Resolution No: AC/II(20-21).2.RUS6

S. P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

Syllabus for M.Sc

Program: M.Sc (Computer Science)

Program Code: Computer Science (RPSCS)

(Credit Based Semester and Grading System
for academic year 2021–2022)

PROGRAM OUTCOMES

PO	PO Description **A student completing master's degree in Computer Science program will be able to:**
PO 1	Demonstrate an in-depth understanding of the relevant science discipline. Recall, explain, extrapolate, and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance.
PO 2	Critically evaluate, analyze, and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
PO 3	Access, evaluate, understand, and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation.
PO 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
PO 5	Demonstrate initiative, competence, and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups.
PO 6	Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance
PO 7	Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills, and lead a team for planning and execution of a task.
PO 8	Understand cross-disciplinary relevance of scientific developments and relearn and reskill to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

PSO	Description A student completing master's degree in Science program in the subject of Information Technology will be able to:
PSO 1	Develop keen interest in the emerging technologies in the industry.
PSO 2	Analyze, innovate, and solve real-life case studies using technology.
PSO 3	Work in teams with various disciplines; working on an interdisciplinary project.
PSO 4	Understand work culture in the industry and attain skills to become a successful entrepreneur.
PSO 5	Develop a skillset analyze, describe, and innovate various methodologies to solve a given problem
PSO 6	Understand the philosophy of the subject to apply to various fields of research.
PSO 7	Work in an industrial environment under expert supervision and develop expertise in various technologies
PSO 8	Effective utilization of available resources to overcome challenging tasks.

PROGRAM OUTLINE

M.Sc (COMPUTER SCIENCE)							
SEMESTER – I (THEORY)					**SEMESTER – I (PRACTICALS)**		
Year	**Sem**	**Course code**	**Course title**	**Credits**	**Course code**	**Course title**	**Credits**
Part I	I	RPSCS101	Analysis of Algorithm	4	RPSCSP101	Analysis of Algorithm	2
Part I	I	RPSCS102	Advanced-Data Modelling	4	RPSCSP102	Advanced-Data Modelling	2
Part I	I	RPSCS103	Natural Language Processing	4	RPSCSP103	Natural Language Processing	2
Part I	I	RPSCS104	Blockchain	4	RPSCSP104	Blockchain	2

M.Sc (COMPUTER SCIENCE)							
SEMESTER – II (THEORY)					**SEMESTER – II (PRACTICALS)**		
Year	**Sem**	**Course code**	**Course title**	**Credits**	**Course code**	**Course title**	**Credits**
Part I	I	RPSCS201	Machine Learning	4	RPSCS201	Machine Learning	2
Part I	I	RPSCS202	Cyber & information Security	4	RPSCS202	Cyber & information Security	2
Part I	I	RPSCS203	Wireless and Mobile Networks	4	RPSCS203	Wireless and Mobile Networks	2
Part I	I	RPSCS204	Advanced Mining Techniques	4	RPSCS204	Advanced Mining Techniques	2

M.Sc (COMPUTER SCIENCE)							
SEMESTER – III (THEORY)					**SEMESTER – III (PRACTICALS)**		
Year	**Sem**	**Course code**	**Course title**	**Credits**	**Course code**	**Course title**	**Credits**
Part I	I	RPSCS301	Social Network Analysis	4	RPSCSP301	Social Network Analysis	2
Part I	I	RPSCS302	Internet of Things	4	RPSCS302	Internet of Things	2
Part I	I	RPSC303	Big Data using Hadoop and R	4	RPSCP303	Big Data using Hadoop and R	2
Part I	I	--	--	--	RPSCSP304	Project	6

M.Sc (COMPUTER SCIENCE)							
SEMESTER – IV (THEORY)					**SEMESTER – IV (PRACTICALS)**		
Year	**Sem**	**Course code**	**Course title**	**Credits**	**Course code**	**Course title**	**Credits**
Part I	I	RPSCS401	Simulation and Modelling	4	RPSCSP401	Simulation and Modelling	2
Part I	I	--	--	--	RPSCSP402	Internship	18

Course Code: RPSC101

Course Title: Analysis of Algorithms

The academic year 2020-21

COURSE OUTCOMES:

COURSE OUTCOME	Description
CO 1	Understanding Algorithmic complexity and analyzing the same
CO 2	Developing an understanding of various techniques and methods to design algorithms
CO 3	Skill to make the algorithm and solve real-world problems
CO 4	Developing algorithms to solve real-life problems.
CO 5	Analysis of traditional algorithms and apply to various problems.
CO 6	Find applications to algorithms in real-time case studies

COURSE CODE RPSCS101	**COURSE NAME** **ANALYSIS OF ALGORITHMS**	**CREDITS** **4** **LECTURES**
I	***Foundations:*** Introduction The Role of Algorithms in Computing, Algorithms as a technology, Insertion sort, Analyzing algorithms, Designing algorithms, Growth of Functions, Asymptotic notation, Standard notations and common functions, Divide-and-Conquer, The maximum-subarray problem, Strassen's algorithm for matrix multiplication, The substitution method for solving recurrences, The recursion-tree method for solving recurrences, The master method for solving recurrences, Proof of the master theorem. Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables.	15 L
II	Sorting and Order Statistics: Introduction, Heapsort, Heaps, Maintaining the heap property, Building a heap, The heapsort algorithm, Priority queues, Quicksort, Description of quicksort, Performance of quicksort, A randomized version of quicksort, Analysis of quicksort, Sorting in Linear Time, Lower bounds for sorting, Counting sort, Radix sort, Bucket sort, Medians and Order Statistics, Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time.	15 L

III	Dynamic Programming, Rod cutting, Matrix-chain multiplication, , Elements of dynamic programming, Longest common subsequence, Optimal binary search trees, Greedy Algorithms, An activity-selection problem, Elements of the greedy strategy, Huffman codes, Matroids and greedy methods, A task-scheduling problem as a matroid, Amortized Analysis, Aggregate analysis, The accounting method, The potential method, Dynamic tables	15 L
IV	String Matching: The naive string-matching algorithm, The Rabin-Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm NP-Completeness: Polynomial-time, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, NP-complete problems, Approximation Algorithms, The vertex-cover problem, The travelling-salesman problem, The set-covering problem, Randomization and linear programming, The subset-sum problem	15 L

Text book:

1. Introduction to Algorithms Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein

References:

1. Analysis and Design of Algorithms: A Beginner's Approach by Rajesh K. Shukla

2. Design and Analysis of Algorithms: A Contemporary Perspective by Sandeep Sen

COURSE CODE **RPSCSP101**	**COURSE NAME** **PRACTICAL OF ANALYSIS OF ALGORITHMS**	**CREDITS** **2**
1	Demonstrate Strassen Matrix Multiplication.	
2	Solve the Hiring Problem with an appropriate algorithm	
3	Demonstrate various sorting algorithm and compute the efficiency of each	
4	Demonstrate dynamic programming with Rod Cutting problem.	
5.	Demonstrate the Long Subsequence problem and its solution using recursion.	
6	Demonstrate the Huffman Codes and its application.	
7.	Implement The Knuth-Morris-Pratt algorithm	
8.	Demonstrate the travelling Sales man’s problem	

Course Code: RPSC102

Course Title: Advanced Data Modelling

The academic year 2020-21

COURSE OUTCOMES:

Course Outcomes	Description
CO 1	Interpret different Data modelling Techniques for handling a variety of data.
CO 2	Evaluate and Apply appropriate NoSQL database for a specific use case.
CO 3	Analyze spatial data, relationships and metrics.
CO 4	Design and implement applications for semi-structured data.

COURSE CODE RPSCS102	COURSE NAME ADVANCED DATA MODELLING	CREDITS 4 LECTURES
I	Spatial data modelling: spatial data types, Raster, vector representation, topological spatial relationships, indexing, Geographical information systems: Data management, processing, referencing and analysis, visualization	15 L

II	Semi-structured data modelling: Semi-structured data model, Hierarchical data model, DTD, XML documents and schema, XML documents and databases, XML querying	15 L
III	Nosql: Features,Managing different data types,consistency methods,Distributed scenario, Partitioning,Query model,Storage layout,Enterprise application Evaluating Nosql:Technical ,Business,issues	15 L
IV	NoSQL data stores: features and use cases of key-value, Big Table, document database, hybrid NoSQL, search engines.	15 L

Text book:

1. NoSQL for Dummies by Adam Fowler published by Willey
2. NoSQL and SQL Data modelling By Ted Hills
3. Fundamentals of database systems Navathe
4. Principles of GIS, otto Huisman, Rolf A

COURSE CODE RPSCSP102	COURSE NAME PRACTICAL OF Advanced Data Modelling	CREDITS 2
	Real-world Case studies based on the following single category of databases or a combination of multiple databases 1. Semi-structured data 2. Spatial data 3. GIS 4. Nosql: Columnar data store 5. NoSQL: Key-value datastore 6. NoSQL: Graph datastore 7. NoSQL: Document datastore NoSQL: Search engine	

Course Code: RPSC103

Course Title: Natural Language Processing

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description
CO 1	To learn how to apply basic algorithms & design and implement applications based on natural language processing

CO 2	Implement a rule-based system to tackle morphology/syntax of a language
CO 3	To design an innovative application system that uses NLP components
CO 4	Be able to design, implement and test algorithms for NLP problems
CO5	Be able to apply NLP techniques to design real-world NLP applications

COURSE CODE RPSCS103	**COURSE NAME** **NATURAL LANGUAGE PROCESSING**	**CREDITS** **4** **LECTURES**
I	**Introduction:** Knowledge In Speech And Language processing, Ambiguity, History of NLP. **Words Analysis:** Regular expression, Regular Languages and FSA, Words & Transducers, Morphology, Words & sentence Tokenization, Human Morphological processing, N-Grams, Evaluating N-grams, Parts of speech tagging (POST), Hidden Markov Model (HMM).	15 L
II	**Speech:** Phonetics, Speech sound & phonetic transcription, Articulatory phonetics, Speech Synthesis, Automatic Speech recognition, Computational phonology.	15 L

III	**Syntax:** Formal Grammars of English, Parsing with context-free grammars, Statistical Parsing, Language and complexity, Features and unification	15 L
IV	**Semantics & applications:** Representing Meaning, Computational semantic, lexical-semantic, Computational lexical-semantic, Information Extraction, Machine translation.	15 L

Text book:

1. Speech and Language Processing - By Daniel Jurafsky, James H. Martin – 2nd Edition, Prentice-Hall, 2008/2009.
2. Foundations of Statistical Natural Language Processing - By Christopher D. Manning and Hinrich Schutze -The MIT Press(1999), Cambridge, Massachusetts, London, England.
3. Natural Language Processing with Python" Analyzing Text with Natural Language Toolkit. - By Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media

References:

1. Natural Language Processing: A Paninian Perspective By Akshar Bharati, Vineet Chaitanya, Rajeev Sangal.
2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, First Edition, OReilly Media, 2009.

COURSE CODE **RPSCSP103**	**COURSE NAME** **PRACTICAL OF NATURAL LANGUAGE PROCESSING**	**CREDITS** **2**
1.	Preprocessing of text: Word Analysis (Tokenization, Filtration, Script Validation)	
2.	Preprocessing of text: Word Generation (word frequency, Stop Word Removal, Stemming)	

3.	Morphological Analysis	
4.	N-gram model	
5.	POS tagging: HMM	
6.	POS tagging: Viterbi Decoding	
7.	Building POS Tagger	
8.	Chunking	
9.	Building Chunker / Name Entity Extraction	
10.	Case Study based on Application	

Course Code: RPSC104

Course Title: Blockchain

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description

CO 1	Explain blockchain technology as a security mechanism
CO 2	Explore blockchain types and implementation
CO 3	Construct and deploy Smart contracts using Ethereum
CO 4	Implement decentralized applications using blockchain in real-time applications.
CO 5	Describe Private Blockchain using Hyperledger Fabric

COURSE CODE RPSCS104	**COURSE NAME** **BLOCKCHAIN**	**CREDITS** **4** **LECTURES**

I	**Introduction to blockchain:** Web3 – The Decentralized Web Distributed system, History of blockchain, Need of blockchain Satoshi Nakamoto's Blockchain Breakthrough, Basics of blockchain, Block structure, Features, Types of blockchain, Application of blockchain, Consensus in blockchain, Benefits, limitation and challenges of blockchain, Decentralization: Methods of decentralization, Roles to decentralization, Smart contracts, Decentralized organization	15 L
II	**Public blockchain:** Basics of Bitcoin, transactions, blockchain, Mining, Wallet types, Bitcoin network, Bitcoin limitations, Ethereum blockchain, elements of Ethereum blockchain, Block structure, Mining and consensus, Construction of smart contract by solidity, Alternative coins, Bitcoins,namecoin, Peercoin	15 L
III	**Private blockchain:** Hyperledger GreenHouse**,** Introduction to Hyledger Fabric, Features**,** Architecture, Requirements, Components of fabric, Working of fabric, Hyperledger SAWTOOTH, Hyperledger BESU Hyperledger INDY, Hyperleger BURROW	15 L
IV	**Blockchain Use cases:** Business Use Cases, Technology Use Cases, Legal and Governance Use Cases, Private blockchain Use cases	15 L

Text book:

1. Mastering Blockchain, Imran Bashir,packt
2. A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara Paul R. Allen

References:

1. https://bitcoin.org/bitcoin.pdf
2. Mastering Bitcoin by Andreas M. Antonopoulos, O'Reilly
3. Mastering Etherium, Andreas M. Antonopoulos, O'Reilly
4. €https://solidity.readthedocs.io/en/v0.6.2/ (for solidity documentation
5. https://www.hyperledger.org/

6. https://www.leewayhertz.com/blockchain-platforms-for-top-blockchain-companies

COURSE CODE RPSCSP104	COURSE NAME PRACTICAL OF RPSCSP104 BLOCK CHAIN	CREDITS 2
1	Double Linked list Implementation	
2	Hashing algorithms	
3	Cryptography Fundamentals	
4	Simple blockchain implementation	
5	Blockchain with MongoDB	
6	Ethereum Smart contract development	
7	Ethereum Dapp	
8	Hyper ledger Fabric	
9	Blockchain Case Study	

Course Code: RPSC201

Course Title: Machine Learning

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description
CO 1	Understanding Artificial Intelligence, neural networks and its applications in real-life problems
CO 2	Working with evolutionary strategies like genetic algorithms and another evolutionary programming to solve various case studies
CO 3	To solve the Fuzzy logic problem using various strategies and apply the same.
CO 4	Understand deep learning problems and apply machine learning techniques to solve the same.

COURSE CODE RPSCS201	COURSE NAME MACHINE LEARNING	CREDITS 4 LECTURES

I	Artificial Neural Networks The Artificial Neuron, Supervised Learning Neural Networks, Unsupervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Performance Issues.	15 L
II	Evolutionary Computation Introduction to Evolutionary Computation, Genetic Algorithms, Genetic Programming, Evolutionary Programming, Evolution Strategies, Differential Evolution, Cultural Algorithms, Co-evolution.Computational Swarm Intelligence: Particle Swarm Optimization(PSO) - Basic Particle Swarm Optimization, Social Network Structures, Basic Variations and parameters, Single-Solution PSO.	15
III	Advanced Topics and applications. Ant Algorithms-Ant Colony Optimization Meta-Heuristic, Cemetery Organization and Brood Care, Division of Labor, Advanced Topics and applications. Artificial Immune systems, Fuzzy Systems and Rough Set Natural Immune System, Artificial Immune Models, Fuzzy Sets, Fuzzy Logic and Reasoning, Fuzzy Controllers, Rough Sets.	15 L
IV	Deep Learning: Deep forward Networks, Regularization of Deep Learning, Optimization of Train Deep Models, Convolution Networks, Sequence Modeling: Recurrent and Recursive Nets	15 L

Text Book:

1. Computational Intelligence- An Introduction (Second Edition): Andries P.Engelbrecht, John Wiley & Sons Publications (2007).
2. Deep Learning Ian Goodfellow, Yoshua Bengio, Aaron Courville MIT Press

Reference:

1. Computational Intelligence And Feature Selection: Rough And FuzzyApproaches, Richard Jensen Qiang Shen, IEEE Press Series On ComputationalIntelligence, A John Wiley & Sons, Inc., Publication, 2008.

2. Computational Intelligence And Pattern Analysis In Biological Informatics,(Editors). Ujjwal

Maulik, Sanghamitra Bandyopadhyay, Jason T. L.Wang, JohnWiley & Sons, Inc, 2010.

3. Neural Networks for Applied Sciences and Engineering: From Fundamentals to Complex Pattern Recognition 1st Edition, Sandhya Samarasinghe, Auerbach Publications, 2006.

4. Introduction to Evolutionary Computing (Natural Computing Series) 2nd ed, A.E. Eiben, James E Smith, Springer; 2015.

5. Swarm Intelligence, 1st Edition, Russell C. Eberhart, Yuhui Shi, James Kennedy, Morgan Kaufmann,2001

6. Artificial Immune System: Applications in Computer Security, Ying Tan, Wiley-IEEE Computer

Society, 2016.

7. Computational Intelligence and Feature Selection: Rough and Fuzzy Approaches 1st Edition, Richard Jensen, Qiang Shen, Wiley-IEEE Press, 2008

COURSE CODE	COURSE NAME	CREDITS

RPSCSP201	**PRACTICAL OF Machine Learning**	**2**
1.	Implement a feed-forward neural network for the given data.	
2.	Implement a Self Organizing Map neural network.	
3.	Implement a Radial Basis Function neural network with gradient descent.	
4.	Implement a basic genetic algorithm with selection, mutation and crossover as genetic operators.	
5.	Implement an evolution strategy algorithm.	
6.	Implement a general differential evolution algorithm.	
7.	Implement a simple Ant colony optimization algorithm.	
8.	Demonstrate Convolution networks using a deep learning model.	

Course Code: RPSC202

Course Title: Cyber and Information security

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description
CO 1	Explain security mechanisms to secure data
CO 2	Analyze vulnerabilities in Network and cloud platform and find Its secure solution
CO 3	Identify possible attacks on IOT and its countermeasures

COURSE CODE RPSCS202	**COURSE NAME** **Cyber and Information security**	**CREDITS** **4** **LECTURES**
I	**Server Security** Server vulnerabilities, Threats and environment, Basic server security steps, Server security principle, Server security planning, Securing server operating system, Windows security, Unix security, Securing server database system, Securing server software, Maintaining the security of the server, virtual machines, Secure application design, Developing secure software	15 L
II	**Network Security** Secure Network Design, Network device security, Firewalls, Virtual private networks, Wireless network security, IDPS, VOIP and PBX security, SET, Detection and response to attacks, Risk analysis and management, Network security case scenario	15L
III	**Cloud Security** Cloud Computing Software Security Fundamentals, Cloud Computing Risk Issues, Cloud Computing SecurityChallenges, Cloud Computing SecurityArchitecture, Cloud Computing Life Cycle Issues, cloud security case scenario	15 L
IV	**IOT Security:** Threats AND ATTACKS, Computational Security for the IoT, Privacy-Preserving Time, Series Data Aggregation for the Internet of Things, Trust and authentication, Secure Path Generation, Scheme for Real-Time Green Internet of Things, Security Protocols for IoT Access Networks	15 L

Text book:

1. The Complete Reference: Information Security, Mark Rhodes-Ousley, McGraw-Hill 2nd Edition,2013
2. Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Ronald L.Krutz, Russell Dean Vines, Wiley Publishing, Inc., 2010.
3. Security and Privacy in Internet of Things (IoT), Fei Hu, CRC press

References:

1. Guide to General Server Security, Recommendations of the National Institute Of Standards and Technology, Karen Scarfone Wayne Jansen Miles Tracy
2. Cloud Security and Privacy, Tim mather, Subra Kumaraswamy
3. Securing Cloud and Mobility A Practitioner's Guide, Ian Lim. Coleen CoolidgePaul Hourani
4. Security in Computing 4th edition, Charles P. Pfleeger, Charles P.Pfleeger, Shari Lawrence Pfleeger, Prentice Hall; 4th edition (2006)

COURSE CODE **RPSCSP202**	**COURSE NAME** **PRACTICAL OF Cyber & Information Security**	**CREDITS** **2**
1.	Secure Communication	
2.	Secure programming implementation	
3.	Server Security	
4.	Database Security	
5.	cloud database security	
6.	cloud server Security	
7.	Using Docker for deployment to Secure Application code	

8.	Network monitoring tool	

Course Code: RPSC203

Course Title: Wireless and Mobile Networks

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description
CO 1	Understanding Wireless Networking Systems
CO 2	Working with Mobile Technologies and innovations in the same.
CO 3	Using wireless networking for developing applications and projects
CO 4	Detailed understanding of various mobile communication technologies along with wireless systems.

COURSE CODE RPSCS203	COURSE NAME Wireless and Mobile Networks	CREDITS 4 LECTURES
I	Introduction to Telephone Systems, Telephones, Control Functions, telephone Traffic, Switching, Wireless information Networks, Information Transmission, State Diagram of Telephone Network, Modems, Mobile Communication, Need, Requirements, History, Properties of Wireless Medium. Introduction to Cellular Mobile Communication, Cellular Structure, Frequency Reuse, System Architecture, Traffic and Switching Techniques. Mobile Communication Standards: Generation of Wireless networks, Standard Organizations,	15 L
II	Global Systems for Mobile Communication (GSM), GSM Architecture, AMPS, DAMPS, Cordless Telephony, PACS, Third Generation Wireless Standards. Mobility Management: Handoff Techniques, Handoff Detection and Assignment, Types of Handoff, Radio Link transfer, Roaming Management. Frequency Management, Cellular System Spectrum, Adaptive Channel allocation, Frequency Division, Spectrum Utilization, channel reservation for handoff calls, control channels, channel assignment methods, cell splitting. Mobile Computing, Classification of mobile data networks, Cellular digital packet data (CDPD) Systems. Satellite in Mobile Communication. Global Mobile Communication, Interferences in cellular communication, Mobile internet	15 L
III	Wireless Security: Wireless Threats, Authentication and access control, secrecy in communication, Security arrangements in CDMA, Security of wireless data networks, Wireless Local Loop Architecture: Components in WLL, Problems in WLL, Modern Wireless Loop, LDMS, Wireless Application Protocol: Properties of WAP, Bearer Services, WAP Component Integration, WAP Client Support Networks.	15 L

IV	WCDMA and Fibre optic microcellular Mobile communication: System Description, Layout of Optical Fibre and Microcellular Communication System, Adhoc Networks and Bluetooth Technologies: MANET and Technical Factors affecting ad hoc networks, Bluetooth technology Intelligent Mobile Communication: Types of Intelligent Cell, Power delivery Intelligent Cells, Processing Gain intelligent cells, 4G: User-Controlled services, Reconfigurable Technology, Vision of 4G, 4G Mobile System Convergences.	15 L

Text book:

"Wireless and Mobile Communication" by T.G. Nakkeeran, R. Palanivelu

References:

1. Wireless Communications: Principles and Practice, 2e Paperback – 2010 by Rappaport
2. Wireless Communications & Networks, 2e Paperback – 2009 by Stallings
3. Mobile Communications, 2e Paperback – 2008 by Schiller

COURSE CODE RPSCSP203	COURSE NAME **Practical of Wireless and Mobile Networks**	CREDITS 2
1.	Demonstrate Frequency distribution in Cellular Network	
2	Demonstrate and over in Adhoc networks	
3	Demonstrate satellite communication with earth stations	

4	Illustrate the wireless local loops.	
5.	Demonstrate the LDM systems	
6.	Develop a Bluetooth ad hoc network	
7.	Demonstrate the working of an intelligent cell	
8	Demonstrate MANET	

Course Code: RPSC204

Course Title: Advanced Mining Techniques

The academic year 2020-21

COURSE OUTCOMES:

Course Outcome	Description
CO 1	Interpret different Data mining algorithms and Techniques
CO 2	Critically evaluate and apply Mining algorithms to real-world case studies

CO 3	Compare Mapreduce and traditional Software paradigms
CO 4	Assess the similarity of documents
CO 5	Apply different link analysis techniques for specific use cases.

COURSE CODE RPSCS204	**COURSE NAME** **Advanced Mining Techniques**	**CREDITS** **4** **LECTURES**
I	What is data Statistical Modeling?, Machine Learning, Computational Approaches to Modeling, Summarization, Feature Extraction Statistical Limits on Data Mining. MapReduce and the New Software Stack: Distributed File Systems, MapReduce, Algorithms Using MapReduce, Extensions to MapReduce, The Communication Cost Model, Complexity Theory for MapReduce	15 L
II	Finding Similar Items: Applications of Near-Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Locality-Sensitive Hashing for Documents, Distance Measures, The Theory of Locality-Sensitive Functions, LSH Families for Other Distance Measures, Applications of Locality-Sensitive Hashing, Methods for High Degrees of Similarity. Mining Data Streams: The Stream Data Model, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows	15 L

III	Link Analysis: PageRank, Efficient Computation of PageRank, Topic-Sensitive PageRank, Link Spam, Hubs and Authorities. Frequent Itemset: The Market-Basket Model, Market Baskets and the A-Priori Algorithm Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream.	15 L
IV	Clustering: Introduction to Clustering Techniques, Hierarchical Clustering, K-means Algorithms, The CURE Algorithm, Clustering in Non-Euclidean Spaces, Clustering for Streams and Parallelism. Recommendation Systems: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction.	15 L

Text book:

1. Mining of Massive Datasets by Jure Leskovec Stanford Univ., Anand Rajaraman Milliway Labs, Jeffrey D. Ullman Stanford Univ.

References:

1) Data mining concepts and techniques by Jiawei Han, Micheline Kamber, Jian Pei 3rd Edition.

COURSE CODE RPSCSP204	COURSE NAME Practical for Advanced Mining Techniques	CREDITS 2
1	Demonstrate MapReduce for a given dataset	

2	Demonstrate an application of Near Neighbor search	
3	Demonstrate an application of Locality sensitive hashing technique for large datasets	
4	Demonstrate page ranking with an appropriate application	
5	Demonstrate Market basket analysis techniques	
6	Develop an application to implement the apriori algorithm	
7	Develop an application to perform clustering using various techniques.	
8	Develop a content-based recommendations system	

Semester III Detailed Syllabus

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCS301	RPSCS301: Social Network Analysis	4	4

Learning Objective:

- understand the behaviour of the users in the social network
- Predict the possible next outcome of the social network

Learning Outcome:

- Work on the internal components of the social network
- Model and visualize the social network
- Apply social network in real-time applications

UNITS	COURSE CONTENTS	NO. OF LECTURES
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, social networks vs. link analysis, ego-centric and socio-centric density. Visualization and applications of social networks 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, Hybrid representation, Applications - networks, community welfare, collaboration networks, Co-citation networks.	15 L

II	Networks, Centrality and centralization in SNA Understanding networks- density, reachability, connectivity, reciprocity, group-external and group-internal ties in networks, ego networks, extracting and visualizing ego networks, structural holes, Centrality degree of centrality, closeness and betweenness centrality, local and global centrality, centralization and graph centres, the notion of importance within the network, Google Page Rank algorithm, Analyzing network structure-bottom-up approaches using cliques, N-cliques, N-clans, K-plexes, K-cores, blocks and cut-points, lambda sets and bridges & factions.	15 L
III	Measures of similarity and structural equivalence in SNA Approaches to network positions and social roles-defining equivalence similarity, structural equivalence, automorphic equivalence, finding equivalence sets, brute force and Tabu search, regular equivalence, the equivalence of distances: Maxim, regular equivalence, Measuring similarity/dissimilarity- valued relations, Pearson correlations covariance and cross-products, Euclidean, Manhattan, and squared distances, binary relations, Jaccard, Hamming distance	15 L
IV	Two-mode networks for SNA Understanding mode networks- Bi-partite data structures, visualizing two-mode data, Singular value decomposition (SVD) analysis, two-mode factor analysis. Predicting Human Behavior and Privacy Issues Understanding and predicting human behaviour for social communities, User data Management, Enabling human experience, Privacy on social networks	15 L

References:

1. Introduction to Social Network Methods: Robert A. Hanneman, Mark
2. Riddle, University of California, 2005 [Published in digital form and available athttp://faculty.ucr.edu/~hanneman/nettext/index.html].
3. Social Network Analysis for Startups- Finding connections on the social web: MaksimTsvetovat, Alexander Kouznetsov, O'Reilly Media, 2011.
4. Social Network Analysis- 3rd edition, John Scott, SAGE publications, 2012.
5. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, —Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012
6. Charu C. Aggarwal, —Social Network Data Analytics‖, Springer; 2014

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCSP301	RPSCSP301: PRACTICAL OF Social Network Analysis & Simulation	2	4

	1. Write a program to compute the following for a given a network: 1. number of edges, 2. number of nodes; 3. degree of the node; 4. node with the lowest degree; 5. the adjacency list; 6. matrix of the graph. 7. Length of the shortest path 8. edge list 2. Perform the following tasks: 1. View data collection forms and/or import one-mode/two-mode datasets; 2. Basic Networks matrices transformations 3. Compute the following node level measures: 1. Density; 2. Degree; 3. Reciprocity; 4. Transitivity; 5. Centralization; 6. Clustering. 7. equivalence 4. Create sociograms for the persons-by-persons network and the committee-by-committee network for a given relevant problem. Create a one-mode network and two-node network for the same. 5. Bipartite Graph 6. Hamming distance, Manhattan, Euclidean 7. Perform SVD analysis of a network. 8. Case studies		

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCS302	RPSCS302: Internet of Things	4	4

Course Objective:

- Work on cloud-based Embedded Systems
- Explore various aspects of IOT
- Explore and understand different technologies associated with IOT

Expected Learning Outcome:

- Implement various IOT based project in Business and Healthcare
- Exploit the IOT Technologies for the benefit of humans and to solve problems today.

UNITS	COURSE CONTENTS	NO. OF LECTURES
I	Introduction to internet of things: Introduction, Physical Design of IOT, IOT Enabling Technologies, IOT Levels and deployment templates, Domain-Specific IOT: Home IOT, IOT in Cities, IOT in Environment, IOT used for Energy, IOT in Health and lifestyle	15 L
II	IOT and M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software-defined Networking, Function visualization, IOT Management with NETCONF-YANG: Need for IOT System management, Simple Network Management Protocol, Network Operator requirement, NETCONF, YANG, IOT System management with NETCONF, YANG	15 L

III	IOT Physical Server and Cloud offerings: Introduction to cloud storage model and Communication API, WAMP- AutoBahn for IOT, Google Cloud for IOT, Python web application framework Django, Designing restful web API, Amazon Webservices for IOT, Skynet IOT Messaging platform.	15 L
IV	Case Studies: Introduction, Home Automation, Cities, Environments, Agriculture, Productive applications, health care, automobiles.	15 L

Text book:

1. Google IOT cloud
2. Internet of Things: A hands-on Approach by Arshdeep Bahga and Vijay Madisetti

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCSP302	RPSCSP302: PRACTICAL OF Internet of Things	2	4
1	Creating Pub/Sub Topic		
2	Creating registries and devices		

3	Creating cloud Storage bucket		
4	Creating a cloud dataflow pipeline		
5	streaming IOT data to cloud storage		
6	Streaming IOT data to Big Query		
7	Streaming IOT data to Cloud Prep		
8	Innovative challenge lab.		

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCS303	RPSCS303: Big Data Technologies	4	4

Course Objective:

- Understanding various Big Data Technologies
- Working with R and Hadoop

Expected Learning Outcome:

Students completing this course will be able to:

- Develop applications in Hadoop and R for Big Data

UNITS	COURSE CONTENTS	NO. OF LECTURES
I	Installing R, Installing RStudio, Understanding the features of the R language, Installing Hadoop, Understanding Hadoop features, Learning the HDFS and MapReduce architecture, Understanding Hadoop subprojects, Writing Hadoop MapReduce Programs, Understanding the basics of MapReduce, Introducing Hadoop MapReduce, Understanding the Hadoop MapReduce fundamentals, Writing a Hadoop MapReduce example, Learning the different ways to write Hadoop MapReduce in R.	15 L
II	Integrating R and Hadoop: Introducing RHIPE, Understanding the architecture of RHIPE, Understanding RHIPE samples, Introducing RHadoop. Using Hadoop Streaming with R: Understanding the basics of Hadoop streaming, understanding how to run Hadoop streaming with R	15 L
III	Learning Data Analytics with R and Hadoop: Understanding the data analytics project life cycle, Understanding data analytics problems, Exploring web pages categorization, Computing the frequency of stock market change, Predicting the sale price of the blue book for bulldozers – case study	15 L

IV	Importing and Exporting Data from Various DBs: Learning about data files as the database, Understanding MySQL, Understanding Excel, Understanding MongoDB, Understanding SQLite, Understanding PostgreSQL, Understanding Hive, Understanding HBase.	15 L

Text book:

1. Big Data Analytics with R and Hadoop -Set up an integrated infrastructure of R and Hadoop to turn your data analytics into Big Data analytics Vignesh Prajapati

2. Hadoop: The Definitive Guide by Tom White 5th Edith O'Reilly.

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCSP303	PRACTICAL OF RPCSP303 Bigdata Technologies	2	4
1	Implement Mapreduce for a case study		
2	Demonstrate an application which uses RHIPE.		
3	Demonstrate a streaming application using RHadoop		

4	Demonstrate an application in R to implement predictive methods in data analytics.		
5	Demonstrate usage of HIVE in Hadoop		
6.	Demonstrate the usage of HBase		
7.	Extract data from various sources and load it in Hadoop		
8.	Demonstrate the data visualization using R		

Semester IV- Detailed Syllabus

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCS401	RPSCS401 Simulation & Modeling	4	4

Learning Objective:

- **Developing and understanding various simulation models**
- **Understand the application of simulation models to perform projections**

Learning Outcome:

- **Develop skills for encoding a given problem and understanding which statistical technique will help stimulate the same.**

UNITS	COURSE CONTENTS	NO. OF LECTURES

I	**Introduction to Simulation:** **System and System environment, Components of system, Type of systems, Type of models, Steps in the simulation study, Advantages and Disadvantages of simulation.** **Simulation Examples: Simulation of Queueing systems, Other examples of simulation. Concepts of discrete event simulation, List processing,** **History of simulation software, Desirable software features, General-purpose simulation packages, Object-oriented simulation, Trends in simulation software** **Simulation Modeling :** **The need for Simulation, Time to simulate, Inside simulation software: Modeling the progress of Time, Modeling Variability**	**15 L**
II	**Statistical Models in Simulation: Useful statistical model, Discrete** **distribution, Continuous distribution, Poisson process, Empirical distribution.** **Queueing Models: Characteristics of Queueing systems, Queueing notations, Long run measures of performance of Queueing systems, Steady-state behaviour of infinite population Markovian models, Steady-state behaviour finite population model, Network of Queues.** **Random Number Generation: Properties of random numbers, Generation of pseudo-random numbers, Techniques for generating random numbers, Tests for random numbers. Inverse transform technique, Convolution method, Acceptance rejection techniques**	**15 L**

III	**Conceptual Modeling:** **Introduction to Conceptual modelling, Defining conceptual model, Requirements of the conceptual model, Communicating the conceptual model, Developing the Conceptual, A framework for conceptual modelling, methods of model simplification. Types of models, Analytical vs Simulation modelling, Application of simulation modelling, Agent-Based Modelling, Designing state-based behaviour**	**15 L**
IV	**Model Verification and Validation** **Data Collection and Analysis: Introduction, Data requirements, Obtaining data, Representing unpredictable variability, Selecting statistical distributions. Obtaining Accurate Results: Introduction, The nature of simulation models and simulation output, Issues in obtaining accurate simulation results, example model, dealing with initialization bias: warm-up and initial conditions, Selecting the number of replications and run-length. Searching the Solution Space: Introduction, The nature of simulation experimentation, Analysis of results from a single scenario, Comparing alternatives, Search experimentation, and Sensitive analysis. Verification, Validation and Confidence: Introduction, Defining Verification and Validation, The difficulties of verification and validation, Methods of verification and validation, Independent verification and validation.**	**15 L**

References:

1. **Jerry Banks, John Carson, Barry Nelson, David Nicol, *Discrete Event System***

2. *Simulation*.Introduction to Social Network Methods: Robert A. Hanneman, Mark Riddle, University of California, 2005 [Published in digital form and available athttp://faculty.ucr.edu/~hanneman/nettext/index.html].

3. Simulation: The Practice of Model Development and Use by Stewart Robinson, John Wiley and Sons, Ltd, 2004.

4. The Big Book of Simulation Modeling: Multimethod Modeling by AndreiBorshchev, 2013

COURSE CODE	COURSE NAME	CREDITS	LECTURE/WEEK
RPSCSP401	RPSCSP401 PRACTICAL OF Simulation & modeling	2	4
1	Design and develop an agent-based model		
2.	Design and develop the System Dynamic model		
3.	Design and develop a discrete-event model that will simulate the process.		
4.	Design and develop time-slice simulation for a scenario like an airport model to design how passengers move within a small airport that hosts two airlines, each with their own gate. Passengers arrive at the airport, check-in, pass the security checkpoint and then go to the waiting area. After boarding starts, each airline's representatives		

	check their passengers' tickets before they allow them to board.		
5.	**1. Verify and validate a model developed like a bank model or manufacturing model & Create a defense model to simulate aircraft behaviour.**		
6.	**Statistical models**		
7.	**queuing models**		
8.	**random number generation**		
9.	**Case studies**		

MSc Part I (Sem I & II) EVALUATION SCHEME

Owing to the pandemic situation prevailing in 2020 and continuing in 2021, the external examinations (Semester End) may be conducted online as per the instructions/circulars received from the University of Mumbai and Maharashtra State notifications from time to time. The conventional mode of external examination will commence again only after the declaration of normalcy by the Government authorities.

External Examination- 60%- 60 Marks
Semester End Theory Examination: (Deviation from the usual modality)

THEORY

Internal Exam - 40 Marks

1. **20 Marks -- MCQ Test:**
   Test will be taken based on any of the unit/units as informed by the faculty in-charge.
2. **20 Marks –**

   Develop Mini project in group(max four) and presentation of the same. / Online Course.

Note: Students have to acquire at least 40% marks in each paper individually.

External Examination - 60 Marks Duration 2½ Hrs

- **Pandemic changes**
  - MCQ

Theory Question Paper Pattern:-

All Questions are Compulsory		
Questions	**Based On**	**Marks**
Q1	Unit I	12
Q2	Unit II	12

Q3	Unit III	12
Q4	Unit IV	12
Q5	MIX	12

- All questions are compulsory with internal choice within the questions.
- **Each Question will have 3 sub-questions carrying 6 marks each, out of which student has to answer any 2.**

Note: Students have to acquire at least 40% marks in each paper individually.

PRACTICAL

Internal Exam - 20 Marks

1. **Innovative Practical -- 10 Marks**
    1. It can be clubbed with mini project as an additional application.
    2. Give a separate application based on the theory paper.

Regularity -- 10 Marks

1. Timely submission of practical's on the Google classroom.
2. Attendance should be 75%.
3. Submission of e-journal on time.

Note: Students have to acquire at least 40% marks in each paper individually.

External Examination - 30 Marks Practical Question -

- 1 or 2 questions can be asked in the practical exam for each paper.
- External will be called for evaluating the same.

Note:

1. **Students who have submitted their e-Journal and certified are only allowed to appear for the exam.**
2. **Students have to acquire at least 40% marks in each paper individually.**

- **Pandemic changes**
    - MCQ, Viva, Written submission.

MSc Part II (Sem III & IV) EVALUATION SCHEME

THEORY

Internal Exam - 40 Marks

1. **20 Marks -- MCQ Test:**

Test will be taken based on any of the unit/units as informed by the faculty in-charge.

1. **20 Marks -**

Assignments based on syllabus or any other topic in demand based on syllabus.

Note: Students have to acquire at least 40% marks in each paper individually.

External Examination- 60%- 60 Marks

Semester End Theory Examination: (Deviation from the usual modality)

External Examination - 60 Marks Duration 2½ Hrs

- **Pandemic changes**
  - MCQ

Theory Question Paper Pattern:-

All Questions are Compulsory		
Questions	**Based On**	**Marks**
Q1	Unit I	12
Q2	Unit II	12
Q3	Unit III	12
Q4	Unit IV	12
Q5	MIX	12

-

- **Each Question will have 3 sub-questions carrying 6 marks each, out of which student has to answer any 2.**

Note: Students have to acquire at least 40% marks in each paper individually.

PRACTICAL

Internal Exam - 20 Marks

1. Innovative Practical -- 10 Marks

1. It can be clubbed with assignment.
2. Research paper review to be done for an application.

2. Regularity -- 10 Marks

1. Timely submission of practical's on the Google classroom.
2. Attendance should be 75%.
3. Submission of e-journal on time.

Note: Students have to acquire at least 40% marks in each paper individually.

External Examination - 30 Marks Practical Question -

- 1 or 2 questions can be asked in the practical exam for each paper.
- External will be called for evaluating the same.

- **Pandemic changes**
    - MCQ, Viva, Written submission.

Note:

1. **Students who have submitted their e-Journal and certified are only allowed to appear for the exam.**
2. **Students have to acquire at least 40% marks in each paper individually.**

PROJECT EVALUATION - 150 Marks

Internal evaluation - 60 Marks

- Abstract submission & literature Survey / sample data collection - 10 Marks
- Technology Implementation - 10 marks
- Mid-Term Presentation - 20 Marks
- Project Documentation- 20 marks

External evaluation - 90 Marks

- Project Quality - 20 Marks.

- Project Implementation - 40 Marks.
- Presentation - 30 Marks.

A Student should submit project implementation report with following details:

1. **Title:** Title of the project.
2. **Implementation details:** A description of how the project has been implemented. It shall be of 2 to 4 pages.
3. **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.
4. **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.
5. **Conclusion:** A conclusion of the project performed in terms of its outcome (May be half a page).
6. **Future enhancement:** A small description on what enhancement can be done when more time and resources are available (May be half a page).
7. **Program code:** The program code may be given as appendix.

Note:

1. **Students have to acquire at least 40% marks in project evaluation.**
2. **Internal evaluation will be done by the Project guide allotted.**
3. **Timely submission on google classroom as per requirement is must, regularity will be determined based on that.**
4. **Attendance should be 75%.**

INTERNSHIP EVALUATION - 450 Marks

Internal evaluation - 180 Marks

Following are the guidelines for evaluation:

1. Job description : 20 Marks
2. Technical knowledge/skills : 40 Marks
3. Innovation & creativity : 40 Marks
4. Adherence to Schedule (weekly activity report) : 20 Marks
5. Soft Skills (Communication, Team work, Resource Management, Leadership qualities) : 40 Marks
6. Discipline & behavior : 20 Marks

External evaluation - 270 Marks (50% by employer & 50% by external examiner)

On the basis of the detailed internship report submitted by the student duly signed by the employer and the internal faculty. A presentation is expected from the student for sharing his / her learning experience and work done at the internship.

Following are the guidelines for evaluation:

1. Internship Report : 30 Marks
2. Innovation and creativity : 50 Marks
3. Experience based learning : 50 Marks
4. Viva : 20 Marks
5. Internship Genuineness : 20 Marks
6. Soft Skills : 30 Marks
7. Suitability & Clarity of material presented : 30 Marks
8. Quality of oral presentation : 40 Marks

Note: - Students need to find Internship by themselves. It's their responsibility.

Following things are expected to be completed by the student for the final evaluation.

1) The syllabus proposes an internship for about 600 hours to be done by a student.
2) It is expected that a student chooses an IT or IT-related industry and formally works as a full time intern during the period.
3) Evaluation will be done based on the feedback given by the employers about the student.
4) 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.

Following are the guidelines laid for the same

1) Internship joining Letter with proper job description.
2) Weekly Report in Excel format to be shown every week to Internal In-charge
    - Start date
    - End date
    - Task Assigned
    - Task completed
    - Outcome / Learning's
3) Internship completion Letter with proper hours & task completed.
4) Employer Feedback Form is prepared to assess based on the following:
    - Skills/ Knowledge
    - Self-Management
    - Dependability
    - Attitude
    - Relationships
5) Internship report :
    - Organization Overview
    - Description (Role, Activities, Technology Used, Live project link or screenshots)

- SWOT Analysis
- Introspection (knowledge acquired, Skills learned, challenging task performed)
- Employers Feedback.

6) Proper certification by the person, to whom the student was reporting, with Organization's seal should be attached as part of the documentation.

Note: - Students need to find Internship by themselves. It's their responsibility

PASSING CRITERIA 40%: - Students must acquire a minimum of 40% marks in each course individually (Theory, Practical, Project & Internship).