RAMNIRANJAN JHUNJHUNWALA COLLEGE OF ARTS, SCIENCE AND COMMERCE, GHATKOPAR(W), MUMBAI

(AFFILIATED TO MUMBAI UNIVERSITY)

University of Mumbai

SYLLABUS FOR: MSc II
PROGRAM: M. Sc.
COURSE: COMPUTER SCIENCE

WITH EFFECT FROM ACADEMIC YEAR 2019-20

Date: _____

Signature of BOS Members

1) **Chairman :** Anita Gaikwad
2) **Subject Experts from outside the Parent University:**
   - i) Prof Suchita Bhovar, SNDT College, Ghatkopar
   - i) Prof Pratibha Deshmukh, Bharathi Vidyapeeth, Navi Mumbai
3) **Expert to be nominated by Vice Chancellor:**
   Prof Sampada Margaj, Kirti College Dadar
4) **Representative from industry:**
   Mr Uday Pawar, Director Tech, People Interactive Pvt ltd
5) **Post graduate alumni:**
   Prof Sunita Rai, Khalasa College, Matunga
6) **Experts from outside the college:**
   - i) Prof Geeta Brijwani, K C College, Churchgate
   - ii) Prof Maya Nair, SIES College, Sion
   - iii) Prof Poonam Pandey, Somaiya College, Vidyavihar

Preamble

This syllabus is an extension of the syllabus for semester - I and semester - II of MSc Computer Science of R.J College, which came into existence in the academic year 2018-2019. As mentioned in the syllabus of semester I and II, the intended philosophy of the new syllabus is to meet following guidelines:

- Give strong foundation on core Computer Science subjects.
- Expose student to emerging trends in a gradual and incremental way.
- Prepare student community for the demands of ICT industry.
- Create research temper among students in the whole process.

This syllabus for the semester - III and semester - IV has tried to continue the steps initiated in the semester- I and semester -II to meet the goals set.

The semester III will have three subjects. Also includes project implementation of case study that is already accepted at semester II, which has weights equivalent to a full course.

The semester - IV will have three subject. The syllabus also offers an internship in the semester - IV, which has weights equivalent to a full course. This will definitely equip the student with industry readiness as internship in an IT or IT-related organization gives a practical exposure to what is learned and what is practiced. The strong foundation given in the core courses in different semesters will give enough confidence to the learner to face and adapt to the changing trends and requirements of industry and academia.
As one can easily notice, the syllabus offers lots of emphasis on student driven learning and learning through experience. Research is embedded in the course structure. By introducing Researching Computing in semester - I, Case study in semester - II, Project Implementation in semester - III and Internship in semester - IV, the syllabus prepares a strong army of budding computer science researchers. The syllabus designed on the

firm believe that by focusing on student driven research on cutting edge and emerging trends with lots of practical experience will make the learning more interesting and stimulating. It is hoped that the student community and teacher colleagues will appreciate the thrust, direction and treatment given in the syllabus.

We thank all our colleagues in the University of Mumbai for their inputs, suggestions and critical observations. We acknowledge the contributions of experts from premier institutions and industry for making the syllabus more relevant. We thank the chairperson and members of the present and previous Adhoc Board of Studies in Computer Science of R.J College for their constant support. Thanks to one and all who have directly or indirectly helped in this venture.

Structure of the syllabus

This is the syllabus for the semester-III and semester-IV of MSc Computer Science program of R.J College to be implemented from the year 2018-2019.

Semester-III

The syllabus offers three theory courses and three practical courses in semester-III. Each subject has theory and practical components.

Semester-III: Theory courses

The three theory courses offered in semester-III are:

(i) Cloud Computing - II (Cloud Computing Technologies)

(ii) Cyber and Information Security - II (Cyber Forensics)

(iii) Business Intelligence and Big Data Analytics - II (Mining Massive Data sets)

Each of these theory courses is of four credits each and is expected to complete in 60 hours. The details are shown in the following table.

Semester III - Theory courses

Course Code	Course Nomenclature	Lecture In Hours	Credits
RJPSCSS301	Cloud Computing -II (Cloud Computing Technologies)	60	4
RJPSCSS302	Security- II (Cyber Forensics)	60	4
RJPSCSS303	Business Intelligence	60	4
Total Credits for Theory courses in Semester III			12

Semester-III: Practical Laboratory Courses

The syllabus proposes three laboratory courses of 2 credits each. Each theory

subject have its associated practical component. The following table summarizes

the details of the practical courses in the semester -III.

Course code	Course Title	No of hours	Credits
RJPSCSS3P01	Cloud Computing -II (Cloud Computing Technologies)	60	02
RJPSCSS3P02	Security- II (Cyber Forensics)	60	02
RJPSCSS3P03	Business Intelligence	60	02
Total Credits for Practical Laboratory courses in Semester-III			06

Project Implementation: The syllabus introduces a project proposal in the semester-III (RJPSCSS3P03). As per this, a student is expected to select a topic for project based on any subject covered in syllabus.The proposal will contain introduction, related works, objectives and methodology. The implementation, experimental results, analysis and actual implementation will be part of the Project implementation in the semester-III. A student is expected to make a project implementation report and appear for a project viva. He or she needs to spend around 200 hours for the project implementation, which fetches 6 credits. The details are given below:

Project Implementation

Course code	Course Title	No of hours	Credits
RJPSCSS3P04	Project Implementation	200	06

Semester -IV

The syllabus proposes three subjects in semester-IV, each with theory and practical components. In addition, there will be internship with industry.

Semester-IV: Theory courses

The two theory courses offered in semester-IV are:

(i) Cloud Computing - III (Building Clouds and Services)

(ii) Cyber and Information Security-III (Cryptography and Crypt Analysis)

(iii) Social Network Analysis

Each of these courses is expected to complete in 60 hours. The details are given in the following table.

Semester-IV: Theory courses

Course Code	Course Nomenclature	Lecture In Hours	Credits
RJPSCSS 401	Cloud Computing -III (Building Clouds and Services)	60	4
RJPSCSS 402	Cyber and Information Security- II (Cryptography and Crypt Analysis)	60	4
RJPSCSS 403	Social Network Analysis	60	4
Total Credits for Theory courses in Semester-IV			12

The syllabus proposes one laboratory course of 4 credits.

Semester-IV: Practical course

Course Code	Course Nomenclature	Lecture In Hours	Credits
RJPSCSS 4P01	Cloud Computing -III (Building Clouds and Services)	60	2
RJPSCSS4P02	Cyber and Information Security- II (Cryptography and Crypt Analysis)	60	2
RJPSCSS4P03	Social Network Analysis	60	2
Total Credits for Theory courses in Semester-IV			06

Semester-IV: Internship with industry

The syllabus proposes an internship for about 8 weeks to 12 weeks to be done by a student. It is expected that a student chooses an IT or IT-related industry and formally works as a full time intern during the period. The student should subject oneself with an internship evaluation with proper documentation of the attendance and the type of work he or she has done in the chosen organization. Proper certification (as per the guidelines given in Appendix 1 and 2) by the person, to whom the student was reporting, with Organization's seal should be attached as part of the documentation.

Semester-IV: Internship

Course code	Course Title	No of hours	Credits
RJPSCSS4P04	Internship with industry	300	06

Course Code	Course Title	Credits
RJPSCSS301	Cloud Computing -II (Cloud Computing Technologies)	04

Unit I: Parallel and Distributed Computing

Elements of parallel computing, elements of distributed computing, Technologies for distributed computing: RPC, Distributed object frameworks, Service oriented computing Virtualization - Characteristics, taxonomy, virtualization and cloud computing.

Unit II: Computing Platforms

Cloud Computing definition and characteristics, Enterprise Computing, The internet as a platform, Cloud computing services: SaaS, PaaS, IaaS, Enterprise architecture, Types of clouds.

Unit III: Cloud Technologies

Cloud computing platforms, Web services, AJAX, mashups, multi-tenant software, Concurrent computing: Thread programming, High-throughput computing: Task programming, Data intensive computing: Map-Reduce programming.

Unit IV: Software Architecture

Dev 2.0 platforms, Enterprise software: ERP, SCM, CRM

Custom enterprise applications and Dev 2.0, Cloud applications.

Text book:

- Enterprise Cloud Computing Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
- Mastering In Cloud Computing, Rajkumar Buyya, Christian Vecchiola And Thamari Selvi S, Tata Mcgraw-Hill Education, 2013
- Cloud Computing: A Practical Approach, Anthony T Velte, Tata Mcgraw Hill, 2009

References:

- Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS), Michael J. Kavis, Wiley CIO, 2014
- Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, Kris Jamsa, Jones & Bartlett Learning, 2013

Course Code	Course Title	Credits
RJPSCSS302	Cyber and Information Security- II (Cyber Forensics)	04

Unit I: Computer Forensic Fundamentals: Introduction to Computer Forensics and objective, the Computer Forensics Specialist, Use of Computer Forensic in Law Enforcement, Users of Computer Forensic Evidence, Case Studies, Information Security Investigations. Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised, Internet Tracing Methods, Security and Wireless Technologies. Types of Computer Forensics Systems: Study different Security System: Internet, Intrusion Detection, Firewall, Storage Area, Network Disaster Recovery, Public Key Infrastructure, Wireless Network, Satellite Encryption, Instant Messaging (IM), Net Privacy, Identity Management, Biometric, Identity Theft.

Unit II: Data Recovery: Data Recovery and Backup, Role of Data Recovery, Hiding and Recovering Hidden Data. Evidence Collection: Need to Collect the Evidence, Types of Evidences, The Rules of Evidence, Collection Steps. Computer Image Verification and Authentication: Special Needs of Evidence Authentication. Identification of Data: Timekeeping, Forensic Identification and Analysis of Technical Surveillance Devices, Reconstructing Past Events: How to Become a Digital Detective, Useable File Formats, Unusable File Formats, Converting Files.

Unit III: Network Forensics: Sources of Network Based Evidence, Principles of Internetworking, Internet Protocol Suite. Evidence Acquisition: Physical Interception, Traffic Acquisition Software, Active Acquisition. Traffic Analysis: Protocol Analysis,

Packet Analysis, Flow Analysis, Higher-Layer Traffic analysis. Statistical Flow Analysis: Sensors, Flow Record Export Protocols, Collection and Aggregation, Analysis. Wireless: the IEEE Layer 2 Protocol Series, Wireless Access Point, Wireless Traffic Capture and Analysis, Common Attacks, Locating Wireless Devices. Network Intrusion Detection and Analysis: NIDS/NIPS Functionality, Modes of Detection, Types of NIDS/NIPS, NIDS/NIPS Evidence Acquisition.

Unit IV: Network Devices and Mobile Phone Forensics: Sources of Logs, Network Architecture, Collecting and Analyzing Evidence, switches, routers, firewalls, interfaces Web Proxies: Need to Investigate Web Proxies, Functionality, Evidence, Squid, Web Proxy Analysis, Encrypted Web Traffic. Mobile Phone Forensics: Crime and Mobile Phones, Voice, SMS and Identification of Data Interception in GSM, Mobile Phone Tricks, SMS Security, Mobile Forensic.

Text book:

- Computer Forensics Computer Crime Scene Investigation, John R. Vacca, Second Edition, 2005.
- Network Forensics, Sherri Davidoff, Jonathan HAM, Prentice Hall, 2012.
- Mobile Phone Security and Forensic: A Practical Approach, Second Edition, Iosif I. Androulidkis, Springer, 2012.

References:

- Digital forensics:Digital evidence in criminal investigation", Angus M.Marshall, John - Wiley and Sons, 2008.
- Computer Forensics with FTK, Fernando Carbone, PACKT Publishing, 2014.
- Practical Mobile Forensics, Satish Bommisetty, Rohit Tamma, Heather Mahalik, PACKT Publishing, 2014.

Course Code	Course Title	Credits
RJPSCSS303	Business Intelligence and Big Data Analytics -II (Mining Massive Data sets)	04

Unit I: Introduction To Big Data

Big data: Introduction to Big data Platform, Traits of big data, Challenges of conventional systems, Analytic processes and tools, Analysis vs Reporting

Link Analysis And Recommendation Systems

Link analysis: PageRank, Efficient Computation of PageRank. Recommendation Systems: A Model for Recommendation Systems

Unit II: MAP REDUCE

Introduction to Map Reduce: The map tasks, Grouping by key, The reduce tasks, Combiners, Details of MapReduce Execution, Coping with node failures. Algorithms Using MapReduce: Matrix-Vector Multiplication, Computing Selections and Projections, Union, Intersection, and Difference, Natural Join.

SHINGLING OF DOCUMENTS

Finding Similar Items, Applications of Near-Neighbor Search, Jaccard similarity of sets, Similarity of documents, Collaborative filtering as a similar-sets problem, Documents, k-Shingles, Choosing the Shingle Size,Shingles built from Words. Similarity-Preserving Summaries of Sets, Locality-Sensitive hashing for documents.

Unit III: MINING DATA STREAMS

Introduction to streams concepts - Stream data model and architecture, Stream computing, Sampling data in a stream, Filtering streams, Counting distinct elements in a stream, Estimating moments, Counting oneness in a Window, Decaying window, Real time analytics Platform(RTAP).

Unit IV: Clustering

Distance/Similarity, Partitioning Algorithm: K-Means; K-Medoids, Hierarchical Algorithms: Agglomerative (AGNES); Divisive (DIANA).

Classification

Challenges, Distance based Algorithm: K nearest Neighbors and kD-Trees, Rules and Trees based Classifiers, Information gain theory, Statistical based classifiers: Bayesian classification, Document classification, Bayesian Networks. Introduction to Support Vector Machines.

Text book:

- Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
- Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Michael Minelli, Wiley, 2013
- Data Mining: Introductory and Advanced Topics, Margaret H. Dunham, Pearson, 2013.

References:

- Big Data for Dummies, J. Hurwitz, et al., Wiley, 2013
- Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data, Paul C. Zikopoulos, Chris Eaton, Dirk deRoos, Thomas Deutsch, George Lapis, McGraw-Hill, 2012.
- Big data: The next frontier for innovation, competition, and productivity, James Manyika ,Michael Chui, Brad Brown, Jacques Bughin, Richard Dobbs, Charles Roxburgh, Angela Hung Byers, McKinsey Global Institute May 2011.
- Big Data Glossary, Pete Warden, O'Reilly, 2011.
- Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph, David Loshin, Morgan Kaufmann Publishers, 2013

List of practical Experiments for Semester -III

Course Code	Course Title	Credits
RJPSCSS3P01	**Cloud Computing-II (Cloud Computing Technologies)**	**02**

Sr No	List of Practical Experiments
1	Execute & check the performance of existing algorithms using CloudSim.
2	Install a Cloud Analyst and Integrate with Eclipse/Netbeans. Monitor the performance of an Existing Algorithms.
3	Build an application on private cloud.
4	Demonstrate any Cloud Monitoring tool.
5	Evaluate a Private IAAS Cloud using TryStack.
6	Implement FOSS-Cloud Functionality - VDI (Virtual Desktop Infrastructure)
7	Implement FOSS-Cloud Functionality VSI (Virtual Server Infrastructure) Infrastructure as a Service (IaaS)
8	Implement FOSS-Cloud Functionality - VSI Platform as a Service (PaaS)
9	Implement FOSS-Cloud Functionality - VSI Software as a Service (SaaS)
10	Explore FOSS-Cloud Functionality- Storage Cloud

Course Code	Course Title	Credits
RJPSCSS3P02	**Cyber and Information Security- II (Cyber Forensics)**	**02**

Sr No	List of Practical Experiments
1	Write a program to take backup of mysql database
2	Write a program to restore mysql database
3	Use DriveImage XML to image a hard drive
4	Write a program to create a log file
5	Write a program to find a file in a directory
6	Write a program to find a word in a file
7	Create forensic images of digital devices from volatile data such as memory using Imager for: (i) Computer System; (ii) Server; (iii) Mobile Device
8	Access and extract relevant information from Windows Registry for investigation process using Registry View, perform data analysis and bookmark the findings with respect to: (i) Computer System; (ii) Computer Network; (iii) Mobile Device; (iv) Wireless Network
9	Generate a report based on the analysis done using Registry View for different case scenario of the following: (i) Computer System; (ii) Computer Network; (iii) Mobile Device; (iv) Wireless Network
10	Create a new investigation case using Forensic Tool: (i) Computer System; (ii) Computer Network; (iii) Mobile Device ;(iv) Wireless Network.

Course Code	Course Title	Credits
RJPSCSS3P03	**Business Intelligence and Big Data Analytics - II (Mining Massive Data sets -I)**	02

No	List of Practical Experiments
1	Write a map-reduce program to count the number of occurrences of each word in the given dataset. (A word is defined as any string of alphabetic characters appearing between non-alphabetic characters like nature's is two words. The count should be case-insensitive. If a word occurs multiple times in a line, all should be counted)
2	Write a program to construct different types of k-shingles for given document.
3	Write a program for measuring similarity among documents and detecting passages which have been reused.
4	Write a program to compute the n- moment for a given stream where n is given.
5	Write a program to demonstrate the Alon-Matias-Szegedy Algorithm for second moments.
6	Pre-process the given data set and hence apply clustering techniques like K-Means, K-Medoids. Interpret the result.
7	Pre-process the given data set and hence classify the resultant data set using
8	Pre-process the given data set and hence classify the resultant data set using support vector machine. Interpret the result.

Note: The experiments may be done using software/tools like Hadoop / WEKA / R / Java etc.

Course Code	Course Title	Credits
RJPSCSS401	Cloud Computing -III (Building Clouds and Services)	04

Unit I: Cloud R eference Architectures and Security

The NIST definition of Cloud Computing, Cloud Computing reference architecture, Cloud Computing use cases, Cloud Computing standards. Cloud Computing Security-Basic Terms and Concepts, Threat Agents, Cloud Security Threats. Cloud Security Mechanisms, Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images.

Unit II: Cloud Computing Mechanisms

Cloud Infrastructure Mechanisms, Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication Ready-Made Environment. Specialized Cloud Mechanisms, Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database. Cloud Management Mechanisms, Remote Administration System, Resource Management System, SLA Management System, Billing Management System.

Unit III: Cloud Computing Architecture

Fundamental Cloud Architectures, Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. Advanced Cloud Architectures, Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management

Architecture.

Unit IV: Working with Clouds

Cloud Delivery Model Considerations, Cloud Delivery Models: The Cloud Provider Perspective, Building IaaS Environments, Equipping PaaS Environments, Optimizing SaaS Environments, Cloud Delivery Models: The Cloud Consumer Perspective. Cost Metrics and Pricing Models, Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations. Service Quality Metrics and SLAs, Service Quality Metrics, Service Availability Metrics, Service Reliability Metrics, Service Performance Metrics, Service Scalability Metrics, Service Resiliency Metrics.

Text book:

- Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Prentice Hall, 2013.
- Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley Publishing, Inc., 2010.
- Open Stack Cloud Computing Cookbook, Kevin Jackson, Cody Bunch, Egle Sigler, Packt Publishing, Third Edition, 2015.

Reference:

- Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe, Topjian,OpenStack Operations Guide, O'Reilly Media, Inc, 2014.
- NIST Cloud Computing Standards Roadmap, Special Publication 500-291, Version 2, NIST, July 2013, http://www.nist.gov/itl/cloud/upload/NIST_SP-500-291_Version-2_2013_June18_FINAL.pdf
- https://www.openstack.org
- http://cloudstack.apache.org
- http://www.foss-cloud.org/en/wiki/FOSS-Cloud
- http://www.ubuntu.com/cloud/openstack/autopilot

Course Code	Course Title	Credits
RJPSCSS402	Cyber and Information Security (Cryptography and Crypt Analysis)	04

Unit I: Introduction to Number Theory

Topics in Elementary Number Theory: O and notations, time estimates for doing arithmetic-divisibility and the Euclidean algorithm, Congruence: Definitions and properties, linear congruence, residue classes, Euler's phi function, Fermat's Little Theorem, Chinese Reminder Theorem, Applications to factoring, finite fields, quadratic residues and reciprocity: Quadratic residues, Legendre symbol, Jacobi Symbol. (proofs of the theorems are not expected to cover).

Unit II: Simple Cryptosystems

Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Vermin Cipher, Hill Cipher, Permutation Cipher, Stream Cipher, Cryptanalysis of Affine Cipher, Substitution Cipher, Vigenere Cipher and Hill Cipher, Block Ciphers, Algorithm Modes, DES, Double DES, Triple DES, Meet-in-Middle Attack, AES, IDEA algorithm. Cryptographic Hash Functions: Hash Functions and Data Integrity, Security of Hash Functions, Secure Hash Algorithm, Message Authentication Code, Nested MACs, HMAC.

Unit III: RSA Cryptosystem

The RSA Algorithm, Primarily Testing, Legendre and Jacobi Symbols, The Solovay-Strassen Algorithm, The Miller-Rabin Algorithm, Factoring Algorithm: The pollard p-1 Algorithm, Dixon's Random Squares Algorithm, Attacks on RSA, The Rabin Cryptosystem. Public Key Cryptosystems: The idea of public key Cryptography, The Diffie-Hellman Key Agreement, ElGamal Cryptosystem, The Pollard Rho Discrete Logarithm Algorithm, Elliptic Curves, Knapsack problem.

Unit IV: Key Distribution and Key Agreement Scheme

Diffie-Hellman Key distribution and Key agreement scheme, Key Distribution Patterns, Mitchell-Piper Key distribution pattern, Station-to-station protocol, MTI Key Agreement scheme. Public-Key Infrastructure: What is PKI?, Secure Socket Layer, Certificates, Certificate Life cycle, Trust Models: Strict Hierarchy Model, Networked PKIs, The web

browser Model, Pretty Good Privacy.

Text book:

- Discrete Mathematics and Its Applications, Kenneth H. Rosen, 7th Edition, McGraw Hill, 2012.
- Cryptography Theory and Practice, 3rd Edition, Douglas R. Stinson, 2005.

Reference:

- Network Security and Cryptography, Atul Kahate, McGraw Hill, 2003.
- Cryptography and Network Security: Principles and Practices, William Stalling, Fourth Edition, Prentice Hall, 2013.
- Introduction to Cryptography with coding theory, second edition, Wade Trappe, Lawrence C. Washington, Pearson, 2005.

Course Code	Course Title	Credits
RJPSCSS403	**Social Network Analysis**	**04**

Unit I: Introduction to social network analysis (SNA)

Introduction to networks and relations- analyzing relationships to understand people and groups, binary and valued relationships, symmetric and asymmetric relationships, multimode relationships, Using graph theory for social networks analysis- adjacency matrices, edge-lists, adjacency lists, graph traversals and distances, depth-first traversal, breadth-first traversal paths and walks, Dijkstra's algorithm, graph distance and graph diameter, social networks vs. link analysis, ego-centric and socio-centric density.

Unit II: Networks, Centrality and centralization in SNA

Understanding networks- density, reachability, connectivity, reciprocity, group-external and group-internal ties in networks, ego networks, structural holes, Centrality- degree of centrality, closeness and betweenness centrality, local and global centrality, centralization and graph centers, Google pagerank algorithm, Analyzing network structure- bottom-up approaches using cliques, N-cliques, N-clans, K-plexes, K-cores,

F-groups and top-down approaches using components, blocks and cut-points, lambda sets and bridges, and factions.

Unit III: Measures of similarity and structural equivalence in SNA

Approaches to network positions and social roles- defining equivalence or similarity, structural equivalence, automorphic equivalence, finding equivalence sets, brute force and Tabu search, regular equivalence, equivalence of distances: regular equivalence, Measuring similarity/dissimilarity- valued relations, Euclidean, Manhattan, and squared distances, binary relations,.

Unit IV: Two-mode networks for SNA

Understanding mode networks- Bi-partite data structures, visualizing two-mode data, quantitative analysis using two-mode Singular value decomposition (SVD) analysis, two-mode factor analysis, two-mode correspondence analysis, qualitative analysis using two-mode core-periphery analysis, two-mode factions analysis.

Text book:

- Introduction to Social Network Methods: Robert A. Hanneman, Mark Riddle, University of California, 2005 [Published in digital form and available at http://faculty.ucr.edu/~hanneman/nettext/index.html].
- Social Network Analysis for Startups- Finding connections on the social web: Maksim Tsvetovat, Alexander Kouznetsov, O'Reilly Media, 2011.
- Social Network Analysis- 3rd edition, John Scott, SAGE Publications, 2012.

Reference book:

- Exploratory Social Network Analysis with Pajek, Second edition: Wouter de Nooy, Andrej Mrvar, Vladimir Batagelj, Cambridge University Press, 2011.
- Analyzing Social Networks, Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, SAGE Publications, 2013.
- Statistical Analysis of Network Data with R: Eric D. Kolaczyk, Gabor Csardi, Springer, 2014.
- Network Analysis: Methodological Foundations, (Editors) Ulrik Brandes, Thomas

List of Practical Experiments for Semester -IV

Course Code	Course Title	Credits
RJPSCSS4P01	**Cloud Computing (Building Clouds and Services)**	**02**

Sr No	List of Practical Experiments
1	Develop a private cloud using an open source technology.
2	Develop a public cloud using an open source technology.
3	Explore Service Offerings, Disk Offerings, Network Offerings and Templates.
4	Explore Working of the following with Virtual Machines • VM Lifecycle • Creating VMs • Accessing VMs • Assigning VMs to Hosts
5	Explore Working of the following with Virtual Machines • Changing the Service Offering for a VM • Using SSH Keys for Authentication
6	Explore the working of the following: Storage Overview • Primary Storage

	• Secondary Storage
7	Explore the working of the following: Storage Overview • Working With Volumes • Working with Volume Snapshots
8	Explore managing the Cloud using following: • Tags to Organize Resources in the Cloud • Reporting CPU Sockets
9	Explore managing the Cloud using following: • Changing the Database Configuration • File encryption type
10	Explore managing the Cloud using following: • Administrator Alerts • Customizing the Network Domain Name

Note

Recommended Open Source Technologies for completing practical:

- FOSS-Cloud
- Try Stack
- Apache CloudStack
- OpenStack
- Canonical's OpenStack Autopilot

Recommended Configuration: Desktop PC Core I5 with minimum 250 GB Hard Drive and minimum 8 GB RAM

Course Code	Course Title	Credits
RJPSCSS4P02	:Cyber & Information Security (Cryptography and Crypt Analysis)	02

Sr No	List of Practical Experiments
1	Write a program to implement following: • Chinese Reminder Theorem • Fermat's Little Theorem
2	Write a program to implement the (i) Affine Cipher (ii) Rail Fence Technique (iii) Simple Columnar Technique (iv) Vermin Cipher (v) Hill Cipher to perform encryption and decryption.
3	Write a program to implement the (i) RSA Algorithm to perform encryption and decryption.
4	Write a program to implement the (i) Miller-Rabin Algorithm (ii) pollard p-1 Algorithm to perform encryption and decryption.
5	Write a program to implement the ElGamal Cryptosystem to generate keys and perform encryption and decryption.
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 different processes of DES algorithm like (i) Initial Permutation process of DES algorithm, (ii) Generate Keys for DES algorithm, (iii) S-Box substitution for DES algorithm.
9	Write a program to encrypt and decrypt text using IDEA algorithm.
10	Write a program to implement HMAC signatures.

Course Code	Course Title	Credits
RJPSCSS4P03	Social Network Analysis	02

Sr No	List of Practical Experiments
1	Write a program to compute the following for a given a network: (i) number of edges, (ii) number of nodes; (iii) degree of node; (iv) node with lowest degree; (v) • the adjacency list; (vi) matrix of the graph
2	Perform following tasks: (i) View data collection forms and/or import onemode/ two-mode datasets; (ii) Basic Networks matrices transformations
3	Compute the following node level measures: (i) Density; (ii) Degree; (iii) Reciprocity; (iv) Transitivity; (v) Centralization; (vi) Clustering.
4	For a given network find the following: (i) Length of the shortest path from a given node to another node; (ii) the density of the graph; (iii) Draw egocentric network of node G with chosen configuration parameters.
5	Write a program to distinguish between a network as a matrix, a network as an edge list, and a network as a sociogram (or “network graph”) using 3 distinct networks representatives of each.
6	Write a program to exhibit structural equivalence, automatic equivalence, and regular equivalence from a network
7	Write a program to implement the MD5 algorithm compute the message digest. Create sociograms for the persons-by-persons network and the committee-by committee network for a given relevant problem. Create one-mode network and two-node network for the same.
8	Perform SVD analysis of a network
9	Identify ties within the network using two-mode core periphery analysis.
10	Find “factions” in the network using two-mode faction analysis

Scheme of Examination for Theory Courses

There will be internal and external examination for the theory courses. The weightage of internal/external and scheme of examination will be as per common guidelines provided by the University for the PG courses in the faculty of Science.

Scheme of Examination for Practical Courses

There will not be any internal examination for practical courses.

External Examination for practical courses:

The evaluation of the external examination of practical course is given below:

Sr No	Semester	Course Code	Particular	No of questions	Marks per question	Total Marks
1	III	RJPSCSS3P01	Laboratory experiment question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
2	III	RJPSCSS3P02	Laboratory experiment Question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
3	III	RJPSCSS3P03	Laboratory experiment Question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
	Total marks for practical courses					150

Course code	Course Title	No of hours	Credits
RJPSCSS3P04	Project Implementation	200	06

Sr No	Semester	Course Code	Particular	No of questions	Marks per question	Total Marks
1	IV	RJPSCSS4P01	Laboratory experiment Question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
2	IV	RJPSCSS4P02	Laboratory experiment Question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
3	IV	RJPSCSS4P03	Laboratory experiment Question	1	40	40
			Journal	-	05	05
			Viva	-	05	05
	Total marks for practical courses					150

Course code	Course Title	No of hours	Credits
RJPSCSS3P04	Internship	300	06

Guide lines for maintenance of journals:

A student should maintain a journal with at least six practical experiments for each part of the practical course. Certified journals need to be submitted at the time of the practical examination.

Guidelines for Project Implementation in Semester - III

- Student should implement the case study approved at semester II examination.
- A student is expected to devote at least 2 to 3 months of study as part of topic

implementation and its documentation.

- A student is expected to attach case study report signed by external examiner at semester II examination with documentation.

Guidelines for Documentation of Project in Semester -III

A Student should submit project implementation documentation with following details:

- Title: Title of the project (Same as the one proposed and evaluated at the semester II examination).
- Implementation details: A description of how the project has been implemented. It shall be of 2 to 4 pages.
- Experimental set up and results: A detailed explanation on how experiments were conducted, what software used and the results obtained. Details like screen shots, tables and graphs can come here. It shall be of 6 to 10 pages.
- Analysis of the results: A description on what the results means and how they have been arrived at. Different performing measures or statistical tools used etc may be part of this. It shall be of 4 to 6 pages.
- Conclusion: A conclusion of the project performed in terms of its outcome (May be half a page).
- Future enhancement: A small description on what enhancement can be done when more time and resources are available (May be half a page).
- Program code: The program code may be given as appendix.

Guidelines for internship in Semester - IV

- Internship should be of 2 to 3 months with 8 to 12 weeks duration.
- A student is expected to find internship by himself or herself. However, the institution should assist their students in getting internship in good organizations.
- The home institution cannot be taken as the place of internship.
- A student is expected to devote at least 300 hours physically at the organization.
- Internship can be on any topic covered in the syllabus mentioned in the syllabus.
- Internship can be done, in one of the following, but not restricted to, types of

organizations:

o Software development firms o Hardware/ manufacturing firms o Any small scale industries, service providers like banks o Clinics/ NGOs/professional institutions like that of CA, Advocate etc o Civic Depts like Ward office/post office/police station/ punchayat. o Research Centres/ University Depts/ College as research Assistant for research projects or similar capacities.

Guidelines for making Internship Report in Semester -IV

A student is expected to make a report based on the internship he or she has done in an organization. It should contain the following:

- Certificate: A certificate in the prescribed Performa (given in appendix 1) from the organization where the internship done.
- Evaluation form: The form filled by the supervisor or to whom the intern was reporting, in the prescribed Performa (given in appendix 2).
- Title: A suitable title giving the idea about what work the student has performed during the internship.
- Description of the organization: A small description of 1 to 2 pages on the organization where the student has interned
- Description about the activities done by the section where the intern has worked: A description of 2 to 4 pages about the section or cell of the organization where the intern actually worked. This should give an idea about the type of activity a new employee is expected to do in that section of the organization.
- Description of work allotted and actually done by the intern: A detailed description of the work allotted and actual work performed by the intern during the internship period. Intern may give a weekly report of the work by him or her if needed. It shall be of around 7 to 10 pages.
- Self assessment: A self assessment by the intern on what he or she has learnt during the internship period. It shall contain both technical as well as inter personal skills learned in the process. It shall be of around 2 to 3 pages.

The internship report may be around 15 pages and this needs to be submitted to the external examiner at the time of University examination.

Appendix 1

(Proforma for the certificate for internship in official letter head)

This is to certify that Mr/Ms of
College/Institution worked as an intern as part of her MSc course in Computer Science of University of Mumbai. The particulars of internship are given below:
Internship starting date:
Internship ending date:
Actual number of days worked:
Tentative number of hours worked:Hours

Broad area of work:

A small description of work done by the intern during the period:

Signature:
Name:
Designation:
Contact
number: Email:

(seal of the organization)

Appendix 2

(Proforma for the Evaluation of the intern by the supervisor/to whom the intern was reporting in the organization)

Professional Evaluation of intern

Name of intern:

College/institution:

[Note: Give a score in the 1-5 scale by putting V in the respective cells]

Sr No	Particular	Excellent	Very Good	Good	Moderate	Satisfactory
1	Attendance					
2	Punctuality					
3	Adaptability					
4	Ability to shoulder Responsibility					
5	Ability to work in a team					
6	Written and oral communication skills					
7	Problem solving Skills					
8	Ability to grasp new concepts					
9	Ability to complete task					
10	Quality of work Done					

Comments:

Signature:

Name:

Designation:

Contact number:

Email:

(seal of the organization)