

**Hindi Vidya Prachar Samiti's, Ramniranjan Jhunjhunwala College of Arts, Science &
Commerce
(Empowered Autonomous College)
M.Sc. Computer-Science Syllabus Semester I & II**



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

**Affiliated to
UNIVERSITY OF MUMBAI**

**Syllabus for the M.Sc.
Program: M.Sc. COMPUTER-SCIENCE
Program Code: RJSPCS
National Education Policy (NEP 2020)
Level 6.0**

(CBCS 2025-2026)

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THE PREAMBLE

Why Computer Science?

Education is the key to the development of any society. Role of higher education is crucial for securing the right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes.

Why Computer Science at R J College?

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

Our Curriculum, Your Strength

This syllabus is an honest attempt to include following ideas, among other things, into practice:

- Bring a new approach to the syllabus, not a revision of the existing syllabus.
- Create a unique identity for MSC in Computer 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 at semester IV.
- Focus, as far as possible, only on open source software.

This syllabus for the semester I and semester II have initiated 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 the semester - I give an overview on how to do research in Computer Science. 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 a better fit for industry as he or she will have a 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.

PROGRAM OUTCOMES OF GENERAL POSTGRADUATE DEGREE PROGRAMS

Students of all Postgraduate degree program at the time of graduation will be benefited and will be able to:

Critical Thinking

Comprehend the matter they come across and be capable to take a sound viewpoint about things which will highlight their intellectual acumen as well as enable them to look at the world through multiple lenses.

Effective communication

Listen, speak, read and write. They should communicate properly by conveying their thoughts. They will use technology for communication. Will be able to network with people with all available channels. They will be developing communication skills in English, Hindi and a local language would be an added advantage.

Social Interaction

Respect each other and should be able to resolve conflicts and help in reaching amicable solutions. They should be able to work in diverse teams. They should be able to distinguish When and what is socially acceptable.

Responsible citizen

Contribute to Nation development through social service. Being empathetic and Sympathetic to fellow beings.

Honesty and Integrity, Ethics

Recognize different values and systems and respect them. In decision making moral values should be given prime importance.

Environmental and Sustainability

Environmental issues would be considered and problem solving with sustainable development would be chosen.

LifeLong learning

Enjoy learning in every situation.

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Program Specific Outcome M.Sc. Program with Computer Science

M.Sc. Computer Science course allows the candidates to learn technology-oriented knowledge and ability to develop creative solutions. An ability to critically analyze a problem and to design, implement, and evaluate a computing solution that meets requirements. An ability to work effectively in small groups on medium scale computing projects. The program provides the students with knowledge, general competence, and analytical skills on an advanced level, needed in academics, industry.

PSO1:	Ability to be technology-oriented with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society. Enrich the knowledge in the areas like Artificial Intelligence, M/C and Deep Learning, Paradigm of Programming language, Design and Analysis of Algorithms, computing subjects, Research methodologies.
PSO2:	Students understand all dimensions of the concepts of software application and projects. Students understand the computer subjects with demonstration of all programming and theoretical concepts. Developed in-house applications in terms of projects. Interact with IT experts & knowledge by IT visits. Get industrial exposure through the “On Job Training” in the IT industry. To make them employable according to current demand of IT Industry and responsible citizen.

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Credit Structure for M.Sc. Semester-I as per NEP 2020

To be implemented from the academic year 2024-2025.

Papers	Number of Papers	Credits	Total Credits
Major Subject theory	3	3 * 2 = 6 2 * 1 = 2	8
Major Subject Practical	3	2 * 3 = 6	6
Elective1 Trends in cloud computing Practical	1 + 1 (P)	4 2 + 2	4
Elective 2 Cryptography & Cryptanalysis Practical	1+1 (P)	4 2 + 2	4
Research Methodology	1	4	4
Total Credits		22	22

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Credit Structure for M.Sc. Semester-II as per NEP 2020
To be implemented from the academic year 2024-2025.

Papers	Number of Papers	Credits	Total Credits
Major Subject theory	3	3 * 2 = 6 2 * 1 = 2	8
Major Subject Practical	3	2 * 3	6
Elective1 Web 3.0 Technology Practical	1 + 1 (P)	4 2 + 2	4
Elective 2 Cyber Security & Risk assessment Practical	1+1 (P)	4 2 + 2	4
OJT	1	4	4
Total Credits		22	22

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DISTRIBUTION OF TOPICS AND CREDITS

M.Sc. COMPUTER-SCIENCE SEMESTER I

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS101	Paper Title : Machine Learning			
	I	The Fundamentals of Machine Learning	3	1
	II	Supervised and Unsupervised Learning		1
	III	Fundamentals of Deep Learning		1

Course Code	Topic Headings	Credits
RJSPCSP101	Supervised, Unsupervised Models, Training Models	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS102	Paper Title : Statistical Tools for data science			
	I	Introduction to Data Science	3	1
	II	Probability, Probability Distributions		1
	III	Hypothesis Testing		1

Course Code	Topic Headings	Credits
RJSPCSP102	Probability, Probability – Distributions, Histogram	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS103	Paper Title : Algorithms for optimization			
	I	Introduction to Optimization Process & Order Methods	2	1
	II	Sampling Plans, Uncertainty , Discrete & Expression Optimization		

Course Code	Topic Headings	Credits
RJSPCSP103	Order Methods, Sampling and Surrogate Models, Optimization and Uncertainty	2

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Elective Course 1

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS104A	Paper Title : Trends in Cloud Computing			
	I	Basic Concepts & Techniques and API for Cloud Application Development	2	1
	II	Cloud Service Delivery Environment & DevOps and Containers in Cloud & Azure		1

Course Code	Topic Headings	Credits
RJSPCSP104A	Basic Cloud Application Development, Cloud Service Delivery Environment and API, DevOps and Containers in Cloud, Azure & GCP Essentials.	2

Elective Course 2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS104B	Paper Title : Cryptography and Cryptanalysis			
	I	Classic Cryptography Techniques	2	1
	II	Advanced Encryption, Integrity, & Authentication		1

Course Code	Topic Headings	Credits
RJSPCSP104B	Classic Cryptography Techniques, Advanced Encryption, Public-Key Cryptography, Key Management	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS105	Paper Title : Research Methodology			
	I	Introduction to Research	4	1
	II	Formulation of research problem		1
	III	Research Paper Writing		1
	IV	Presentation of selected project proposal		1

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Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS201	Paper Title : Advanced Deep Learning			
	I	Neural Network for Deep Learning	3	1
	II	Convolutional and Recurrent Networks for Deep Learning		1
	III	Advanced Concepts for Deep Learning		1

Course Code	Topic Headings	Credits
RJSPCSP201	Training Models in Deep Learning(ANN,CNN,RNN)	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS202	Paper Title : Embedded and IoT Technology			
	I	Embedded System Basics & Introduction to IOT	3	1
	II	IoT Building Blocks, Sensors, IoT Gateway & IOT Protocol Stack		1
	III	IoT Cloud and Fog Computing, IoT Security & Social IOT		1

Course Code	Topic Headings	Credits
RJSPCSP202	Embedded Electronic Systems, Overview of MSP 430, Digital Input, Output, Displays, Analog Input/output & Communications.	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS203	Paper Title : Web Mining			
	I	Introduction to WebMining, Opinion Mining and Web Usage Mining	2	1
	II	Social Network & Link Analysis, Webpage crawlers and usage mining		1

Course Code	Topic Headings	Credits
RJSPCSP203	Web Scrapping, Opinion Mining and Web Usage Mining, Social Network & Link Analysis, Webpage crawlers and usage mining.	2

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Elective Course 1

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS204A	Paper Title : Web 3.0 Technology			
	I	Introduction to Web3 Technologies, Smart Contracts & Ethereum	2	1
	II	Ethereum, Hyperledger & Tokenization, Solidity Programming		1

Course Code	Topic Headings	Credits
RJSPCSP204A	Smart Contracts & Ethereum, Solidity Programming	2

Elective Course 2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS204B	Paper Title : Cyber Security & Risk assessment			
	I	Introduction to Penetration Testing and Reconnaissance	2	1
	II	Vulnerabilities and Advanced Attacks		1

Course Code	Topic Headings	Credits
RJSPCSP204B	Penetration Testing and Reconnaissance, Vulnerabilities and Advanced Attacks, Web and Cloud Exploitations, Exploiting System Vulnerabilities.	2

Course Code	Unit	Topic Headings	Credits	L/Week
RJSPCS205	Paper Title : On Job Training		4	

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SEMESTER I (THEORY)		L	Cr
Paper-I: Machine Learning	Paper Code: RJSPCS101	30	3
UNIT I		10	
THE FUNDAMENTALS OF MACHINE LEARNING			
1	The Fundamentals of Machine Learning Introduction: What is Machine Learning? Why use Machine Learning? Types of Machine Learning, Supervised Learning, Unsupervised Learning & Reinforcement Learning. Challenges of Machine Learning, Testing and Validation A First Application: Classification, MNIST Dataset, Performance Measures, Confusion Matrix, Precision and Recall, Precision/Recall Tradeoff, The ROC Curve, Multiclass Classification, Error Analysis.		
UNIT II		10	
SUPERVISED AND UNSUPERVISED LEARNING			
1	Linear Models: Regression, Linear SVM Classification, Soft Margin Classification, Nonlinear SVM Classification, Polynomial Kernel, Gaussian RBF Kernel, SVM Regression. Tree Based Models: Decision Trees, Training and Visualizing a Decision Tree, Making Predictions, The CART Training Algorithm, Gini Impurity vs Entropy, Regularization Hyperparameters.		
2	Distance Based Models: Nearest Neighbors Classification; Partitional Algorithm : K-means , K-Medoid ; Hierarchical Algorithm : Agglomerative (AGNES) ; Divisive ; Probabilistic Models		
UNIT III		10	
FUNDAMENTALS OF DEEP LEARNING			

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1	Fundamentals of Deep Learning What is Deep Learning? Need Deep Learning? Introduction to Artificial Neural Network (ANN), Core components of neural networks, Multi-Layer Perceptron (MLP), Activation functions, Sigmoid, Rectified Linear Unit (ReLU), Introduction to Tensors and Operations, Tensorflow framework.		
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Suggested References:

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems by AurélienGéron, Second Edition, O'reilly 2019
2. Deep Learning with Python by François Chollet Published by Manning 2018
3. Reinforcement Learning: An Introduction by Richard S. Sutton and Andrew G. Barto, Second Edition 2014
4. Introduction to Machine with Python - A Guide for Data Scientists by Andreas C. Müller & Sarah Guido O'reilly 2016
5. Artificial Neural Networks with TensorFlow 2 ANN Architecture Machine Learning Projects Poornachandra Sarang by Apress 2021.

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SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Machine Learning
COURSE CODE	:	RJSPCS101
CREDITS	:	03
DURATION	:	30 LECTURES

LEARNING OBJECTIVES	
1	Understand core concepts of ML through implementations in python.
2	Working with diverse toolkits and packages useful for developing projects in ML.
3	Implement and understand deep learning and ANNs useful for industry.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand a wide variety of learning algorithms.	1	BT Level III, IV Apply draw conclusions
CO2	Understand how to evaluate models generated from data.	1, 2	BT level III, IV and V
CO3	Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	1,2	BT level III, IV and V
CO4	Developing projects in machine learning for industrial applications.	1, 2	BT level III, IV and V
CO5	Understanding and implementing algorithms and techniques of Machine Learning useful in the field of Data Science, Image Processing, NLP, etc.	1, 2	BT level III, IV and V

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Practical-I: Machine Learning		Paper Code: RJSPCSP101 Credits: 02
1	Implement Linear Regression (Diabetes Dataset)	
2	Implement Logistic Regression (Iris Dataset)	
3	Implements Multinomial Logistic Regression (Iris Dataset)	
4	Implement SVM classifier (Iris Dataset)	
5	Train and fine-tune a Decision Tree for the Moons Dataset	
6	Train an SVM regressor on the California Housing Dataset.	
7	Implement Batch Gradient Descent with early stopping for Softmax Regression	
8	Implement MLP for classification of handwritten digits (MNIST Dataset)	
9	Classification of images of clothing using Tensorflow (Fashion MNIST dataset)	
10	Implement Regression to predict fuel efficiency using Tensorflow (Auto MPG dataset)	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Machine Learning
COURSE CODE	:	RJSPCSP101
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	Understand the features of machine learning to apply on real world problems.
2	Characterize the machine learning algorithms as supervised learning and unsupervised learning and Apply and analyze the various algorithms of supervised and unsupervised learning.
3	Analyze the concept of neural networks for learning.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the mathematical and statistical perspectives of machine learning algorithms through python programming.	1	BT Level III, IV Apply draw conclusions
CO2	Design and evaluate the supervised and unsupervised models through python in built functions.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming.	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Understand the basic concepts of deep neural network model and design the same.	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER I (THEORY)		L	Cr
Paper-II: Statistical Tools for Data Science	Paper Code: RJSPCS102	30	3
UNIT I		10	
INTRODUCTION TO DATA SCIENCE			
1	The Field of Data Science – The Various Data Science Disciplines, Difference between Analysis and Analytics, Business Analytics, Data Analytics, Life Cycle Of Data Science, Popular Data Science Techniques.		
2	The Basic Probability Formula, Computing Expected Values, Frequency, Events and Their Complements. Probability – Combinatorics Permutations, Simple Operations with Factorials, Solving Variations with Repetition, Solving Variations without Repetition.		
UNIT II		10	
PROBABILITY			
1	Combinations, Symmetry of Combinations, Solving Combinations with Separate Sample Spaces. Probability - Bayesian Inference Sets and Events, The Conditional Probability, The Law of Total Probability		
2	Discrete Distributions: The Uniform Distribution, The Bernoulli Distribution, The Binomial Distribution, The Poisson Distribution, Continuous Distributions: The Normal Distribution, The Students' T Distribution		
UNIT III		10	
STATISTICS			

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1	Statistics: Population and Sample, Types of Data, Levels of Measurement, Categorical Variables, Numerical Variables -Frequency Distribution Table Mean, median and mode, Skewness, Variance, Standard Deviation and Coefficient of Variation Covariance		
2	Correlation Coefficient, The Standard Normal Distribution, Central Limit Theorem, Standard error, Estimators and Estimates Confidence Intervals Hypothesis Testing Null vs Alternative Hypothesis, Rejection Region and Significance Level, Type I Error and Type II Error Test for the Mean p-value.		

Suggested References:

1. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Science", O'Reilly, 2017.
2. James D. Miller, "Statistics for Data Science", Packt, 2017.
3. Dr. J. Ravichandran, "Probability and Statistics for Engineers", 2010.
4. Hadley Wickham, Garrett Golemund, "R for data Science: Import, Tidy, Transform, Visualize and Model Data".
5. Prabhanjan Tatter, Tony Ojeda, Sean Patrik Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", 2ndEdition, Packt, 2014

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SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Statistical tools for Data Science
COURSE CODE	:	RJSPCS102
CREDITS	:	03
DURATION	:	30 LECTURES

LEARNING OBJECTIVES	
1	The Students will get in-depth knowledge of data science related Mathematical and statistical computing concepts.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Apply important algorithmic design paradigms and methods of analysis.	1	BT Level III, IV Apply draw conclusions
CO2	To introduce mathematical statistical computing with practical Approach.	1, 2	BT level III, IV and V

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Practical-2: Statistical methods for data science		Paper Code: RJSPCSP102 Credits : 02
1	Exploratory data analysis.	
2	Exploring Binary and categorical data	
3	Data and sampling distributions.	
4	Solving Combinations with Separate Sample Spaces	
5	Bayesian Inference	
6	Probability Distributions	
7	Descriptive Statistics	
8	Inferential Statistics	
9.	Test for the mean of Independent Samples and dependent Samples	
10	Hypothesis Testing	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Statistical methods for data science
COURSE CODE	:	RJSPCSP102
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	Design, develop & deploy real-world applications in the field of data science.
2	Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques
3	Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
4	Apply principles of Data Science to the analysis of business problems.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Develop in depth understanding of the key technologies in data science and statistics.	1	BT Level III, IV Apply draw conclusions
CO2	Practice problem analysis and decision-making.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Gain practical, hands-on experience with statistics, python programming languages and data tools.	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER I (THEORY)		L	Cr
Paper-III: Algorithm for Optimization		Paper Code: RJSPCS103	
		20	2
UNIT I		10	
Introduction to Optimization Process & Order Methods			
1	Introduction : Basic Optimization Problem , Constraints , Critical Points , Conditions for Local Minima , Contour Plots . Bracketing : Unimodality , Fibonacci Search , Golden Section Search First-Order Methods: Gradient Descent , Conjugate Gradient , Adagrad , RMSProp , Adadelta , Adam Second-Order Methods : Newton's Method		
UNIT II		10	
Sampling Plans, Uncertainty , Discrete & Expression Optimization			
1	Sampling Plans : Full Factorial , Random Sampling , Uniform Projection Plans , Stratified Sampling , Space-Filling Metrics. Optimization under Uncertainty : Uncertainty , Set-Based Uncertainty , Probabilistic Uncertainty. Uncertainty Propagation : Sampling Methods Discrete Optimization : Dynamic Programming Expression Optimization : Grammars, Grammatical Evolution		

Suggested References:

1. Decision Making Under Uncertainty: Theory and Application by Mykel J. Kochenderfer MIT Lincoln Laboratory Series 2015.
2. Introduction to Algorithms, By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein 3Ed. (International Edition) (MIT Press) 2009.
3. Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI Learning Pvt. Ltd-New Delhi (2009).
4. Researching Information Systems and Computing, Brinoy J Oates, Sage Publications India Pvt Ltd (2006).
5. Algorithms, Sanjoy Dasgupta , Christos H. Papadimitriou, Umesh Vazirani, McGraw-Hill Higher Education (2006)

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6. Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, AdityaBhargava, <http://www.manning.com/bhargava>
7. Research Methodology, Methods and Techniques, Kothari, C.R.,1985, third edition, New Age International (2014) .
8. Basic of Qualitative Research (3rd Edition), Juliet Corbin & Anselm Strauss:, Sage Publications (2008).

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SEMESTER	:	I MAJOR (CORE) SUBJECT
TITLE OF THE SUBJECT/COURSE	:	Algorithm for Optimization
COURSE CODE	:	RJSPCS103
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	Optimization with a focus on practical algorithms for the design of engineering systems.
2	Exposure to multivariable calculus, linear algebra, and probability concepts.
3	Learn a wide variety of optimization topics, introducing the underlying mathematical problem formulations and the algorithms for solving them.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Students will be able to effectively implement optimization techniques to the existing algorithm to improve its performance.	1	BT Level III, IV Apply draw conclusions
CO2	Students will be able to work in the areas of Machine Learning and Data Sciences Algorithms.	1, 2	BT level III, IV and V

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	Practical-03 Algorithm for Optimization	Paper Code: RJSPCSP103
1	Implement Contour Plots I.	
2	Implement Contour Plots II.	
3	Implement Fibonacci and Golden section search.	
4	Implement Quadratic Fit Search.	
5	Implement Gradient descent.	
6	Implement quasi-Newton methods to find the local maxima.	
7	Implement the Adagrad method with application.	
8	Implement the RMSprop and Adadelata optimizer.	
9	Implement radial basis functions using surrogate modelling.	
10	Apply Random Forest in surrogate Model.	
11	Implement Gaussian Process and its application.	
12	Path finding using Ant Colony Optimization with an application.	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Algorithm for Optimization
COURSE CODE	:	RJSPCSP103
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To understand Julia tool to explore different algorithms.
2	To explore search algorithms.
3	To implement order methods
4	To implement surrogate & modeling methods
5	To implement optimization & uncertainty methods

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Explore different plots.	1	BT Level III, IV Apply draw conclusions
CO2	Test different searching algorithms.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Understand results of order methods	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Understand results of surrogate & modeling methods	1,2	BT level III, IV and V Apply, analyze and evaluate
CO5	Understand results of optimization & uncertainty methods	1, 2	BT level III, IV and V Apply, analyze, and evaluate

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SEMESTER I (THEORY)		L	C r
Paper-IV: Trends in Cloud Computing		Paper Code: RJSPCS104A	
		20	2
UNIT I		10	
Basic Concepts & Techniques and API for Cloud Application Development			
1	Fundamentals of Cloud Application Development: Business case for implementing cloud application, Requirements collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud interoperability and standards, scalability and fault tolerance, security, trust, and privacy		
2	Application Development framework: Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC). Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, CloudFoundry		
3	Sessions and API: Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API.		
UNIT II		10	
Cloud Service Delivery Environment & DevOps and Containers in Cloud & Azure			
1	Managing the data in the Cloud: Securing data in the cloud, ACL, OAuth, OpenID, XACML, securing data for transport in the cloud, scalability of applications and cloud services.		
2	Basics of DevOps: Introduction to DevOps, Continuous Deployment: Containerization with Docker, Orchestration (Kubernetes and Terraform), Automating Infrastructure on Cloud, Application Deployment and Orchestration using ECS, ECR & EKS, Application Deployment using Beanstalk, Configuration Management using OpsWorks		
3	Azure essentials: Azure Compute and Storage, Azure Database and Networking, Monitoring and Managing Azure Solutions, GCP Compute and Storage, GCP Networking and Security, Google App Engine (PaaS)		

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Suggested References:

1. JJ GEEWAX, Google Cloud Platform in Action, Manning Publications Co, 2018
2. Haishi Bai, Dan Stoltz, Santiago Fernández Muñoz, Exam Ref 70-535 Architecting Microsoft Azure Solutions, Pearson Education, 2018
3. Dr. Kumar Saurabh, Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms, Wiley, 2017

COURSE OUTCOMES (COs) M. Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Trends in Cloud Computing
COURSE CODE	:	RJSPCS104A
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	Design, develop & deploy real-world applications in the cloud computing platforms
2	Demonstrate the ability to access the various cloud platforms
3	Describe the standardization process of the cloud platform and various API's used in Cloud Computing
4	Describe the methods for managing the data in the cloud

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Learners will be able to develop and launch applications in the cloud environment	1	BT Level III, IV Apply draw conclusions
CO2	Explore various frameworks and APIs that are used for developing cloud-based applications	1, 2	BT level III, IV and V

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Practical-4 Trends in Cloud Computing		Paper Code: RJSPCSP104A
		Credits: 02
1	Using the software like / API / Tools JDK 1.7/1.8, Eclipse IDE, Dropbox API, Apache tomcat server 7.0/8.0, GoogleAppEngine API, Servlets, Struts, Spring framework design and develop Web applications using MVC Framework	
2	Installing and configuring the required platform for Google App Engine.	
3	Studying the features of the GAE PaaS model.	
4	Creating and running Web applications (Guest book, MVC) on localhost and deploying the same in Google App Engine	
5	Developing an ASP.NET based web application on the Azure platform	
6	Creating an application in Dropbox to store data securely. Develop a source code using Dropbox API for updating and retrieving files.	
7	Installing Cloud Foundry in localhost and exploring CF commands.	
8	Cloud application development using IBM Bluemix Cloud.	
9	Installing and Configuring Dockers in localhost and running multiple images on a Docker Platform.	
10	Configuring and deploying VMs/Dockers using Chef/Puppet Automation tool	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Trends in Cloud Computing
COURSE CODE	:	RJSPCSP104A
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	Identify the technical foundations of cloud systems architectures.
2	Analyze the problems and solutions to cloud application problems.
3	Apply principles of best practice in cloud application design and management.
4	Identify and define technical challenges for cloud applications and assess their importance.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing.	1	BT Level III, IV Apply draw conclusions
CO2	Analyze the performance of Cloud Computing.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Understand the concept of Cloud Security.	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Learn the Concept of Cloud Infrastructure Model.	1,2	BT level III, IV and V Apply, analyze and evaluate
CO5	Able to develop MVC and Web API .	1, 2	BT level III, IV and V Apply, analyze, and evaluate

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SEMESTER I (THEORY)		L	Cr
Paper - IV :Cryptography and Cryptanalysis	Paper Code: RJSPCS104B	20	2
UNIT I			
Classic Cryptography Techniques			
1	Cryptosystems and Basic Cryptographic Tools: Introduction, Secret-key Cryptosystems, Public-key Cryptosystems, Block and Stream Ciphers, Hybrid Cryptography, Message Integrity, Message Authentication Codes, Signature Schemes, Nonrepudiation, Certificates, Hash Functions, Cryptographic Protocols, Security		
2	Classical Cryptography: Introduction to Some Simple Cryptosystems, Shift Cipher, Substitution Cipher, Affine Cipher, Vigenere Cipher, Hill Cipher, Permutation Cipher, Stream Ciphers, Cryptanalysis, Cryptanalysis of the Affine Cipher, Cryptanalysis of the Substitution Cipher, Cryptanalysis of the Vigenere Cipher, Cryptanalysis of the Hill Cipher, Cryptanalysis of the LFSR Stream Cipher.		
UNIT II			
Advanced Encryption, Integrity, and Authentication			
1	RSA Cryptosystem and Factoring: Public-key Cryptography, Number Theory-Euclidean Algorithm, Chinese Remainder Theorem, Other Useful Facts, RSA Cryptosystem, Primality Testing, Square Roots Modulo n , Factoring Algorithms, Rabin Cryptosystem, Semantic Security of RSA		
2	Hash Functions and Message Authentication: Hash Functions and Data Integrity, Security of Hash Functions, Message Authentication Codes, Unconditionally Secure MACs Signature Schemes: Introduction to RSA Signature Scheme, Security Requirements, ElGamal Signature Scheme, Variants of the ElGamal Signature Scheme, Full Domain Hash, Certificates, Signing and Encrypting		

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Suggested References:

1. Cryptography Theory and Practice Douglas R. Stinson, , Fourth Edition, CRC Press, 2019
2. Applied Cryptanalysis, Breaking Ciphers in Real World, John Wiley, 2015
3. Implementing Cryptography, Shannon W. Bray, John Wiley, 2020
4. Algorithmic Cryptanalysis, Antoine Joux, CRC Press, 2017
5. Modern Cryptography: Applied Mathematics for Encryption and Information Security, William Easttom, Springer, 2021

COURSE OUTCOMES (COs) M. Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Cryptography and Cryptanalysis
COURSE CODE	:	RJSPCS104B
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	Insights related to cryptography and cryptanalysis.
2	Analyze and use methods for cryptography.
3	Implement some of the prominent techniques for public-key cryptosystems and digital signature schemes.
4	Understand the notions of public-key encryption and digital signatures and sketch their formal security definitions.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To develop the foundation for the study of cryptography and its use in security.	1	BT Level III, IV Apply draw conclusions
CO2	To understand the application of Number Theory and Algebra for the design of cryptographic algorithms	1, 2	BT level III, IV and V
CO3	To understand the role of cryptography in communication over an insecure channel.	1, 2	BT level III, IV and V

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Practical-4 Cryptography and Cryptanalysis		Paper Code: RJSPCSP104B Credits:02
1	Program to implement password salting and hashing to create secure passwords.	
2	Program to implement various classical ciphers-Substitution Cipher, Vigenère Cipher	
3	Program to implement various classical ciphers-Substitution Cipher, Affine cipher	
4	Program to demonstrate cryptanalysis (e.g., breaking Caesar or Vigenere Cipher)	
5	Program to implement AES algorithm for file encryption and decryption	
6	Program to implement various block cipher modes	
7	Program to implement Steganography for hiding messages inside the image file.	
8	Program to implement HMAC for signing messages.	
9	Program to implement Sending Secure Messages Over IP Networks	
10	Program to implement RSA encryption/decryption	
11	Program to implement (i) El-Gamal Cryptosystem	
12	Program to implement (i) Elliptic Curve Cryptography	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Cryptography and Cryptanalysis
COURSE CODE	:	RJSPCSP104B
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To implement different methods of security.
2	To implement different encryption & decryption techniques.
3	To implement steganography technique.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understanding & testing of security methods.	1	BT Level III, IV Apply draw conclusions
CO2	Implement & test different encryption & decryption techniques.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	To verify results of steganography technique.	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER I (THEORY)		L	Cr
Paper - V :Research Methodology	Paper Code: RJSPCS105	60	4
UNIT I		15	
Introduction to Research			
1	Introduction to Research: Meaning and Definition of Research, Purpose of Research, Scientific Method, Positivism and post-positivist approach to research, Types of Research, Beginning Stages of Research Process: Problem definition, Qualitative research, Quantitative Research, primary and Secondary data research. Business Research: Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues.		
UNIT II		15	
Research Methods and Formulation of research problem			
1	Research Methods and Data Collection: Survey research, communicating with respondents, Observation methods, Descriptive and experimental Research type, Inductive and deductive approach, Action research, research steps. Formulation of research problem: problem selection, literature review, formulation of hypothesis. Variables: dependent, independent and Intervening variables.		
UNIT III		15	
Data collection and sampling			

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1	Data collection and sampling: Probability sampling, Non probability sampling, Survey method, contact method, questioner. Selection of project domain: Publication ethics, Tools and evaluation. Selection of tentative project area and process of literature survey – Literature survey components and procedures Basic components of a research paper – procedures and processes, Journal types, Scopus, web of science, Science Citation Index, H-index, Google citations.		
	UNIT IV	15	
	Research Paper Writing & Presentation		
1	Research Paper Writing: Title selection, paragraph writing, report design, conclusion formation, diagrams and equations, citations, plagiarism, paper format, scopus indexed journals, predatory journals, digital object identifier/ISBN number and publication, research ethics. Presentation of selected project proposal: Oral presentation. Preparation of a report on the selected project proposal, Attending special invited lectures, practical orientation in searching and collecting literature through library, online tools, presenting a seminar on selected project.		

References:

1. William G. Zikmund, B J Babin, J.C. Carr, Atanu Adhikari, M. Griffin, “Business Research Methods”, Cengage, 8e, 2016.
2. Professionals, Second Edition, New York: IEEE Press, 2002.
3. Handbook of Qualitative Research, Norman K. Denzin, Yvonna S. Lincoln

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COURSE OUTCOMES (COs) M. Sc. COMPUTER SCIENCE

SEMESTER	:	I
TITLE OF THE SUBJECT/COURSE	:	Research Methodology
COURSE CODE	:	RJSPCS105
CREDITS	:	04
DURATION	:	60 LECTURES

LEARNING OBJECTIVES	
1	To understand the research methodologies such as survey and field research, questionnaire design, content analysis, analysis of existing data, focus group, individual and group observation (including participatory observation) etc.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To understand the research methodologies such as survey and field research, questionnaire design, content analysis, analysis of existing data, focus group, individual and group observation (including participatory observation) etc.	1	BT Level III, IV Apply draw conclusions
CO2	To be able to understand the latest theories of doing research.	1, 2	BT level III, IV and V
CO3	To understand and explore the research techniques used for solving any real world or innovative problem.	1, 2	BT level III, IV and V

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SEMESTER II (THEORY)		L	Cr
Paper-I: Advanced Deep Learning	Paper Code: RJSPCS201	30	3
UNIT I		10	
Neural Network for Deep Learning			
1	Optimization and Neural Network: Review of Neural Network fundamentals, the problem of Learning, Implementing single Neuron-Linear and Logistic Regression, Deep Learning: Fundamentals, Deep Learning Applications, Popular open-source libraries for deep learning		
2	Feed-Forward Networks: Networks architecture and Matrix notation, Overfitting, Multiclass Classification with Feed-Forward Neural Networks, Estimating Memory requirement of Models		
UNIT II		10	
Convolutional and Recurrent Networks for Deep Learning			
1	Regularization: Complex Network and Overfitting, Regularization and related concepts, Hyperparameter tuning Convolutional Neural Networks: Kernels and Filters, Building Blocks of CNN, Inception Network, Transfer Learning		
2	Recurrent Neural Network: Notation and Idea of recurrent neural networks, RNN Topologies, backpropagation through time, vanishing and exploding gradients		
UNIT III		10	
Advanced Concepts for Deep Learning			
1	Autoencoders: Introduction, Network Design, Regularization in Autoencoders, Denoising autoencoders, Feed-Forward Autoencoders, sparse and Contractive autoencoders Unsupervised Feature Learning: Hopfield networks and Boltzmann machines, restricted Boltzmann machine, Deep belief networks		
2	Generative Adversarial Networks (GANs): Introduction, training algorithms, Conditional GANs, applications, Deep convolutional generative adversarial networks Deep Learning for Language Modelling and Speech Recognition		

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Suggested References:

TEXTBOOKS:

1. Python Deep Learning, Valentino Zocca, Packt Publication, 2017
2. Applied Deep Learning, with TensorFlow 2, Umberto Michelucci, Apress, 2022
3. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress, 2017

REFERENCE BOOKS:

1. Advanced Deep Learning with Keras, Rowel Atienza, Packt Publication, 2018
2. Python Deep Learning Cookbook, Indra den Bakker, Packt Publication, 2017
3. Deep Learning with Keras, Antonio Gulli, Packt Publication, 2017

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Advanced Deep Learning
COURSE CODE	:	RJSPCS201
CREDITS	:	03
DURATION	:	30 LECTURES

LEARNING OBJECTIVES	
1	Understand the context and use of neural networks and deep learning. Understand the tools and libraries for deep learning.
2	Have a working knowledge of neural networks and deep learning.
3	Explore the parameters for neural networks.
4	Identify emerging applications of deep learning.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Knowledge of implementing neural network architectures for deep learning.	1	BT Level III, IV Apply draw conclusions
CO2	Skill to implement regularization and optimization of neural network	1, 2	BT level III, IV and V
CO3	Ability to implement advanced networks like CNN, RNN and GAN	1	BT Level III, IV Apply draw conclusions
CO4	Implement deep learning for advanced applications like object identification, speech, and language	1, 2	BT level III, IV and V

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Practical-I: Advanced Deep Learning		Paper Code: RJSPCSP201 Credits:02
1	Implement Feed-forward Neural Network and train the network with different optimizers and compare the results.	
2	Write a Program to implement regularization to prevent the model from overfitting	
3	Implement deep learning for recognizing classes for datasets like CIFAR-10 images for previously unseen images and assign them to one of the 10 classes.	
4	Implement deep learning for the Prediction of the autoencoder from the test data (e.g. MNIST data set)	
5	Implement Convolutional Neural Network for Digit Recognition on the MNIST Dataset	
6	Write a program to implement Transfer Learning on the suitable dataset (e.g. classify the cats versus dogs dataset from Kaggle).	
7	Write a program for the Implementation of a Generative Adversarial Network for generating synthetic shapes (like digits)	
8	Write a program to implement a simple form of a recurrent neural network. a. E.g. (4-to-1 RNN) to show that the quantity of rain on a certain day also depends on the values of the previous day b. LSTM for sentiment analysis on datasets like UMICH SI650 for similar.	
9	Write a program for object detection from the image/video.	
10	Write a program for object detection using pre-trained models to use object detection.	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Advanced Deep Learning
COURSE CODE	:	RJSPCSP201
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To introduce the idea of artificial neural networks and their architecture.
2	To introduce techniques used for training artificial neural networks.
3	To enable design of an artificial neural network for classification.
4	To enable design and deployment of deep learning models for machine learning problems.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the main fundamentals that drive Deep Learning.	1	BT Level III, IV Apply draw conclusions
CO2	Be able to build, train and apply fully connected deep neural networks.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Know how to implement efficient CNN or RNN.	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Understand the key features in a neural network's architecture. .	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER II (THEORY)		L	Cr
Paper-II: Embedded and IoT Technology		Paper Code: RJSPCS202	30 3
UNIT I		10	
Embedded System Basics & Introduction to IOT			
1	Introduction to Embedded Systems :What & where are Embedded systems? Approaches to ES, Anatomy of a Typical Small Microcontroller, Instruments MSP430 :The Outside View – Pin-out, The inside view – Functional Block Diagram.		
2	Basic Electronics: Semiconductors, Transistors, BJT, Resistors, Capacitors, CMOS, MOSFET, FPGA, Relays. Types of Communication: Microcontrollers, UART Communications, SPI-peripherals interface, I2C communication, Wireless Sensor Network (WSN) Introduction IoT: Evolution of the IoT concept, vision and definition of IoT, basic characteristics of IoT, distinguish the IoT from other related technologies, IoT enablers, IoT architectures, pros and cons of IoT, IoT architecture concepts for specific IoT applications.		
UNIT II		10	
IoT Building Blocks, Sensors, IoT Gateway & IOT Protocol Stack			
1	IoT Building Blocks -Hardware and Software: The basic IoT building blocks, smart thing components and capabilities, basics of IoT gateway, Cloud, and analytics Sensing Principles and Wireless Sensor Network: Sensor fundamentals and classification of sensors, physical principles of some common sensors, basics of WSNs, WSN architecture and types, layer-level functionality of WSN protocol stack.		

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2	IoT Gateway: IoT architecture domains, IoT gateway architecture, IoT gateway functionalities, IoT gateway selection criteria, IoT gateway and edge computing, edge computing-based solution for specific IoT applications IoT Protocol Stack: Mapping of IoT protocols to layered IoT architecture, functionality of infrastructure, service discovery, and application layer protocols of IoT protocol stack		
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UNIT III	10	
IoT Cloud and Fog Computing, IoT Security & Social IOT		

1	IoT Cloud and Fog Computing: Components of IoT Cloud architecture, usage of application domains of IoT Cloud platforms, layered architecture of Fog computing, distinguish Fog computing from other related terms IoT Applications: Main applications of IoT, Implementation details of various IoT application domains.		
2	IoT Security: Security constraints in IoT systems, security requirements of IoT systems, IoT attacks, security threats at each layer of IoT architecture, design secure IoT system for specific application Social IoT: Nature of social relationships among IoT Devices, functionality of different components of social IoT architecture, social aspects of smart devices in IoT applications.		

Suggested References:

1. MSP430 Microcontroller Basics by John Davies.
2. Introduction to Embedded Systems – Cyber physical systems Approach Edward Ashford Lee & Sanjit Arunkumar Seshia Second Edition — MIT Press — 2017
3. Enabling the Internet of Things Fundamentals, Design and Applications by Muhammad Azhar Iqbal, Sajjad Hussain, Huanlai Xing, Muhammad Ali Imran Wiley Pub. 1st Edition 2021
4. Introduction Embedded Systems by K.V. Shibu Second Edition McGraw Hills–2017
5. Build your own IoT Platform Develop a Fully Flexible and Scalable Internet of Things Platform in 24 Hours by Anand Tamboli 2019 Apress

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Embedded and IoT Technology
COURSE CODE	:	RJSPCS202
CREDITS	:	03
DURATION	:	30 LECTURES

LEARNING OBJECTIVES	
1	The course is designed to enable students to understand and implement IoT in industry.
2	Design and executive projects in IoT with Automatic Identification and Data Capture.
3	The course is designed to enable students to understand and implement IoT in industry.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand basic components and functionalities of Embedded System including its hardware.	1	BT Level III, IV Apply draw conclusions
CO2	Effectively achieve collaboration of various technologies in IoT and enable the same using software programming like Python, Embedded C etc.	1, 2	BT level III, IV and V
CO3	Understand case studies in IoT and replicate the same for more detailed analysis of the IoT development.	1	BT Level III, IV Apply draw conclusions

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Practical 2: Embedded and IoT Technology		Paper Code: RJSPCSP202 Credits: 02
Note: - The following set of practical's should be implemented in CodeVision AVR, Proteus8, Cisco Packet Tracer, Keli V5, Python Link: -Python: https://www.python.org/downloads/ Arduino UNO, Raspberry Pi CodeVisionAVR: https://www.codevision.be/ Proteus8 : https://www.labcenter.com/downloads/ Cisco Packet Tracer: https://www.netacad.com/courses/packet-tracer Keli V5: https://www.keil.com/download/		
1	Basic Embedded Practicals Using Arduino UNO : Push button, LED,Buzor	
2	Embedded Practicals Using Arduino UNO & Components - I : 7-segment, LCD,	
3	Embedded Practicals Using Arduino UNO & Components - I : Keypad, Servo Motor	
4	Embedded Practicals Using Arduino UNO & Sensors I : IR Proximity sensor, Ultrasonic sensor	
5	Embedded Practicals Using Arduino UNO & Sensors II : DHT Sensor	
6	IOT Practicals using Raspberry Pi - I :Using OS (LINUX commands)	
7	IOT Practicals using Raspberry Pi - II : Using Components (Stepper Motor)	
8	Practicals using Cisco Packet Tracer I	
9.	Practicals using Cisco Packet Tracer II	
10	Practicals using Cisco Packet Tracer III	
11	Practicals using simulator Proteus8 & Code vision AVR I	

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12	Practicals using simulator Proteus8 & Code vision AVR II
13	Practicals using simulator Proteus8 & Code vision AVR III

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Advanced Embedded System
COURSE CODE	:	RJSPCSP202
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To implement small scale Embedded & IOT systems.
2	To Understand communication between devices.
3	To understand automation in systems using sensors.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand small scale embedded & IOT systems.	1	BT Level III, IV Apply draw conclusions
CO2	Understanding of device communications.	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Understanding of different sensors , motions etc	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER II (THEORY)		L	Cr
Paper-III: Web Mining	Paper Code: RJSPCS203	20	2
UNIT I		10	
Introduction to Web Mining			
1	Web Mining, Data Mining, Difference, Mining Sequential Patterns on Prefix Span, Generating Rules from Sequential Patterns. Basic Concepts of Information Retrieval, Information Retrieval Models, Relevance feedback, Evaluation measures Text and Web Page Preprocessing, Inverted Index and Its Compression, Web Search, Web Spamming Opinion Mining and Web Usage Mining: Web Information Retrieval, Sentiment Classification, Feature based Opinion Mining and Summarization, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam. Web Usage Mining.		
UNIT II		10	
1	Link Analysis, Scrapy using python (without pipelining), Social Network Analysis, Co-Citation and Bibliographic Coupling, PageRank, HITS, Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics and Conflicts, Data modelling and webpage usage mining., Discovery and analysis of web usage patterns, Recommender systems and collaborative filtering, query log mining		

Suggested References:

1. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications) 2017 publication
2. Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications),2017
3. Web Mining: Applications and Techniques by Anthony Scime,2010
4. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti 2010

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Web Mining
COURSE CODE	:	RJSPCS203
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	To Understand the difference between Web Mining and Data mining.
2	To Understand the Basics and Needs of Web Mining.
3	To Understand Web-based Data.
4	To Understand Opinion Mining and Sentiment classification.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Develop deep understanding of mining techniques exclusively for the Internet.	1	BT Level III, IV Apply draw conclusions
CO2	Understand and develop analytics for social media data.	1, 2	BT level III, IV and V
CO3	Design and implementation of various web analytical tool to understand complex unstructured data on the Internet for aiding individuals and Businesses to grow their business.	1	BT Level III, IV Apply draw conclusions

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Practical- 3: Web Mining		Paper Code: RJSPCSP203
1	Scrape an online E-Commerce Site for Data. 1. Extract product data from Amazon - be it any product and put these details in the MySQL database. One can use pipeline. Like 1 pipeline to process the scraped data and other to put data in the database and since Amazon has some restrictions on scraping of data, ask them to work on small set of requests otherwise proxies and all would have to be used. 2. Scrape the details like color, dimensions, material etc. Or customer ratings by features.	
2	Scrape an online Social Media Site for Data. Use python to scrape information from twitter	
3	Page Rank for link analysis using python Create a small set of pages namely page1, page2, page3 and page4 apply random walk on the same	
4	Perform Spam Classifier.	
5	Demonstrate Text Mining and Webpage Pre-processing using meta information from the web pages (Local/Online).	
6	Apriori Algorithm implementation in case study.	
7	Develop a basic crawler for the web search for user defined keywords.	
8	Develop a focused crawler for local search.	
9	Develop a programme for deep search implementation to detect plagiarism in documents online.	
10	Sentiment analysis for reviews by customers and visualize the same.	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I MAJOR (CORE) SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Web Mining
COURSE CODE	:	RJSPCSP203
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To understand what is Web Mining, Web Scraping and Web Crawling
2	To understand and perform Link analysis and Web page preprocessing
3	To understand workin with deep search
4	To understand Sentimental analysis

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand how to scrape different online Websites	1	BT Level III, IV Apply draw conclusions
CO2	Perform Link analysis and Preprocessing of web pages	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Perform deep search and detect plagiarism in documents online	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Understand and perform Sentiment analysis	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER II (THEORY)		L	Cr
Paper-III: Web3 Technologies		Paper Code: RJSPCS204A	
		20	2
UNIT I		10	
Introduction to Web3 Technologies, Smart Contracts & Ethereum			
1	Web3: Introduction to web3, Web3 Evolution, Web3 Technologies. Blockchain: Growth of blockchain technology, Distributed systems, the history of blockchain and Bitcoin, Blockchain, Consensus, CAP theorem and blockchain, Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, The consensus problem, Analysis and design, Classification, Algorithms,		
2	Bitcoin: Overview, Cryptographic keys, Transactions, Blockchain Mining, Bitcoin network, Wallets, Bitcoin payments, Innovation in Bitcoin, Advanced protocols, Bitcoin investment, and buying and selling Bitcoin.		
3	Smart Contracts: History, Definition Ricardian contracts, Smart contract templates, Deploying smart contracts, The DAO Ethereum: Overview, Ethereum network, Components of the Ethereum ecosystem, The Ethereum Virtual Machine (EVM), Smart contracts, Blocks and Blockchain, Wallets and client software, Nodes and miners, APIs, tools, and DApps, Supporting protocols, Programming languages.		
UNIT II		10	
Ethereum, Hyperledger, Tokenization, Solidity Programming			
1	Ethereum Development Environment: Overview, Test networks, Components of a private network, starting up the private network, mining on the private network, Remix IDE, MetaMask, Using MetaMask and Remix IDE to deploy a smart contract		
2	Hyperledger: Projects under Hyperledger, Hyperledger reference architecture, Hyperledger Fabric, Hyperledger Sawtooth, Setting up a sawtooth development environment. Tokenization: Tokenization on a blockchain, Types of tokens, Process of tokenization, Token offerings, Token standards, Trading and finance, DeFi, Building an ERC-20 token, emerging concepts		

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3	Introduction to Solidity Programming: Layout of a Solidity Source File, Structure of a Contract, Types, Units, and Globally Available Variables, Input Parameters and Output Parameters, Control Structures, Function Calls, Creating Contracts via new, Order of Evaluation of Expressions, Assignment, Scoping and Declarations, Error handling: Assert, Require, Revert and Exceptions.		
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Suggested References:

1. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition 2020
2. Andreas M. Antonopoulos, Dr.Gavin wood “Mastering Ethereum” O’Reilly Media Inc, 2019
3. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and BlockChain”, Packt Publishing.

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Web3 Technologies
COURSE CODE	:	RJSPCS204A
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	Understand blockchain technology.
2	Develop blockchain-based solutions and write smart contracts using Hyperledger Fabric and Ethereum frameworks.
3	Build and deploy blockchain applications for on-premise and cloud-based architecture.

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	To cover the technical aspects of crypto currencies, blockchain technologies, and distributed consensus.	1	BT Level III, IV Apply draw conclusions
CO2	To familiarize potential applications for Bitcoin-like crypto currencies	1, 2	BT level III, IV and V
CO3	To Basics of smart contracts,decentralized apps, and decentralized anonymous organizations (DAOs)	1	BT Level III, IV Apply draw conclusions

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Practical 4 A: Web3 Technologies		Paper Code: RJSPCSP204A Credits: 02
1	Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run.	
2	Create and deploy a block chain network using Hyperledger Fabric SDK for Java.	
3	Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules.	
4	Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network.	
5	Use block chain to track fitness club rewards Build a web app that uses Hyperledger Fabric to track and trace member rewards.	
6	Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Block chain Starter Plan. Use Hyperledger Fabric to invoke chaincode while storing results and data in the starter plan.	
7	Develop an IoT asset tracking app using Block chain. Use an IoT asset tracking device to improve a supply chain by using Block chain, IoT devices, and Node-RED.	
8	Create a global finance block chain application with IBM Block chain Platform Extension for VS Code. Develop a Node.js smart contract and web app for a Global Finance with block chain use case.	
9	Develop a voting application using Hyperledger and Ethereum. Build a decentralized app that combines Ethereum's Web3 and Solidity smart contracts with Hyperledger's hosting Fabric and Chaincode EVM	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Web3 Technologies
COURSE CODE	:	RJSPCSP204A
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	Basic understanding of Blockchain Technology
2	Knowledge of Cryptocurrencies, especially Ethereum

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	design Smart Contracts	1	BT Level III, IV Apply draw conclusions
CO2	Understand of decentralized applications	1, 2	BT level III, IV and V Apply, analyze, and evaluate

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SEMESTER II (THEORY)		L	Cr
Paper-IV: Cyber Security and Risk Assessment	Paper Code: RJSPCS204B	20	2
UNIT I		10	
Introduction to Penetration Testing and Reconnaissance			
1	Goal-based penetration testing: Introduction to Penetration Testing, Different types of threat actors, Conceptual overview of security testing, Common pitfalls of vulnerability assessments, penetration testing, and red team exercises, Objective-based penetration testing, The testing methodology Kali Linux & Red Team Tactics,		
2	Open-source Intelligence and Reconnaissance: Basic Principles of Reconnaissance, Scraping, Google Hacking Database, creating custom wordlist for cracking password Active Reconnaissance of External and Internal Networks: Stealth scanning techniques, DNS reconnaissance, and route mapping, Employing comprehensive reconnaissance applications,		
UNIT II		10	
Vulnerabilities and Advanced Attacks			
1	Vulnerability Assessment: Local and online vulnerability databases, Vulnerability scanning with Nmap, Web application vulnerability scanners, Threat modeling.		
2	Advanced Social Engineering and Physical Security: Common Methodology, Physical attacks at a console, Social Engineering Toolkit,, Escalating an attack using DNS redirection, Exploiting Web-based applications: Web app Hacking methodology, Browser exploitation Framework Metasploit Exploitation: Metasploit framework, exploiting single and multiple targets using MSF Privilege Escalation: Escalation methodology, escalating from domain user to system administrator		

Suggested References:

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Mastering Kali Linux for Advanced Penetration Testing Fourth Edition, Vijay Kumar Velu, Packt, 2022
 Learn Kali Linux 2019: Perform Powerful Penetration Testing Using Kali Linux, Metasploit, Nessus, Nmap, And Wireshark, Glen D. Singh, Packt, 2019
 Hands-on Penetration Testing for Web Applications: Run Web Security Testing on ModernApplications Using Nmap, Burp Suite and Wireshark, Richa Gupta, BPB, 2021
 Advanced Penetration Testing, Wil Allsopp, Wiley, 2017
 William G. Zikmund, B J Babin, J.C. Carr, Atanu Adhikari, M. Griffin, "Business Research Methods", Cengage, 8e, 2016.
 Professionals, Second Edition, New York: IEEE Press, 2002.
 Handbook of Qualitative Research, Norman K. Denzin, Yvonna S. Lincoln

COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT THEORY
TITLE OF THE SUBJECT/COURSE	:	Cyber Security and Risk Assesment
COURSE CODE	:	RJSPCS204B
CREDITS	:	02
DURATION	:	20 LECTURES

LEARNING OBJECTIVES	
1	Develop skills to use kali Linux for penetration testing
2	Use open-source tools for Reconnaissance
3	Perform vulnerability assessment using popular tools
4	Learn about advanced ways to exploit web apps and cloud security

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Learn about an advanced concept related to penetration testing.	1	BT Level III, IV Apply draw conclusions
CO2	Use of Kali Linux in performing penetration tests against networks, systems, and applications	1, 2	BT level III, IV and V
CO3	Understand ways to protect system and digital assets.	1	BT Level III, IV Apply draw conclusions

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Practical 4B: Cyber Security and Risk Assessment		Paper Code: RJSPCSP204B Credit: 02
1	Exploring and building a verification lab for penetration testing (Kali Linux)	
2	Use of open-source intelligence and passive reconnaissance	
3	Practical on enumerating host, port, and service scanning	
4	Practical on vulnerability scanning and assessment	
5	Practical on use of Social Engineering Toolkit	
6	Practical on Wireless and Bluetooth attacks	
7	Practical on Exploiting Web-based applications	
8	Practical on using Metasploit Framework for exploitation.	
9	Practical on injecting Code in Data Driven Applications: SQL Injection	
10	Wireless Network threats (sniff wifi hotspots, analyze strength, discover wireless access points)	

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COURSE OUTCOMES (COs) M.Sc. COMPUTER SCIENCE

SEMESTER	:	I ELECTIVE SUBJECT PRACTICAL
TITLE OF THE SUBJECT/COURSE	:	Cyber Security and Risk Assessment
COURSE CODE	:	RJSPCSP204B
CREDITS	:	02
DURATION	:	40 HOUR

LEARNING OBJECTIVES	
1	To understand working with Kali Linux
2	To understand vulnerability and different attacks
3	To understand Exploitation of Web-based applications
4	To understand Wireless Network threats

COURSE OUTCOME NUMBER	On completing the course, the student will be able to:	PSO Addressed	BLOOMS LEVEL
CO1	Understand the working of Kali Linux	1	BT Level III, IV Apply draw conclusions
CO2	Understand different types of attacks and scan vulnerability	1, 2	BT level III, IV and V Apply, analyze, and evaluate
CO3	Understand Exploitation of Web-based applications	1,2	BT level III, IV and V Apply, analyze and evaluate
CO4	Understand different threats in Wireless Networks	1,2	BT level III, IV and V Apply, analyze and evaluate

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SEMESTER	:	II
TITLE OF THE SUBJECT/COURSE	:	On Job Training
COURSE CODE	:	RJSPCS205
CREDITS	:	02
DURATION	:	120 HOUR

A. Introduction

On Job training (OJT) is an integral component of the M.Sc. Computer Science program that provides students with a unique opportunity to bridge the gap between theoretical knowledge gained in the classroom and practical application in a real-world environment. This training aims to equip students with both technical and non-technical skills that are essential for success in industry.

- By participating in OJT, students are able to apply the concepts and theories learned during their coursework to real-world scenarios. They gain hands-on experience, problem-solving skills, and a deeper understanding of how the industry operates. This practical exposure enhances their competence and confidence, preparing them to tackle the challenges they may encounter in their professional careers.
- From an organizational perspective, hosting OJT programs allows companies to gain insights into the curriculum and content of the M.Sc. Computer Science program. They can provide valuable feedback on the relevance of the coursework and industry requirements, enabling academic institutions to continually improve the program's alignment with industry needs. This collaboration between academia and industry fosters a mutually beneficial relationship, ensuring that graduates are well-prepared for the job market.
- Moreover, OJT benefits the faculty members involved in the program. They have the opportunity to gain firsthand exposure to the industry and observe the type of work being performed. This experience enables them to enhance their teaching methodologies and delivery techniques, ensuring that they remain up-to-date with the latest industry practices. The insights gained from OJT also enable faculty members to provide relevant guidance and mentorship to students, preparing them for successful careers in the field of computer science.

B. Enhancing Practical Skills through OJT

- The On Job Training (OJT) program spans 4-6 weeks, requiring a minimum of 120 hours of physical presence at the organization.
- Students are expected to find their own OJT placements, although the institution provides support and guidance in securing positions with reputable organizations.
- OJT must be conducted outside the home institution to expose students to real-world work environments.
- OJT covers any subject within the syllabus, allowing students to align their experience with their academic interests.
- In recognition of changing dynamics, some OJT sessions can be conducted online to accommodate virtual work environments.

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- OJT will offer students the opportunity to apply classroom learning in a real-world setting, fostering the development of technical and non-technical skills.
- Mutual Benefits: Organizations gain insights into the program's curriculum and industry requirements, enabling them to provide constructive feedback and enhance course relevance.
- OJT bridges the gap between theoretical knowledge and practical application, preparing students for successful careers in computer science

C. Interning organization: Students have the flexibility to pursue their OJT in various types of organizations, including but not limited to:

- Software Development Firms: Gain practical experience in software development and programming.
- Hardware/Manufacturing Firms: Learn about hardware design, manufacturing processes, and quality assurance.
- Small-Scale Industries/Service Providers: Explore opportunities in diverse sectors such as banking, clinics, NGOs, and professional institutions like CA firms or law firms.
- Civic Departments: Engage with local civic departments such as ward offices, post offices, police stations, or panchayats to understand their functioning and contribute to their activities.
- Research Centre's/University Departments/Colleges: Contribute as research assistants or in similar roles for research projects or initiatives, fostering collaboration between academia and industry. Note: The listed options provide a range of possible OJT placements, offering students valuable exposure to different sectors and professional settings.

D. Faculty Mentor Role: The faculty mentor serves as the overall coordinator of the OJT program. They oversee the entire internship process and evaluate the quality of the OJT in a consistent manner across all students. The faculty mentor ensures that the OJT aligns with the program's objectives and provides valuable learning opportunities. They also facilitate communication between the institution, industry mentor, and student to ensure a fruitful OJT experience. By having both an industry mentor and a faculty mentor, students benefit from a comprehensive guidance system that combines industry expertise and academic support.

E. Submission of documentation for OJT:

The student will make two documents as part of the OJT

- OJT report: A student is expected to make a report based on the OJT he or she has done in an organization. It should contain the following:
 - ♣ Certificate: A certificate in the prescribed Performa (given in Appendix I and Appendix I) from the

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organization where the OJT was done.

- ♣ Title: A suitable title giving the idea about what work the student has performed during the OJT.
- ♣ Description of the organization: A small description of the organization where the student has interned
- ♣ Description of the activities done by the section where the intern has worked: A description of the section or cell of the organization where the intern 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 done by the intern: A detailed description of the work allotted, and actual work performed by the intern during the OJT period. It shall be the condensed and structured version of the daily report mentioned in the online diary.
- ♣ Self-assessment: A self-assessment by the intern on what he or she has learned during the OJT period. It shall contain both technical as well as interpersonal skills learned in the process.

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Scheme of Examinations

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

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EVALUATION SCHEME

A. Evaluation for Mandatory Theory Courses (4 Credit Courses) (RJSPCS105)

I. Presentation – 50 Marks

II. External Examination for Mandatory Theory Courses – 50 Marks

- **Duration: 2 Hours**

B. Evaluation for Mandatory Theory Courses (3 Credit Courses) (RJSPCS101, RJSPCS102, RJSPCS201, RJSPCS202)

I. Internal Evaluation for Mandatory Theory Courses – 25 Marks

II. External Examination for Mandatory Theory Courses – 50 Marks

- **Duration: 2.0 Hours**
- **Theory question paper pattern:**

All questions are compulsory			
Question	Based on	Options	Marks
Q.1	Unit1	Any 2 out of 4	10
Q.2	Unit2	Any 2 out of 4	10
Q.3	Unit3	Any 2 out of 4	10
Q.4	Unit 1,2,3	Any 4 out of 8	20

C. Evaluation for Elective Theory Courses (2 Credit Courses) (RJSPCS103, RJSPCS104A/B, RJSPCS203, RJSPCS204A/B)

I. Internal Evaluation for Mandatory Theory Courses – 20 Marks

II. External Examination for Mandatory Theory Courses – 30 Marks

- **Duration: 1 Hour 15**
- **Theory question paper pattern:**

All questions are compulsory			
Question	Based on	Options	Marks
Q.1	Unit1	Any 2 out of 4	10
Q.2	Unit2	Any 2 out of 4	10
Q.3	Unit3	Any 2 out of 4	10

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D. Evaluation of Practicals 50marks /subject (RJSPCSP101,RJSPCSP102, RJSPCSP103, RJSPCSP104A/B,RJSPCSP201,RJSPCSP202,RJSPCSP203, RJSPCSP204A/B)

**E. Evaluation of On Job Training Course (2 Credit Course)
(RJSPCS205)**

Evaluation (OJT)		
OJT Documentation	Quality & Relevance	OJT Viva
10	20	20
Total	50	

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

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

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APENDIX-I

(Proforma for the certificate for OJT in official letterhead)

This is to certify that Mr. /Ms. ofCollege/Institution worked as an intern as part of his/her M.Sc. 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 details:

Email:

(Seal of the organization)

Hindi Vidya PracharSamiti's, **Ramniranjan Jhunjhunwala College of Arts, Science &
Commerce (Empowered Autonomous College)**
M.Sc. Computer-Science Syllabus Semester I & II

APENDIX-II

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

Professional Evaluation of intern

Name of intern: _____

College/institution: _____

[Note: Give a score on the 1 to 5 scale by putting √ in the respective cells]

No	Particular	Excellent	Very Good	Good	Moderate	Satisfactory
1	Attendance & Punctuality					
2	Ability to work in a team					
3	Written and oral communication skills					
4	Problem solving skills					
5	Ability to grasp new concepts					
6	Technical skill in terms of technology, programming etc					
7	Ability to complete the task					
8	Quality of overall work done					

Comments: _____

Signature: _____

Name :

Designation:

Contact details:

Email :

(Seal of the organization)

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COMPUTER SCIENCE
Mapping of the courses to employability / entrepreneurship / skill development

Class	Course Name	Course Code	Unit No. And topics focusing on Employability / Entrepreneurship / Skill development	Employability / Entrepreneurship / Skill development
MSC SEM I				
MSC	Machine Learning	RJSPCS101	Employability Unit1 :The Fundamentals of Machine Learning Unit2: Training Models Unit 3: Bagging and Boosting Unit 4: Fundamentals of Deep Learning	Employability in the field of M/L & researching
MSC	Statistical Tools for data science	RJSPCS102	Employability Unit 1 :Business Analytics, Popular Data Science Technique Unit 2 :Probability, Probability, Probability Unit 3 :Discrete & Continuous Distributions Unit 4 :Histogram, Histogram, Hypothesis Testing	Employability in the field of Data Scientist, data engineer
MSC	Algorithms for optimization	RJSPCS103	Employability Unit1 : Introduction to Optimization Process Unit2: Order Methods Unit3: Sampling and Surrogate Models Unit4: Optimization and Uncertainty	Employability in the field of Algorithms & researching

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MSC	Trends in Cloud computing	RJSPCS104A	Employability Unit 1 : Techniques for Cloud Application Development Unit 2 : Cloud Service Delivery Environment and API Unit 3 : DevOps and Containers in Cloud Unit 4 : Azure & GCP Essentials	Employability in the field of Cloud application and data management
MSC	Cryptography & Cryptanalysis	RJSPCS104B	Unit 1: Classic Cryptography Techniques Unit 2: Advanced Encryption, Integrity, and Authentication Unit 3: Public-Key Cryptography and Identity Verification Unit4: Key Management	Employability in the Security Management.
MSC	Research Methodology	RJSPCS105	Unit 1: Introduction to Research Unit 2: Formulation of research problem Unit 3: Research Paper Writing Unit4: Presentation of selected project proposal	Employability in the Field of Research methodology.
MSC SEM II				
MSC	Big Data	RJSPCS201	Employability Unit 1 : Big Data and Hadoop Unit 2: Map Reduce and HBASE Unit 3 : Spark Framework and Applications Unit 4 : Tools for Data Analytics	Employability in the Big data and data analytics

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MSC	Embedded and IoT Technology	RJSPCS202	Employability Unit 1 : Embedded Electronic Systems & Microcontrollers, Instruments & Development Unit 2 : Architecture of MSP430 processor, Functions, Interrupts & low power modes Unit 3 : Digital Input, Output, Displays, Timers Unit 4 : Analog Input/output, Communication	Employability in the field of embedded & IOT system design
MSC	Web Mining	RJSPCS203	Employability Unit 1: Introduction to WebMining Opinion Mining and Web Usage Mining Unit 2: Social Network & Link Analysis Webpage crawlers and usage mining	Employability in the field of social networking and mining
MSC	Web 3.0 Technology	RJSPCS204A	Entrepreneurship Unit1: Introduction to Web3 Technologies Smart Contracts & Ethereum Unit 2: Serenity, Ethereum, Hyperledger & Tokenization Solidity Programming	Employability in the field of Blockchain Technology.
	Cyber Security & Risk assessment	RJSPCS204B	1. Introduction to Penetration Testing and Reconnaissance 2. Vulnerabilities and Advanced Attacks	Employability in the field of Cyber security