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

(AFFILIATED TO MUMBAI UNIVERSITY)

University of Mumbai

SYLLABUS FOR: MSc I
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 honest attempt to include following ideas, among other things, into practice:

- Bring a new approach to syllabus, not a revision of the existing syllabus.
- Create a unique identity for MSc in Comp Science distinct from similar degrees in other related subjects.
- Offers focus on core Computer Science subjects.
- Incorporate advanced and most recent trends.
- Identify and nurture research temper among students.
- Offer provision for internship with industry.
- Focus, as far as possible, only on open source software.

This syllabus for the semester I and semester II has tried to initiate steps to meet these goals. By extending the syllabus to semester III and semester IV, it is assumed that these goals will be met to a larger extent.

In order to give an impetus to research among students, one of the courses in semester I gives an overview on how to do research in Computer Science. Provision for case study in the practical course in the semester II is an attempt to translate that theory into practice. It is assumed that, with this back ground, a student can take up a challenging research project in the semester III.

In a nutshell, the core philosophy of the syllabus is to (i) give strong foundation on core Computer Science subjects;(ii) expose the student to emerging trends in a gradual and incremental way; (iii) create a research temper among students in the whole process; (v) prepare student community for the demands of ICT industry.

We hope that the student and teaching community will appreciate the thrust, direction and treatment given to the courses in the syllabus. We sincerely believe that a student

who takes up this course will be better fit for industry as he or she will have strong foundation on fundamentals and exposure to advanced and emerging trends. We earnestly believe that by focusing on student driven research, learning will be more interesting and stimulating.

We thank all the industry experts, senior faculties and our colleagues department of Computer Science of college as well as University of Mumbai; who have given their valuable comments and suggestions, which we tried to incorporate. We thank the Chairperson and members of the Adhoc Board of Studies in Computer Science of R J College for their faith in us. 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 -I and semester -II of MSc Computer Science program of R J College to be implemented from the year 2019-2020. The syllabus offers four theory courses and two practical courses each in each semester.

Semester I

The syllabus proposes four subjects in semester -I. Each subject has theory and practical components.

Semester -I: Theory courses

The four theory courses offered in semester I are:

(i) Analysis of Algorithms and Researching Computing

(ii) Distributed Computing & Parallel Computing

(iii) Bio-Informatics and

(iv) Data Warehousing & Data Mining.

Each of these courses is of four credits each and is expected to complete in 60 hours. The following table gives the details of the theory courses in Semester -I.

Semester - I: Theory courses

Course Code	Course Title	No of hours	Credits
RJSPCS101	Analysis of Algorithms and Researching Computing	60	04
RJSPCS102	Distributed Computing & Parallel Computing	60	04
RJSPCS103	Bio-Informatics	60	04
RJSPCS104	Data Warehousing & Data Mining	60	04
Total Credits for Theory courses in Semester –I			16

Semester -I: Practical Lab courses

The syllabus proposes two laboratory courses of 4 credits each. The laboratory experiments from first two theory courses (RJPSCSS101 and RJPSCSS102) are combined together and are proposed as the first practical course (RJPSCSS1P01).

Similarly, the laboratory experiments from the last two theory courses (RJPSCSS103 and RJSPCS104) are combined together and called as the second practical course (RJSPCS1P02). As far as the practical are concerned, equal weightage similar to that of theory courses has been given in terms of the number of hours. The following table summarizes the details of the practical courses in the semester I.

Semester I - Practical Laboratory courses

Course code	Course Title	No of hours	Credits
RJSPCS1P01	Analysis of Algorithms and Researching Computing and Distributed Computing & Parallel Computing	60+60= 120	04
RJSPCS1P02	Bio-Informatics and Data Warehousing & Data Mining	60+60= 120	04
Total Credits for Practical Laboratory courses in Semester-I			08

Semester -II

The syllabus proposes four subjects in semester -II also. As in the case of semester -I, each subject has theory and practical components.

Semester II- Theory courses

The four theory courses offered in semester II are

(i) Simulation and Modeling

(ii) Business Intelligence and Big Data Analytics

(iii) Design and implementation of Modern Compilers

(iv) Advanced Embedded System

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

Semester II - Theory courses

Course code	Course Title	No of hours	Credits
RJSPCS201	Design and implementation of Modern Compilers	60	04
RJSPCS202	Advanced Embedded System	60	04
RJSPCS203	Simulation and Modeling	60	04
RJSPCS204	Business Intelligence and Big Data Analytics	60	04
Total Credits	for Theory courses in Semester II		16

Semester -II: Practical Laboratory courses

The syllabus proposes two laboratory courses of 4 credits each. The laboratory experiments from the first two theory courses (RJPSCSS201 and RJPSCSS202) are combined together and are proposed as the first practical course (RJPSCSS2P01). Similarly, the laboratory experiments from next two courses (RJPSCSS203 and RJPSCSS204) are combined together and taken as the second practical course (RJPSCSS2P02). The following table summarizes the details of the practical courses in the semester -II.

Semester II - Practical Laboratory courses

Course code	Course Title	No of hours	Credits
RJSPCS2P01	Design and implementation of Modern Compilers And Advanced Embedded System	60+60= 120	04
RJSPCS2P02	Simulation and Modeling And Business Intelligence and Big Data Analytics	60+60= 120	04
Total Credits	for Practical Laboratory courses in Semester -II		08

Case study: The syllabus proposes a case study under the lab course on (RJSPCS2P02). A student is expected to select a topic related to any of theory subject and make a case study report. It is expected that the student refers at least five research papers in the process of making the case study. By introducing the case study in the second semester, the syllabus prepares a student to take up a research project in the semester III.

Detailed syllabus of semester - I

Course Code	Course Title	Credits
RJSPCS101	Analysis of Algorithms and Researching Computing	04

Unit I

Introduction

The Role of Algorithms in Computing,Analyzing algorithms,Loop Invariance

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.

Probabilistic Analysis and Randomized Algorithms:

The hiring problem, Indicator random variables,Randomized algorithms

Unit II

Heapsort : Heaps,Maintaining the heap propert**,** Building a heap **,**The heapsort algorithm

Sorting in Linear Time: Lower bounds for sortin,Counting sort**,**Radix sort **,**Bucket sort

Medians and Order Statistics: Minimum and maximum**,**Selection in expected linear time

Selection in worst-case linear time.

All-Pairs Shortest Paths: Shortest paths and matrix multiplication**,**The Floyd-Warshall algorithm**,**Johnson's algorithm for sparse graphs.

Unit III

Multithreaded Algorithms: The basics of dynamic multithreading**,**Multithreaded matrix multiplication**,**Multithreaded merge sort.

Linear Programming: Standard and slack forms **,**Formulating problems as linear programs**,** The simplex algorithm**,** Duality **,**The initial basic feasible solution

Number-Theoretic Algorithms: Elementary number-theoretic notions **,**Greatest common divisor **,**Modular arithmetic **,**Solving modular linear equations **,**The Chinese remainder theorem **,**Powers of an element **,**The RSA public-key cryptosystem.

Approximation Algorithms: The vertex-cover problem **,**The traveling-salesman problem,

The set-covering problem,Randomization and linear programming,The subset-sum problem.

Unit IV:

Introduction, purpose and products of research, overview of research process, internet research, participants and research ethics, reviewing literature, design and creation, experiments, Quantitative data analysis, presentation of research.

Text book:

- Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI Learning Pvt. Ltd-New Delhi (2009).
- Researching Information Systems and Computing, Brinoy J Oates, Sage Publications India Pvt Ltd (2006).

References:

- Algorithms, Sanjoy Dasgupta , Christos H. Papadimitriou, Umesh Vazirani, McGraw-Hill Higher Education (2006)
- Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, Aditya Bhargava, http://www.manning.com/bhargava
- Research Methodology, Methods and Techniques, Kothari, C.R.,1985, third edition, New Age International (2014) .
- Basic of Qualitative Research (3rd Edition), Juliet Corbin & Anselm Strauss:, Sage Publications (2008).

Course Code	Course Title	Credits
RJSPCS102	Distributed Computing & Parallel Computing	04

Unit I:

Introduction: Parallel Processing Architectures: Parallelism in sequential machines, Abstract model of parallel computer, Multiprocessor architecture, Pipelining, Array processors.
Programmability Issues: An overview, Operating system support, Types of operating systems, Parallel programming models, Software tools
Data Dependency Analysis: Types of dependencies loop and array dependences, Loop dependence analysis.

Unit II:

Algorithms for Parallel Machines: Speedup, Complexity and cost, Histogram computation, Parallel reduction, Quadrature problem, Parallel sorting algorithms
Message Passing Programming: Introduction, Model, Interface, Circuit satisfiability, Introducing collective, Benchmarking parallel performance
Memory and I/O Subsystems: Hierarchical memory structure, Virtual memory system, Memory allocation and management, Cache allocation and management, Cache memories and management.

Unit III:

Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Examples of distributed systems.
Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication.
Processes: Threads, Clients, Servers, Code Migration, Software agent.
Naming: Naming entities, Locating mobile entities, Removing un-referenced entities.

Unit IV:

Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions.
Security: Introduction, Secure channels, Access control, Security management.
Distributed File System: Sun network file system, CODA files system.

Text book:

1. A. Taunenbaum, “Distributes System: Principles and Paradigms”
2. G. Coulouris, J. Dollimore, and T. Kindberg. “Distributed Systems: Concepts and Design” , Pearson Education.

Reference book:

1. M. Singhal, N. Shivaratri, “Advanced Concepts in Operating Systems”, TMH.
2. Shasikumar M., “Introduction to Parallel Processing”, PHI

Course Code	Course Title	Credits
RJSPCS103	BioInformatics	04

Unit I:

Introduction
The biological sequence structure deficit- Genome Projects-pattern recognition and prediction –the role of chaperones-sequence Analysis-Homology and analogy.

Unit II:
Information Networks
Review of computer communication networks-the European molecular biology network-EMBnetNational Center for Biotechnology Information-NCBI- virtual tourism.

Unit III:
Protein Information resources
Biological Data Bases-Primary sequence Databases-Composite Protein sequence databasesSecondary databases- Composite Protein pattern databases-structure classification databases-web addresses .

Unit IV:
Genome Information resources
DNA Sequence Analysis, Pair-wise alignment Techniques, Multiple sequence alignment, Secondary database searching, Building a sequence search Protocol, Analysis packages .

Text book:

1. “Introduction to Bio – Informatics”, by T.K. Attwood and D.J. Perry –smith, Longman, Essen, 1999

References:
1. “Bio Informatics Computing”, by Bryan Bergeron, Second Edition, Pearson Education, 2003.

Course Code	Course Title	Credits
RJSPCS104	Data Warehousing and Data Mining	04

Unit I: Introduction to Business Intelligence

Operational and Decision Support System, Data-Information-Knowledge-Decision making-Action cycle. Basic definitions- Business Intelligence; Data warehousing, Business Intelligence architecture, Use and benefits of Business Intelligence. Knowledge Discovery in Databases: KDD process model, Data Pre-processing: Cleaning: Missing Values; Noisy Values; Inconsistent values; redundant values. Outliers, Integration, transformation, reduction, Discretization: Equal Width Binning; Equal Depth Binning, Normalization, Smoothing.

Unit II: Introduction to Business Data Warehouse

Definition of Data warehouse, Logical architecture of Data Warehouse, Data Warehouse model- Enterprise warehouse; Data Marts; Virtual warehouse. Populating business Data Warehousing: data integration and extract, transform, load (ETL).

Unit III: Designing Business Data Warehouse

OLTP and OLAP systems, Designing business information warehouse: Principles of dimensional modeling, Data cubes, Data cube operations, data cube schemas.

Unit IV: Introduction to Data Mining

Data mining definitions and process: business and data understanding, Data mining techniques.

Data Mining Algorithms: Classification, Clustering, Association rules.

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.

Clustering

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

Association Analysis: Definition of association rule, General issues: Support; Confidence; Lift; Conviction, Frequent Item sets: APriori Algorithm; Issues with APriori Algorithm, Data structures: Hash tree and FP tree.

Text book:

- Business Intelligence (2nd Edition), Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Pearson (2013)
- Business Intelligence for Dummies, Swain Scheps, Wiley Publications (2008).
- Building the Data Warehouse, Inmon: Wiley (1993).
- Data Mining: Introductory and Advanced Topics, Dunham, Margaret H, Prentice

Hall (2006)

- Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Witten, Ian and Eibe Frank, Morgan Kaufmann (2011)

Reference:

- Business Intelligence Road Map, Larissa T. Moss, Shaku Atr, Addison-Wesley
- Data Modeling Techniques for Data Warehousing by IBM; International Technical Support Organization, Chuck Ballard, Dirk Herreman, Don Schau, Rhonda Bell, Eunsaeng Kim, Ann Valencic :http://www.redbooks.ibm.com
- Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems, Han J. and Kamber M. Morgan Kaufmann Publishers, (2000).
- Data Mining with Microsoft SQL Server 2008, MacLennan Jamie, Tang ZhaoHui and Crivat Bogdan, Wiley India Edition (2009).

List of practical Experiments for Semester – I

Course Code	Course Title	Credits
RJSPCS1P01	Practical Course on Analysis of Algorithms & Researching Computing & Distributed Computing & Parallel Computing	04

Sr No	List of Practical Experiments on Analysis of Algorithms and Researching Computing
1	Write a Program for Randomized Selection Algorithm
2	Write a Program for Heap sort Algorithm.
3	Write a Program to perform Redix sort Algorithm.
4	Write a Program to perform Bucket Sort Algorithm.
5	Write a Program to perform Folyd-Warshall Algorithm.
6	Write a Program for Counting Sort Algorithm.
7	Write a Program for set Covering Problem.
8	Write a Program for found a subset with given sum.
9	Write a Program for Travelling Sales man problem.
10	Write a Program for Hash Table.

Sr No.	List of Practical Experiments on Distributed Computing & Parallel Computing
1	Write a program for implementing Client Server communication model.
2	Write a program for implementation of Remote Procedure Call.
3	Write a program to execute any one mutual exclusion algorithm.
4	Write a program to implement any one election algorithm.
5	Write a program for implementation of any one clock synchronization algorithm.
6	Write a program for Remote Objects for Database Access.
7	Write a program for Parallel Sorting Algorithm.
8	Write a program on Histogram Computation.
9	Write a program on parallel Reduction.
10	Write a program on parallel Sorting Algorithm.
9	

Course Code	Course Title	Credits
RJSPCS102	Practical Course on BioInformatics and Data Warehousing & Data Mining	04

Sr. No	List of Practical Experiments on BioInformatics
1	Genome structure analysis by genome browser .
2	Sequence similarity searching by BLAST.
3	Phylogenetics Analysis.
4	Gene Expression Profiling by Microarray.
5	Gene Expression Profiling by SAGE..
6	Regulation of Gene Expression.
7	Proteome and Protein Sequence Analysis.
8	DNA Analysis Tools.

List of Practical Experiments on Data Warehousing & Data Mining

1	**Creation of database in Microsoft Management Studio.**
2	**Import database in Business Intelligent Project.**
3	**Star Schema table, snowflake Schema table.**
4	**Cube using cube wizard.**
5	**Dimension tables**.
6	**Firing queries on the cube.**
7	**Excel Pivot Chart.**
8	**Data pre-processing.**
9	**Data discretization.**
10	**Classification problems.**
11	**Clustering Analysis.**
12	**Association Rule Mining.**
13	**Data visualization.**

Detailed syllabus of semester – II

Course Code	Course Title	Credits
RJSPCS201	Design and implementation of Modern Compilers	04

Unit I: Introduction to Compilers

The structure of a compiler, A simple approach to the design of lexical analyzers, Regular expressions, Finite automata, From regular expressions to finite automata, Minimizing the number of states of a DFA, Context-free grammars, Derivations and Parse trees. Simple precedence Grammar, Parsing using SPM.

Unit II: Automatic Construction of Efficient Parsers

Parsers, Shift-reduce parsing, Top- down parsing, Predictive parsers.
LR parsers, Constructing SLR parsing tables, Constructing LALR parsing tables.

Unit III: Advanced syntax analysis and basic semantic analysis

Syntax-directed translation schemes, Implementation of syntax-directed translators, translation to intermediate code, intermediate code and its type.

Unit IV: Dataflow analysis and loop optimization

The principle sources of optimization, Loop optimization: The DAG representation of basic blocks, Dominators, Reducible flow graphs, Loop-invariant computations, Induction variable elimination, Some other loop optimizations. Dataflow Analysis: intermediate representation for flow analysis, various dataflow analyses, transformations using dataflow analysis, speeding up dataflow analysis.

Text book:

- Compilers: Principles, Techniques and Tools 2nd edition, Alfred V. Aho , Monica S. Lam , Ravi Sethi , Jeffrey D. Ullman , Pearson (2011)
- Modern Compiler Implementation in Java, Second Edition, Andrew Appel and Jens Palsberg, Cambridge University Press (2004).

References:

- Principles of Compiler Design, Alfred Aho and Jeffrey D. Ullman, Addison Wesley (1997).
- Compiler design in C, Allen Holub, Prentice Hall (1990)

Course Code	Course Title	Credits
RJSPCS202	Advanced Embedded System	04

Unit I:

Embedded Electronic Systems & Microcontrollers : What (and Where) Are Embedded Systems?, Approaches to Embedded Systems, Small Microcontrollers, Anatomy of a Typical Small Microcontroller, Memory, Software, Where Does the MSP430 Fit?

Instruments MSP430 : The Outside View—Pin-Out, The Inside View—Functional Block Diagram, Memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets, Where to Find Further Information.

Development: Development Environment, The C Programming Language, Assembly Language, Access to the Microcontroller for Programming and Debugging, Demonstration Boards, Hardware, Equipment.

Unit II:

Overview of MSP 430 : First Program on a Conventional Desktop Computer, Light LEDs in C, Light LEDs in Assembly Language, Read Input from a Switch, Automatic Control: Flashing Light by Software Delay, Automatic Control: Use of Subroutines, Automatic Control: Flashing Light by Polling Timer_A, Header Files and Issues Brushed under the Carpet.

Architecture of MSP430 processor: Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Examples, Reflections on the CPU and Instruction Set, Resets, Clock System.

Functions, Interrupts & low power modes: Functions and Subroutines, What Happens when a Subroutine Is Called?, Storage for Local Variables, Passing Parameters to a Subroutine and Returning a Result, Mixing C and Assembly Language, Interrupts, What Happens when an Interrupt Is Requested?, Interrupt Service Routines, Issues Associated with Interrupts, Low-Power Modes of Operation.

Unit III:

Digital Input, Output, Displays : Digital Input and Output: Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Interface between 3V and 5V Systems, Driving Heavier Loads, Liquid Crystal Displays, Driving an LCD from an MSP430x4xx, Simple Applications of the LCD.

Timers : Watchdog Timer, Basic Timer1, Timer_A, Measurement in the Capture Mode, Output in the Continuous Mode, Output in the Up Mode: Edge-Aligned Pulse-Width Modulation, Output in the Up/Down Mode: Centered Pulse-Width Modulation, Operation of Timer_A in the Sampling Mode, Timer_B, What Timer Where?, Setting the Real-Time Clock: State Machines.

Unit IV:

Analog Input/output : Comparator_A, Analog-to-Digital Conversion: General Issues, Analog-to-Digital Conversion: Successive Approximation, The ADC10 Successive-Approximation ADC, Basic Operation of the ADC10, More Advanced Operation of the ADC10, The ADC12 Successive-Approximation ADC, Analog-to-Digital Conversion: Sigma–Delta, The SD16_A Sigma–Delta ADC, Operation of SD16_A, Signal Conditioning and Operational Amplifiers, Digital-to-Analog Conversion.

Communication : Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, AThermometer Using SPI in Mode 3 with the F2013 as Master, AThermometer Using SPI in Mode 0 with the FG4618 as Master, Inter-integrated Circuit Bus, A Simple I²C Master with the USCI_B0 on a FG4618, A Simple I²C Slave with the USI on a F2013, State Machines for I²C Communication, AThermometer Using I²C with the F2013 as Master, Asynchronous Serial Communication, Asynchronous Communication with the USCI_A, A Software UART Using Timer_A, Other Types of Communication.

Text book: MSP430 Microcontroller Basics by John Davies

References:

Course Code	Course Title	Credits
RJSPCS203	**Simulation Modeling**	**04**

Unit I: Introduction

Introduction to Simulation, Need of Simulation, Time to simulate, Inside simulation software: Modeling the progress of Time, Modeling Variability, Conceptual Modeling: Introduction to Conceptual modeling, Defining conceptual model, Requirements of the conceptual model, Communicating the conceptual model, Developing the Conceptual Model: Introduction, A framework for conceptual modeling, methods of model simplification.

Unit II: 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.

Unit III: Modeling and simulation modeling

Types of models, Analytical vs Simulation modeling, Application of simulation modeling, Level of abstraction, Simulation Modeling. Methods, System Dynamics, Discrete Event Modeling, Agent Based modeling: Introduction to Agent, Agent-based modeling**,** Time in agent based models, Space in agent based models, Discrete space, Continuous space movement in continuous space, Communication between agents, Dynamic creation and destruction of agents, Statics on agent population, Condition triggered events and transition in agents. Building agents based models: The problem statement, Phases of modeling, Assumptions, 3 D animation. Dynamics Systems: Stock and flow diagrams, examples of stock and flow diagrams. Multi-method modeling: Architecture, Technical aspects of combining modeling methods, Examples.

Unit IV: Design and behavior of models

Designing state-based behavior: Statecharts, State transitions, Viewing and debugging Statecharts at runtime, Statecharts for dynamic objects. Discrete events and Event model object: Discrete event, Event-the simplest low level model object, Dynamic events, and Exchanging data with external world. Presentation and animation: Working with shapes, groups and colors, Designing interactive models: using controls, Dynamic properties of controls, 3D Animation. Randomness in Models: Probability distributions, sources of randomness in the model, randomness in system dynamics model, random number generators, Model time, date and calendar: Virtual and real time: The model time, date and calendar, Virtual and real-time execution modes.

Text book:

- Simulation: The Practice of Model Development and Use by Stewart Robinson, John Wiley and Sons, Ltd, 2004.
- The Big Book of Simulation Modeling: Multi Method Modeling by Andrei Borshchev, 2013.

Reference:

- Agent Based Modeling and Simulation, Taylor S, 2014.
- Simulation Modeling Handbook: A Practical Approach, Christopher A. Chung, 2003.
- Object Oriented Simulation: A Modeling and Programming Perspective, Garrido, José M, 2009.

- Simulation, Modeling and Analysis, Averill M Law and W. David Kelton, "Tata McGraw Hill, Third Edition, 2003.
- Process Control: Modeling, Design and Simulation, Wayne Bequette W, Prentice Hall of India, 2003.

Course Code	Course Title	Credits
RJSPCS204	Business Intelligence and Big Data Analytics	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
Hadoop Mapreduce Fundamentals, HDFS Architecture, Mapreduce Algorithm.

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.

Unit III: 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 IV: 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).

Link Analysis And Recommendation Systems

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

Text book:

(i) Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.

(ii) Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for

Today's Businesses, Michael Minelli, Wiley, 2013

(iii) Data Mining: Introductory and Advanced Topics, Margaret H. Dunham, Pearson, 2013.

Reference:

(i) Big Data for Dummies, J. Hurwitz, et al., Wiley, 2013

(ii) 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.

(iii) 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.

(iv) Big Data Glossary, Pete Warden, O'Reilly, 2011.

(v) 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 -II

Course Code	Course Title	Credits
RJSPCS2P01	Practical Course on Paper I and Paper II	04

	Design and implementation of Modern Compilers
1	Write a program to construct NDFA.
2	Write a program to convert the given Right Linear Grammar to Left Linear Grammar form.
3	Write a program to illustrate the generation of First, First+, Last and Last+ matrix on SPM for the input grammar.
4	Write a java code to parse a string by using SPM.
5	Write a java code for postfix evaluation.
6	Write a java code to generate 3-address code.
7	Write a code to generate the DAG for the input arithmetic expression.
8	Write a program to demonstrate loop unrolling and loop jamming for the given code sequence containing loop.

	Advanced Embedded System
1.	To Blink an LED with GPIO
2.	LED Control Using a Switch
3.	Low Power Modes and Current Measurement
4.	Interrupt Programming Through GPIO
5.	Pulse Width Modulation
6.	Interfacing Potentiometer with MSP430
7.	PWM Based Speed Control of Motor by Potentiometer
8.	Using ULP Advisor on MSP430
9.	Serial Communication
10.	Master Slave Communication Using SPI
11.	Wi-Fi Application
12.	Energy Trace and Energy Trace++ Modes
13.	Computation of Energy and Estimation of Battery Lifetime

Course Code	**Course Title**	**Credits**
RJSPCS2P02	**Practical Course on Paper I and Paper II**	**04**

Sr No	**List of Practical Experiments on Simulation Modeling**
1	Design and develop agent based model by • Creating the agent population • Defining the agent behavior • Add a chart to visualize the model output. [Use a case scenario like grocery store, telephone call center etc for the purpose].
2	Design and develop agent based model by • Creating the agent population • Defining the agent behavior • Adding a chart to visualize the model output • Adding word of mouth effect • Considering product discards • Considering delivery time [Use a case scenario like restaurant].

3	Design and develop agent based model by • Creating the agent population • Defining the agent behavior • Adding a chart to visualize the model output • Adding word of mouth effect • Considering product discards • Consider delivery time • Simulating agent impatience • Comparing model runs with different parameter values [Use a scenario like market model]
4	Design and develop System Dynamic model by • Creating a stock and flow diagram • Adding a plot to visualize dynamics • Parameter Variation • Calibration [Use a case scenario like spread of contagious disease for the purpose]
5	Design and develop a discrete-event model that will simulate process by: • Creating a simple model • Adding resources • Creating 3D animation • Modeling delivery [Use a case situation like a company's manufacturing and shipping].
6	Design and develop time-slice simulation for a scenario like 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.
7	Verify and validate a model developed like bank model or manufacturing model
8	Create defense model to stimulate aircraft behavior
9	Stimulate the travelling sales man problem to compute the shortest path.
10	Stimulate the Urban dynamics to address the scenarios like: (a) The problem of public transport line (b) To compute the time taken for train to enter the station

List of Practical Experiments on

Business Intelligence and Big data Analytics

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 tree classification techniques. Interpret the result.
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.	

Scheme of Examination for Theory Courses

There will be an 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 R J College 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 particulars of the external examination for each practical course are given below:

Sr No	Semester	Course Code	Particular	No of questions	Marks/ question	Total Marks
1	I	RJSPCS1P01	Laboratory experiment question with internal choice	2	40	80
2			Journal	-	10	10
3			Viva		10	10
		Total Marks		100		
1	I		Laboratory experiment question with internal choice	2	40	80

2		**RJSPCS1P02**	Journal	-	10	10
3			Viva		10	10
		Total Marks		100		
Sr No	**Semester**	**Course Code**	**Particular**	**No of questions**	**Marks/ question**	**Total Marks**
1	II	RJSPCS2P01	Laboratory experiment question with internal choice	2	40	80
2			Journal		10	10
3			Viva		10	10
		Total Marks		100		
1	II	RJSPCS2P02	Laboratory experiment question with internal choice	2	40	80
2			Journal		10	10
3			Viva		10	10
		Total Marks		100		

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