbai. College facilitate departmental library with near about 1200+ books. There are 3 dedicated well-upgraded laborites for CS department. With the management extensive support, department believes in "**1 Student 1 PC policy**" which helps students to rigorous practice and focus. Projects, hands on training sessions, guest lectures, laboratory experimentation, lecture-based learning, industry visits etc. motivate students to explore more in terms of applications of the subject. Under autonomy, the department has made curriculum more robust by incorporating skill-based learning and value added course that imparts practical knowledge of the subject to the students. Department of CS (DBT), New Delhi has identified CS Department of R J College as DBT Star College Department which has further strengthened our hands in being able to provide hands on training to the students to satisfy their curiosity.

Our Curriculum, Your Strength

The syllabus of CS for the total six semesters is meticulously designed so as to make students understand the various programming languages and other many subjects of CS. FY level syllabus have great potential to serve the need of students for being strong basic foundation in computer science. Then gradually stepping ahead the students at higher complexities at every subsequent semesters, till semester 6. In all, 38 subjects are covered in 6 semesters, which gives adequate knowledge in the fields of computer science. Practical's of all semesters and project at TY level boost high level confidence of students to crack immense career opportunities.

DISTRIBUTION OF TOPICS AND CREDITS

T.Y.B.Sc. COMPUTER-SCIENCE SEMESTER V

Course	Nomenclature	Credits	Topics
RJSUCS501	Artificial Intelligence	03	1. Introduction To AI 2. Learning from Examples 3. Probabilistic model and Deep learning
RJSUCS502	Linux Server Administration	03	1. Introduction. 2. Internet Services 3. Network File System.
RJSUCS503	Information and Network Security	03	1. Introduction 2. Message security 3. Mail & Web Security
RJSUCS504	Web Services	03	1. Introduction to SOAP Webservice and WCF 2. REST services 3. MicroServices
RJSUCS505	Software Testing and Quality Assurance	02	1. Introduction to S/w Testing 2. Software Testing Strategies 3. Software Quality Assurance
RJSUCSP501	Practical of RJSUCS501 + RJSUCS502	02	Introduction To AI Learning from Examples Probabilistic model and Deep learning.Internet Services Network File System.
RJSUCSP502	Practical of RJSUCS503+RJSUCS504	02	Encryption,Decryption, Message security Mail & Web Security, SOAP Webservice and WCF, REST services,MicroServices.

RJSUCSP503	Project Documentation	01	Project Documentation
RJSUCSP504	Practical of RJSUCS505	01	Software Testing Strategies Software Quality Assurance

T.Y.B.Sc. COMPUTER-SCIENCE SEMESTER VI

Course	Nomenclature	Credits	Topics
RJSUCS601	Wireless Sensor Networks and Mobile Communication	03	1. Introduction to WSN 2. Protocols used in WSN 3.Mobile and Satellite communication.
RJSUCS602	Cloud Computing	03	1. Introduction to Cloud computing 2. Virtualized Environments 3. Open Stack
RJSUCS603	Advanced Database Systems	03	1. Distributed & Parallel Computing. 2. Introduction to OODBMS & Temporal database 3. Active, Deductive & XML database
RJSUCS604	Data Science	03	1. Introduction to Data Science. 2. Data curation 3. Statistical Modelling and Machine Learning.
RJSUCS605	Ethical Hacking	02	1. Introduction to Ethical hacking. 2. Introduction to Pre-attacks. 3. Enterprise Security.
RJSUCSP601	Practical of RJSUCS601 + RJSUCS602	02	Access Control,Wireless Transmission and Medium Access, Cloud computing, Virtualized Environments , Open Stack.

RJSUCSP602	Practical of RJSUCS603+RJSUCS604	02	Distributed & Parallel Computing, OODBMS & Temporal database, Active, Deductive & XML database, Data curation, Statistical Modelling and Machine Learning.
RJSUCSP603	Project Implementation	01	Project Implementation
RJSUCSP604	RJSUCS605	01	Ethical hacking Tools, Pre-attacks, Enterprise Security.

SEMESTER V (THEORY)		L	Cr
Paper-I: Artificial Intelligence	**Paper Code: RJSUCS501**	45	3
UNIT I		15	
INTRODUCTION TO AI			
1	**What Is AI:** Foundations, History and State of the Art of AI. **Intelligent Agents:** Agents and Environments, Nature of Environments, Structure of Agents,Types of agents, knowledge representation.		
2	**Problem Solving by searching:** Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Automata.		
3	**Propositional logic and Predicate logic :** Definition, Examples		
UNIT II		15	
LEARNING FROM EXAMPLES			
1	**Learning from Examples:** Forms of Learning, Supervised Learning, Learning Decision Trees, Unsupervised Learning: K-means , Hierarchical clustering, Evaluating and Choosing the Best Hypothesis, Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Ensemble Learning of Practical Machine Learning.		
2	Genetic Algorithm: random selection, crossover, mutation, Fuzzy logic, operations in Fuzzy logic.		

	UNIT III	15	
	PROBABILISTIC MODEL AND DEEP LEARNING		
1	**Learning probabilistic models:** Reinforcement learning: Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Applications of Reinforcement Learning. Robotics: Difference between robotics and AI, Robot locomotion, computer vision, task of computer vision, application of computer vision and robotics, Bayesian network, Natural language processing: components of NLP, steps in NLP, Expert System: components of expert system, Knowledge base: components of knowledge base.		
2	**Deep Learning:**What is DL ? ; objectives of DL ; categories of DL ; Biological and ANN ; Difference between AI,ML,DL.		

T.Y.BSc	Semester V Theory
RJSUCS501 Paper I **Artificial Intelligence**	**Course Outcomes 5.1:** Artificial Intelligence (AI) and accompanying tools and techniques bring transformational changes in the world. Machines capability to match, and sometimes even surpass human capability, make AI a hot topic in Computer Science. This course aims to introduce the learner to this interesting area. **Learning Outcomes:** After completion of this course, learners should get a clear understanding of AI and different search algorithms used for solving problems. The learner should also get acquainted with different learning algorithms and models used in machine learning.

SEMESTER V (THEORY)		L	Cr
Paper-II: Linux System Administration	**Paper Code: RJSUCS502**	45	3
UNIT I		15	
INTRODUCTION			
1	Technical Summary of Linux Distributions, Managing Software		
2	**Single-Host Administration:** Managing Users and Groups, Booting and shutting down processes, File Systems, Core System Services, Process of configuring, compiling, Linux Kernel.		
3	**Networking and Security:** TCP/IP for System Administrators, basic network Configuration, Linux Firewall.		
UNIT II		15	
INTERNET SERVICES			
1	**Internet Services:** Domain Name System (DNS), File Transfer Protocol (FTP), Apache web server, Simple Mail Transfer Protocol (SMTP), Post Office Protocol and Internet Mail Access Protocol (POP and IMAP),		
2	Secure Shell (SSH), Network Authentication, OpenLDAP Server, Samba and LDAP, Network authentication system (Kerberos), Domain Name Service (DNS), Security.		

	UNIT III	15	
	NETWORK FILE SYSTEM		
1	Network File System (NFS), Samba, Distributed File Systems (DFS), Network Information Service (NIS), Dynamic Host Configuration Protocol (DHCP), MySQL, LAMP Applications File Servers, Email Services, Chat Applications.		

T.Y.BSc	Semester V Theory
RJSUCS502 Paper II **Linux System Administration**	**Course Outcomes 5.2:** Demonstrate proficiency with the Linux command line interface, directory & file management techniques, file system organization, and tools commonly found on most Linux distributions. Effectively operate a Linux system inside of a network environment to integrate with existing service solutions. Demonstrate the ability to troubleshoot challenging technical problems typically encountered when operating and administering Linux systems. **Learning Outcomes:** Learner will be able to develop Linux based systems and maintain. Learner will be able to install appropriate service on Linux server as per requirement. Learner will have proficiency in Linux server administration.

SEMESTER V (THEORY)		L	Cr
Paper-III: Information and Network Security	**Paper Code: RJSUCS503**	45	3
UNIT I		15	
INTRODUCTION TO SECURITY			
1	**Introduction:** Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms.		
2	**Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, AES (round details not expected), Multiple Encryption DES, Block Cipher Modes of Operation, Stream Ciphers.		
3	**Public-Key Cryptography and RSA:** Principles of Public-Key Cryptosystems, The RSA Algorithm.		
UNIT II		15	
MESSAGE SECURITY			
1	**Key Management:** Public-Key Cryptosystems, Key Management, Diffie-Hellman Key Exchange **Message Authentication and Hash Functions**: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs, Secure Hash Algorithm, HMAC		
2	**Digital Signatures and Authentication:** Digital Signatures, Authentication Protocols, Digital Signature Standard.		

3	**Authentication Applications:** Kerberos, X.509 Authentication, Public-Key Infrastructure **.**		
UNIT III		15	
ELECTRONIC MAIL & WEB SECURITY			
1	**Electronic Mail Security:** Pretty Good Privacy, S/MIME **IP Security:** Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management		
2	**Web Security:** Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction .		
3	**Intrusion:** Intruders, Intrusion Techniques, Intrusion Detection **Malicious Software:** Viruses and Related Threats, Virus Countermeasures, DDOS **Firewalls:** Firewall Design Principles, Types of Firewalls		

T.Y.BSc	Semester V Theory
RJSUCS503 Paper III **Information and Network Security**	**Course Outcomes 5.3:** To provide students with knowledge of basic concepts of computer security including network security and cryptography. **Learning Outcomes:** Understand the principles and practices of cryptographic techniques. Understand a variety of generic security threats and vulnerabilities, and identify & analyse particular security problems for a given application. Understand various protocols for network security to protect against the threats in a network.

SEMESTER V (THEORY)		L	Cr
Paper-IV: Web Services	**Paper Code: RJSUCS504**	45	3
UNIT I		15	
INTRODUCTION TO SOAP & WCF SERVICES			
1	What Are Web Services? Types of Web Services , overview of XML, SOAP, Building Web Services with JAX-WS, Registering and Discovering Web Services, Service Oriented Architecture, Web Services Development Life Cycle, Developing and consuming simple Web Services across platform.		
2	WCF INTRODUCTION , Developing Service-Oriented Applications with WCF.		
UNIT II		15	
RESTFUL SERVICES			
1	Introducing HTTP, HTTPS, The core architectural elements of a RESTful system, Description and discovery of RESTful web services, Java tools and frameworks for building RESTful web services, JSON message format and tools and frameworks around JSON, Build RESTful web services with JAX-RS APIs.		
2	The Description and Discovery of RESTful Web Services, Design guidelines for building RESTful web services, Secure RESTful web services.		
UNIT III		15	
MICROSERVICES			

1	**Microservices:** The Concept of Going Micro, Advantages & Disadvantages, Microservice Over SOA, Microservice Scaling, Different Elements of Microservices, Composition Patterns, Examples.		

T.Y.BSc	Semester V Theory
RJSUCS504 Paper IV **Web Services**	**Course Outcomes 5.4:** To understand the details of web services technologies like SOAP, WSDL, and UDDI. To learn how to implement and deploy web service client and server. To understand the design principles and application of SOAP and REST based web services (JAX-Ws and JAX-RS).To understand WCF service. To design secure web services and QoS of Web Services. **Learning Outcomes:** Emphasis on SOAP based web services and associated standards such as WSDL. Design SOAP based / RESTful / WCF services Deal with Security and QoS issues of Web Services.

SEMESTER V (THEORY)		L	Cr
Paper-V: Software Testing and Quality Assurance	**Paper Code: RJSUCS505**	45	2
UNIT I		15	
INTRODUCTION TO S/W TESTING			
1	**Software Testing and Introduction to quality** : Introduction, Nature of errors, an example for Testing, Definition of Quality , QA, QC, QM and SQA , Software Development Life Cycle, Software Quality Factors		
2	**Verification and Validation :** Definition of V &V , Different types of V & V Mechanisms, Concepts of Software Reviews, Inspection and Walkthrough.		
3	**Software Testing Techniques :** Testing Fundamentals, Test Case Design, White Box Testing and its techiques, Black Box Testing and its techniques, Introduction to manual testing and automation testing tools.		
UNIT II		15	
SOFTWARE TESTING STRATEGIES			
1	**Software Testing Strategies :** Strategic Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, System Testing . **Software Metrics :** Concept and Developing Metrics, Different types of Metrics, Complexity metrics		

2	**Defect Management:** Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.		
3	**Analytic Geometry:** Review of Geometry, 2D Analytic Geometry, Intersection Points, Point in Triangle, and Intersection of circle with straight line.		
UNIT III		15	
SOFTWARE QUALITY ASSURANCE			
1	**Software Quality Assurance :** Quality Concepts, Quality Movement, Background Issues, SQA activities, Software Reviews, Formal Technical Reviews, Formal approaches to SQA, Statistical Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, , SQA Plan , Six sigma, Informal Reviews .		
2	**Quality Improvement :** Introduction, Pareto Diagrams, Cause-effect Diagrams, Scatter Diagrams, Run charts. **Quality Costs :** Defining Quality Costs, Types of Quality Costs, Quality Cost Measurement, Utilizing Quality Costs for Decision-Making.		

T.Y.BSc	Semester V Theory
RJSUCS505 Paper V **Software Testing and Quality Assurance**	**Course Outcomes 5.5:** To provide learner with knowledge in Software Testing techniques. To understand how testing methods can be used as an effective tools in providing quality assurance concerning for software. To provide skills to design test case plan for testing software **Learning Outcomes:** Understand various software testing methods and strategies. Understand a variety of software metrics, and identify defects and managing those defects for improvement in quality for given software. Design SQA activities, SQA strategy, formal technical review report for software quality control and assurance.

SEMESTER VI (THEORY)		**L**	**Cr**
Paper-I: Wireless Sensor Networks and Mobile Communication	**Paper Code: RJSUCS601**	45	3
UNIT I		15	
INTRODUCTION TO WSN			
1	**Introduction:** Introduction to Sensor Networks, unique constraints and challenges. Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks.		
2	**Sensor Node Hardware and Network Architecture:** Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC. Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.		
UNIT II		15	
ACCESS CONTROL			
1	**Medium Access Control Protocols:** Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study.		
2	**Routing Protocols** : Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks.		
3	**Transport Control Protocols :** Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols.		

	UNIT III	15	
	WIRELESS TRANSMISSION AND MEDIUM		
1	**Access Control:** Applications, A short history of wireless communication. **Wireless Transmission:** Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.		
2	**Telecommunication, Satellite and Broadcast Systems: GSM:** Mobile services, System architecture, Radio interface, Protocols, Localization And Calling, Handover, security, New data services; DECT: System architecture, Protocol architecture; ETRA, UMTS and IMT- 2000.		
3	**Satellite Systems**: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover.Algorithms, Advantages and Disadvantages of Greedy Method, Greedy Applications, Understanding Greedy Technique with Huffman coding and Knapsack problem.		

T.Y.BSc	Semester VI Theory
RJSUCS601 Paper I **Wireless Sensor Networks and Mobile Communication**	**Course Outcomes 6.1:** In this era of wireless and adhoc network, connecting different wireless devices and understanding their compatibility is very important. Information is gathered in many different ways from these devices. Learner should be able to conceptualize and understand the framework. On completion, will be able to have a firm grip over this very important segment of wireless network. **Learning Outcomes:** After completion of this course, learner should be able to list various applications of wireless sensor networks, describe the concepts, protocols, design, implementation and use of wireless sensor networks. Also implement and evaluate new ideas for solving wireless sensor network design issues.

SEMESTER VI (THEORY)		L	Cr
Paper-II: Cloud Computing	**Paper Code: RJSUCS602**	45	3
UNIT I		15	
INTRODUCTION TO CLOUD COMPUTING			
1	Introduction to Cloud Computing, Characteristics and benefits of Cloud Computing, Basic concepts of Distributed Systems, Web 2.0, Service Oriented Computing, Utility-Oriented Computing. Elements of Parallel Computing. Elements of Distributed Computing. Technologies for Distributed Computing.		
2	Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service. Types of clouds.		
UNIT II		15	
VIRTUALIZED ENVIRONMENTS			
1	Characteristics of Virtualized Environments. Taxonomy of Virtualization Techniques. Virtualization and Cloud Computing. Pros and Cons of Virtualization. Virtualization using KVM, Creating virtual machines, oVirt - management tool for virtualization environments. Open challenges of Cloud Computing.		
UNIT III		15	
OPENSTACK & FOSS CLOUD			
1	**OpenStack:** Introduction to OpenStack, Understanding cloud computing and openstack,Components of openstack, Relating openstack to the computational resources it controls: OpenStack and hypervisor,		

	OpenStack and storage, OpenStack and network services, OpenStack and cloud terminology.		
2	Foss Cloud: Building Private,public and Hybrid clouds in foss.		

T.Y.BSc	Semester VI Theory
RJSUCS602 Paper II **Cloud Computing**	**Course Outcomes 6.2:** To provide learners with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture, implantations and applications. To expose the learners to frontier areas of Cloud Computing, while providing sufficient foundations to enable further study and research. **Expected Learning Outcomes:** After successfully completion of this course, learner should be able to articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the art cloud computing using open source technology. Learner should be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc. They should explain the core issues of cloud computing such as security, privacy, and interoperability.

SEMESTER VI (THEORY)		**L**	**Cr**
Paper-III: Advanced Database Systems	**Paper Code: RJSUCS603**	45	3
UNIT I		15	
DISTRIBUTED AND PARALLEL COMPUTING			
1	**Distributed Database Concepts:** Definition of Distributed databases and Distributed Database Management System (DDBMS), Distributed transparent system. DDBMS Architecture, Distributed database design, Design problem of distributed systems, Design, strategies (top-down, bottom-up), Fragmentation, Allocation and replication of fragments. Query Processing Overview, Query Optimization. Distributed Reliability Protocols, Two phase commit protocol, Three phases commit protocol.		
2	**Parallel Database System:** Definition of Parallel Database Systems. Parallel query evaluation: Speed up and scale up, Query Parallelism: I/O Parallelism (Data Partitioning) Intraquery Parallelism, Inter -Query Parallelism, Intra Operation Parallelism, Inter Operation Parallelism.		
UNIT II		15	
OODBMS & TEMPORAL DATABASE			
1	**Object Oriented Database:** Object Identity, Object structure, Type Constructors , Encapsulation of Operations, Methods, Persistence, Type and Class Hierarchies, Inheritance, Complex Objects, Object-oriented DBMS , Languages and Design: ODMG Model, Object Definition Languages (ODL), Object Query Languages (OQL).		
2	**Temporal Database:** Introduction to Temporal Database: Time ontology, structure, and granularity, Temporal data models, Temporal relational algebras.		

	UNIT III	15	
	ACTIVE, DEDUCTIVE & XML DATABASE		
1	**Deductive Database:** Introduction to recursive queries, Datalog Notation, Clause Form and Horn Clauses, Interpretation of model: Least Model semantics, The fixed point operator, safe Datalog program, recursive query with negation.		
2	**Active Database:** Languages for rule specification: Events, Conditions, Actions.		
3	**XML Database:** Structure of XML Data, XML Document Schema, Querying and Transformation, Storage of XML Data.		

T.Y.BSc	Semester VI Theory
RJSUCS603 Paper III **Advanced Database Systems**	**Course Outcomes 6.3:** What a distributed database management system (DDBMS) is and what its components are. How database implementation is affected by different levels of data and process distribution. Also understand the concepts of Temporal, Deductive and XML databases. **Learning Outcomes:** • What a distributed database management system is and what its components are. • How database implementation is affected by different levels of data and process distribution. • How transactions are managed in a distributed database environment. • How database design is affected by the distributed database environment.

SEMESTER VI (THEORY)		L	Cr
Paper-IV: Data Science	**Paper Code: RJSUCS604**	45	3
UNIT I		15	
INTRODUCTION TO DATA SCIENCE			
1	**Introduction to Data Science:** What is Data? Different kinds of data, Introduction to high level programming language + Integrated Development Environment (IDE), Exploratory Data Analysis (EDA) + Data Visualization, Different types of data sources.		
2	**Data Management**: Data Collection, Data cleaning/extraction, Data analysis & Modeling.		
UNIT II		15	
DATA CURATION			
1	**Data Curation:** Query languages and Operations to specify and transform data, Structured/schema based systems as users and acquirers of data Semi-structured systems as users and acquirers of data, Unstructured systems in the acquisition and structuring of data, Security and ethical considerations in relation to authenticating and authorizing access to data on remote systems, Software development tools, Large scale data systems, Amazon Web Services (AWS).		
UNIT III		15	
STATISTICAL MODELLING AND MACHINE LEARNING			
1	**Statistical Modelling and Machine Learning:** Introduction to model selection: Regularization, bias/variance tradeoff e.g. parsimony, AIC, BIC, Cross validation, Ridge regressions and penalized regression e.g. LASSO .		

2	**Data transformations**: Dimension reduction, Feature extraction, Smoothing and aggregating.		
3	**Supervised Learning**: Regression, linear models, Regression trees, Time-series Analysis, Forecasting, Classification: classification trees, Logistic regression, separating hyperplanes, k-NN **Unsupervised Learning**: Principal Components Analysis (PCA), k means clustering, Hierarchical clustering, Ensemble methods.		

T.Y.BSc	Semester VI Theory
RJSUCS604 Paper IV **Data Science**	**Course Outcomes 6.4:** Understanding basic data science concepts. Learning to detect and diagnose common data issues, such as missing values,special values, outliers, inconsistencies, and localization. Making aware of how to address advanced statistical situations, Modeling and Machine Learning. **Expected Learning Outcomes:** After completion of this course, the students should be able to understand & comprehend the problem; and should be able to define suitable statistical methods to be adopted.

SEMESTER VI (THEORY)		**L**	**Cr**
Paper-V: ETHICAL HACKING	**Paper Code: RJSUCS605**	45	2
UNIT I		15	
INTRODUCTION TO ETHICAL HACKING			
1	**Information Security :** Attacks and Vulnerabilities Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security Functionality-Ease of Use Triangle Types of malware :Worms, viruses, Trojans, Spyware, Rootkits		
2	**Types of vulnerabilities** : OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, inputparameter manipulation, broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, OWASP Mobile Top 10, CVE Database .		
3	**Types of attacks and their common prevention mechanisms** : Keystroke Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs Case-studies : Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit.		
UNIT II		15	
PRE-ATTACK			
1	**Ethical Hacking – I** (Introduction and pre-attack)		

	Introduction: Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?, Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.		
2	**Approach :** Planning - Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report.		
3	**Enterprise strategy :** Repeated PT, approval by security testing team, Continuous Application Security Testing, Phases: Reconnaissance/foot-printing/Enumeration, Phases: Scanning, sniffing.		
	UNIT III	15	
	ENTERPRISE SECURITY		
1	**Phases : Gaining and Maintaining Access** : **Systems hacking** – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPSpoofing, SYN Flooding, Smurf attack.		
2.	**Applications hacking** : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security.		
3	**Malware analysis** : Netcat Trojan, wrapping definition, reverse engineering **Phases :** Covering your tracks : Steganography, Event Logs alteration **Additional Security Mechanisms** : IDS/IPS, Honeypots and evasion		

	techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines).		

T.Y.BSc	Semester VI Theory
RJSUCS605 Paper V **Ethical Hacking**	**Course Outcomes 6.5:** To understand the ethics, legality, methodologies and techniques of hacking. **Learning Outcomes:** Learner will know to identify security vulnerabilities and weaknesses in the target applications. They will also know to test and exploit systems using various tools and understand the impact of hacking in real time machines.

Semester V (PRACTICALS)	
Practical-I: Artificial Intelligence + Linux Server Administration	**Paper Code: RJSUCSP501 (RJSUCS501 + RJSUCS502)**
Artificial Intelligence	
1	Implement Breadth first search algorithm.
2	Implement depth first search algorithm.
3	Implement a decision tree learning algorithm.
4	Write a program to build ANN.
5	Implement Naive Bayes' learning algorithm.
6	Implement a program to design a game of shuffle deck of cards.
7	Implement a program to design the simulation of a tic-tac-toe game.
8	Implement a program to solve the Tower of Hanoi problem.
Linux Server Administration	
1	Install DHCP Server in Ubuntu 16.04

2	Initial settings: Add a User, Network Settings, Change to static IP address, Disable IPv6 if not needed, Configure Services, display the list of services which are running, Stop and turn OFF auto-start setting for a service if you don't need it, Sudo Settings
3	Configure NTP Server (NTPd), Install and Configure NTPd, Configure NTP Client (Ubuntu and Windows)
4	SSH Server : Password Authentication
5	Configure SSH Server to manage a server from the remote computer, SSH Client : (Ubuntu and Windows)
6	Install DNS Server BIND, Configure DNS server which resolves domain name or IP address, Install BIND 9, Configure BIND, Limit ranges you allow to access if needed. 6. Configure DHCP Server, Configure DHCP (Dynamic Host Configuration Protocol) Server, Configure NFS Server to share directories on your Network, Configure NFS Client. (Ubuntu and Windows Client OS)
7	Configure LDAP Server, Configure LDAP Server in order to share users' accounts in your local networks, Add LDAP User Accounts in the OpenLDAP Server, Configure LDAP Client in order to share users' accounts in your local networks. Install phpLDAPadmin to operate LDAP server via Web browser.
8	Configure NIS Server in order to share users' accounts in your local networks, Configure NIS Client to bind NIS Server.
9.	Install MySQL to configure database server, Install phpMyAdmin to operate MySQL on web browser from Clients.
10	Install Samba to share folders or files between Windows and Linux.
Practical-II: Information and Network Security + Web Services	**Paper Code: RJSUCSP502 (RJSUCS503+ RJSUCS504)**
Information and Network Security	
1	Write programs to implement the following Substitution Cipher Techniques: - Caesar Cipher - Monoalphabetic Cipher

2	Write programs to implement the following Substitution Cipher Techniques: - Vernam Cipher - Playfair Cipher
3	Write programs to implement the following Transposition Cipher Techniques: - Rail Fence Cipher - Simple Columnar Technique
4	Write program to encrypt and decrypt strings using - DES Algorithm - AES Algorithm
5	Write a program to implement RSA algorithm to perform encryption / decryption of a given string.
6	Write a program to implement the Diffie-Hellman Key Agreement algorithm to generate symmetric keys.
7	Write a program to implement the MD5 algorithm compute the message digest.
8	Write a program to implement SSL.
Web Services	
1	Write a program to implement to create a simple web service that converts the temperature from Fahrenheit to Celsius and vice a versa.
2	Write a program to implement to create a simple web service that check whether given number is Armstrong or not.
3	Implement a typical service and a typical client using WCF.
4	Demonstrates using the binding attribute of an endpoint element in WCF. 5. Develop client which consumes web services developed in different platform.
5	Write a JAX-WS web service to perform the following operations. Define a Servlet / JSP that consumes the web service.
6	Define a web service method that returns the contents of a database in a JSON string. The contents should be displayed in a tabular format.

7	Define a RESTful web service that accepts the details to be stored in a database and performs CRUD operation.
8	Build one microservice application that will consume different available services.
9	Create a custom Microservice, which will work as input service for other services.

Practical-III: Project Implementation	**Paper Code: RJSUCSP503**

Software Testing and Quality Assurance Paper Code: RJSUCSP504

Software Testing and Quality Assurance	
1	Install Selenium IDE; Write a test suite containing minimum 4 test cases for different formats.
2	Conduct a test suite for any two web sites.
3	Install Selenium server (Selenium RC) and demonstrate it using a script in Java/PHP.
4	Write and test a program to login a specific web page.
5	Write and test a program to update 10 student records into table into Excel file 6. Write and test a program to select the number of students who have scored more than 60 in any one subject (or all subjects).
6	Write and test a program to provide total number of objects present / available on the page.
7	Write and test a program to get the number of items in a list / combo box.
8	Write and test a program to count the number of check boxes on the page checked and unchecked count.
9	Load Testing using JMeter, Android Application testing using Appium Tools, Bugzilla Bug tracking tools.

T.Y.B.Sc	Semester V (Practical)

RJSUCSP501 (RJSUCS501+ RJSUCS502)	**Artificial Intelligence** Course Outcomes: To cover modern paradigms of AI that go beyond traditional learning Cover various analysis paradigms that come under the broad umbrella of AI. Develop strategic AI applications for games, such as Tic-tac-toe, Dec of Cards and Tower of hanoi. Learning outcomes: Develop an understanding of where and how AI can be used. Analyze existing algorithms as well as design novel algorithms to analyse data. **Course Outcomes:** **Linux System Administration** Understand the role and responsibilities of a Unix system administrator Install and configure the Linux operating system Manage the resources and security of a computer running Linux at a basic level Make effective use of Linux utilities, and scripting languages Learning outcomes: *Upon completion of **Linux System Administration Practicals**, the students will be able to:* *Demonstrate the role and responsibilities of a Linux system administrator.* *Distinguishvarious filter and server commands.*
RJSUCSP502 (RJSUCS503+ RJSUCS504)	**Information & NetworkK Security** Course Outcomes 1)Understand the most common type of cryptographic algorithm 2)Understand the Public-Key Infrastructure · 3)Understand security protocols for protecting data on networks · Be able to digitally sign emails and files · 4)Understand different cryptographic tools like Message digest,MAC,HMAC · Learning outcomes: 1)To Understand how the most common type of cryptographic algorithm developed. 2) To Understand how the most common type of cryptographic algorithm maintains data integrity, data confidentiality,and data privacy. **Web Services**: Course Outcomes: To provide learner with knowledge in Webservices. To understand how testing methods can be used as an effective tools in providing basic understanding of Services.

	Learning outcomes: 1) To explore different Test Strategies for Services and microservices. Learning outcomes: 2) Efficiently use market leading environment tools to create and consume web services 3) Identify and select the appropriate framework components in creation of service solution.
RJSUCSP504 (RJSUCS505)	**Software Testing and Quality Assurance** Course Outcomes: To provide learner with knowledge in Software Testing techniques. To understand how testing methods can be used as an effective tools in providing quality assurance concerning for software. To provide skills to design test case plan for testing software. Learning outcomes: Understand various software testing methods and strategies. Understand a variety of software metrics, and identify defects and managing those defects for improvement in quality for given software. Design SQA activities, SQA strategy, formal technical review report for software quality control and assurance.

Semester VI (PRACTICALS)	
Practical-I: Wireless Sensor Networks and Mobile Communication + Cloud Computing	**Paper Code: RJSUCSP601 (RJSUCS601 + RJSUCS602)**
Wireless Sensor Networks and Mobile Communication	
1	Understanding the Sensor Node Hardware. (For Eg. Sensors, Nodes(Sensor mote), Base Station, Graphical User Interface.) .
2	Exploring and understanding TinyOS computational concepts:- Events, Commands and Task. a. nesC model b. nesC Components
3	Understanding TOSSIM for a. Mote-mote radio communication b. Mote-PC serial communication
4	Create and simulate a simple ad hoc network .
5	Understanding, Reading and Analyzing Routing Table of a network.
6	Create a basic MANET implementation simulation for Packet animation and Packet Trace.
7	Implement a Wireless sensor network simulation.
8	Create MAC protocol simulation implementation for wireless sensor Network.

Cloud Computing	
1	Study and implementation of Infrastructure as a Service.
2	Installation and Configuration of virtualization using KVM.
3	Study and implementation of Infrastructure as a Service
4	Study and implementation of Storage as a Service
5	Study and implementation of identity management
6	Study Cloud Security management
7	Write a program for web feed.
8	Study and implementation of Single-Sign-On.
9.	User Management in the Cloud.
10	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

Practical-II: Advance Database Systems + Data Science	**Paper Code: RJSUCSP602 (RJSUCS603+ RJSUCS604)**
Advance Database Systems	

1	For a given a global conceptual schema, divide the schema into vertical fragments and place them on different nodes. Execute queries on these fragments that will demonstrate distributed databases environment.
2	For a given a global conceptual schema, divide the schema into horizontal fragments and place them on different nodes. Execute queries on these fragments that will demonstrate distributed databases environment.
3	For a given a global conceptual schema, divide the schema into vertical fragments and place them on different nodes. Insert records using triggers Execute queries on these fragments that will demonstrate distributed databases environment.
4	For a given a global conceptual schema, divide the schema into horizontal fragments and place them on different nodes. Insert records using triggers Execute queries on these fragments that will demonstrate distributed databases environment.
5	Create a nested table and insert sufficient number of tuples and execute queries,
6	Practical on object oriented concepts.
7	Create a temporal database and issue queries on it.
8	Formulate a database using active rules with row and statement level.
9	Demonstrate the concept of Deductive database.
10	Create a XML data base and demonstrate insert, update and delete operations For a given a global conceptual schema, divide the schema into vertical fragments and place them on different nodes. Execute queries on these fragments that will demonstrate distributed databases environment.
Data Science	
1	Implement a program of Simple/Multiple Linear Regression.
2	Implement a program of Time-series forecasting
3	Implement a program of Time Series Analysis.
4	Implement a program of k-means Clustering.
5	Implement a program of Logistics Regression.

6	Implement a program of Decision Tree.
7	Implement a program of Hypothesis Testing.
8	Implement a practical of Analysis of Variance.
9	Implement a practical of Principal Component Analysis.

Practical-III: Project Implementation	**Paper Code: RJSUCSP603**

	Project Implementation
1	A learner is expected to carry out two different projects: one in Semester V and another in Semester VI.
2	A learner can choose any topic which is covered in Semester I- semester VI or any other topic with the prior approval from head of the department/ project in charge.
3	The Project has to be performed individually.
4	A learner is expected to devote around three months of efforts in the project.
5	The project can be application oriented/web-based/database/research based.
6	It has to be an implemented work; just theoretical study will not be acceptable.
7	A learner can choose any programming language, computational techniques and tools which have been covered during BSc course or any other with the prior permission of head of the department/ project guide.
8	A project guide should be assigned to a learner. He/she will assign a schedule for the project and hand it over to a learner. The guide should oversee the project progress on a weekly basis by considering the workload of 3 lectures as assigned.
9	The quality of the project will be evaluated based on the novelty of the topic, scope of the work, relevance to the computer science, adoption of emerging techniques/technologies and its real-world application.
10	A learner has to maintain a project report with the following subsections a) Title Page b) Certificate
11	A certificate should contain the following information –

	- The fact that the student has successfully completed the project as per the syllabus and that it forms a part of the requirements for completing the BSc degree in computer science of University of Mumbai. - The name of the student and the project guide - The academic year in which the project is done - Date of submission, - Signature of the project guide and the head of the department with date along with the department stamp, - Space for signature of the university examiner and date on which the project is evaluated. c) Self-attested copy of Plagiarism Report from any open source tool. d) Index Page detailing description of the following with their subsections: - Title: A suitable title giving the idea about what work is proposed. - Introduction: An introduction to the topic giving proper back ground of the topic. - Requirement Specification: Specify Software/hardware/data requirements. - System Design details : Methodology/Architecture/UML/DFD/Algorithms/protocols etc. used(whichever is applicable) - System Implementation: Code implementation - Results: Test Cases/Tables/Figures/Graphs/Screen shots/Reports etc. - Conclusion and Future Scope: Specify the Final conclusion and future scope - References: Books, web links, research articles, etc.
12	The size of the project report shall be around twenty to twenty five pages, excluding the code.
13	12. The Project report should be submitted in a spiral bound form
14	The Project should be certified by the concerned Project guide and Head of the department.
Ethical Hacking Paper Code: RJSUCSP604	
Ethical Hacking	
1	Use Google and Whois for Reconnaissance
2	a) Use CrypTool to encrypt and decrypt passwords using RC4 algorithm b) Use Cain and Abel for cracking Windows account password using Dictionary attack

3	Run and analyze the output of following commands in Linux – ifconfig, ping, a)netstat, traceroute b) Perform ARP Poisoning in Windows
4	Use NMap scanner to perform port scanning of various forms – ACK, SYN, FIN, NULL, XMAS
5	a) Use Wireshark (Sniffer) to capture network traffic and analyze b) Use Nemesy to launch DoS attack
6	Simulate persistent cross-site scripting attack
7	Session impersonation using Firefox and Tamper Data add-on
8	Perform SQL injection attack
9	Create a simple keylogger using python.

T.Y..BSc	Semester VI (Practical)
RJSUCSP601 (RJSUCS601+ RJSUCS602)	**Wireless sensor network and mobile communication** Course Outcomes: 1)Introduction to wireless networks, architectures and technologies. 2)Wireless sensor network platforms: Hardware and Software. 3)Communication architecture and protocols for WSN (MAC, Link, Routing). 4)Communication architecture with antenna. 5)Sensor data acquisition, processing and handling. Learning outcomes: 1)Explain the basic concepts of how to design wireless sensor networks,and send packets. 2)Describe and explain radio standards and communication protocols adopted in wireless sensor networks. 3)Describe and explain the hardware, software and communication for wireless sensor network nodes. 4)Learn the architectures, features, and performance for wireless sensor network systems and platforms. 5)describe and analyze the specific requirements of applications in wireless sensor networks routing and data transmission.

	Cloud Computing: Course Outcomes: Key concepts of virtualization. Various deployment models such as private, public, hybrid and community. Various service models such as IaaS and PaaS. Security and Privacy issues in the cloud. Learning Outcomes: Build a private cloud using open source technologies. Analyze security issues on the cloud. Demonstrate various service models. Demonstrate various storage services Analyze the components of open stack & Google Cloud platform. Describe the key components of Amazon web Service.
RJSUCSP602 (RJSUCS603+ RJSUCS604)	**ADBMS** Course Outcomes: To provide a strong foundation in advanced database concepts from an industry perspective using Oracle. To cover advanced data modeling concepts like OOD Modeling and ORD Modeling To learn query processing and transaction management concepts for object-relational database and distributed database. Learning outcomes: After completion of this course, student will be able to: Identify advanced database concepts and database models using Oracle. Apply and analyze various terms related to transaction management in centralized and distributed databases. Produce data modeling and database development process for object – oriented DBMS. **Data Science:** Course Outcomes: This course will highlight the practical aspects of data science, with a focus on implementing and making use of the machine learning techniques. Learning outcomes: After completion of this course, students will be able to: study and practice of how we can extract insight and knowledge from large amounts of data.

RJSUCSP603 Project Implementation	Course Outcomes: To provide a strong foundation in developing project from an industry perspective using different trending Technologies. Learning outcomes: After completion of Project, students will be able to: Identify advanced project techniques & Apply and analyze various terms related to Project management in Industry,
RJSUCSP604 (RJSUCS605)	**Ethical Hacking:** Course Outcomes: Determine the techniques and tools used in system hacking. Learning outcomes: Identify footprinting techniques and tools. Recognize the characteristics of the enumeration phase of an attack and effective countermeasures.

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Scheme of Examinations

1. Two Internals of 20 marks each. Duration 30 min for each.
2. One External (Semester End Examination) of 60 marks. Duration: 2 hours.
3. One Practical at the end of Semester consists of Groups and each group has 2 practicals each of 50 marks but passing combined out of 100.
4. Minimum marks for passing Semester End Theory and Practical Exam is 40 %.
5. Students 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. Two short field excursions for habitat studies are compulsory.
8. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15students.
9. A candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of T.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 T.Y.B.Sc. Computer-Science as per the minimum requirements.
10. 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.
11. HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

Evaluation (Theory): Total marks per course - 100.

CIA- 40 marks

CIA 1: Written test -20 marks

CIA 2: Written Test / Assignment / Field Trip/mini project/ & Report -20 marks

Semester End Examination – 60 marks

Question paper covering all units

Evaluation of Practicals 100 marks /group (RJSUCSP501, RJSUCSP502, RJSUCSP503, RJSUCSP504, RJSUCSP601, RJSUCSP602, RJSUCSP603, RJSUCSP604)

Course SemesterEnd Examination in Semester1 and II Paper I to VII (RJSUCS301 To RJSUCS307, RJSUCS401 To RJSUCS407)

Qustion	KNOWLEDGE	UNDERSTANDING	APPLICATION and ANALYSES	TOTAL MARKS- Per unit
Unit 1	08	03	04	15
Unit 2	08	03	04	15
Unit 3	08	03	04	15
Short notes from topics covering all the units	08	03	04	15
TOTAL Per objective	32	12	16	**60**
% WEIGHTAGE	53	20	27	**100%**

Evaluation of Practicals 100 marks /group (RJSUCSP501, RJSUCSP502, RJSUCSP503, RJSUCSP504, RJSUCSP601, RJSUCSP602, RJSUCSP603, RJSUCSP604)

Continuous Evaluation of components which require adequate duration for completion of the task, observation and interpretation: 25%

Course end Practical Evaluation of skills of students in terms of skill, analysis, interpretation and conclusion.

Mapping of the course to employability/ Entrepreneurship/skill development

Class	Course Name	Course Code	Unit No. And topics focusing on Employability / Entrepreneurship / Skill development	Employability / Entrepreneurship / Skill development
TYBSC SEM V				
TYBSC	Artificial Intelligence	RJSUGCS501	**Employability** **UNIT 1:** Intelligent Agents, Problem Solving by searching **UNIT 2:** Learning from Examples **UNIT 3:** Learning probabilistic models, Deep Learning	Employability in the field of Data Scientist, data engineer
TYBSC	Linux Server Administration	RJSUGCS502	**Employability** **UNIT 1:** Single-Host Administration, Networking and Security **UNIT 2:** Internet Services **UNIT 3:** File System	Employability in the field of server administration

TYBSC	Information and Network Security	RJSUGCS503	**Employability** **UNIT 1:** Classical Encryption Techniques, Public-Key Cryptography and RSA **UNIT 2:** Key Management, Message Authentication and Hash Functions, Digital Signatures and Authentication, Authentication Applications **UNIT 3:** Electronic Mail Security, IP Security, Web Security, Intrusion, Malicious Software, Firewalls	Employability in the field of networking & security
TYBSC	Web Services	RJSUGCS504	**Employability** **UNIT 1:** Introduction, Life cycle **UNIT 2:** Restful Services **UNIT 3:** Micro services	Employability in the field of cloud computing

TYBSC	Software Testing and Quality Assurance	RJSUGCS505	**Employability** **UNIT 1:** Software Testing and Introduction to quality, Verification and Validation, Software Testing Techniques **UNIT 2:** Software Testing Strategies, Software Metrics, Defect Management, Analytic Geometry **UNIT 3:** Software Quality Assurance, Quality Improvement, Quality Costs	Employability in the field of software testing
TYBSC SEM VI				
TYBSC	Wireless Sensor Networks and Mobile Communication	RJSUGCS601	**Employability** **UNIT 1:** Introduction**,** Sensor Node Hardware and Network Architecture **UNIT 2:** Medium Access Control Protocols, Routing Protocols, Transport Control Protocols **UNIT 3:** Introduction, Wireless Transmission and Medium Access Control, Wireless Transmission, Telecommunication, Satellite and Broadcast Systems, GSM	Employability in the field of networking & communiaction

TYBSC	Cloud Computing	RJSUGCS602	**Entrepreneurship** **UNIT 1:** Introduction & architecture **UNIT 2:** Virtualization **UNIT 3:** OpenStack	Employability in the field of cloud computing
TYBSC	Advance Database Systems	RJSUGCS603	**Employability** **UNIT 1:** Distributed Database Concepts, Parallel Database System **UNIT 2:** Object Oriented Database, Temporal Database **UNIT 3:** Deductive Database, Active Database, XML Database	Employability in the field of database management & backend developer
TYBSC	Data Science	RJSUGCS604	**Employability** **UNIT 1:** Introduction, Data Management **UNIT 2:** Data Curation **UNIT 3:** Statistical Modelling and Machine Learning, Data transformations, Supervised Learning, Unsupervised Learning	Employability in the field of data scientist, big data engineer

TYBSC	Ethical Hacking	RJSUGCS605	**Employability** **UNIT 1:** Attacks and Vulnerabilities **UNIT 2:** Introduction and pre-attack **UNIT 3:** Enterprise Security	Employability in the field of security