Shri Vile Parle Kelavani Mandal's

MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE & AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),
Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of India,
Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: Master of Science

Subject: Computer Science Semester:

I & II

Choice Based Credit System (CBCS) with effect from the Academic year 2021-22

Neelam Jain

Ashish Gavande Ashish Gavande

Dr. Amol Joglekar

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Jayshree Ravi Jayshree

The courses are as follows: -

Semester – I		
Course Title	**Credits**	**Lecture/Week**
Analysis of Algorithms and Research Methodology	4	4
Machine Learning	4	4
Business Intelligence	4	4
System Security & Digital Forensics	4	4
Practical - Analysis of Algorithms and Research Methodology	2	4
Practical - Machine Learning	2	4
Practical - Business Intelligence	2	4
Practical - System Security & Digital Forensics	2	4

Semester – II		
Course Title	**Credits**	**Lecture/Week**
Compiler Construction & Design	4	4
Cloud Computing	4	4
Neural Network and Fuzzy Logic	4	4
Blockchain Technology	4	4
Practical - Compiler Construction & Design	2	4
Practical - Cloud Computing	2	4
Practical - Neural Network and Fuzzy Logic	2	4
Practical - Blockchain Technology	2	4

N.B.- (i) The duration of each theory lecture will be of 60 minutes. A course consists of 4 modules. For each module the number of hours allotted are 15. The total number of lecture hours for each course will thus be 60.

For theory component value of One Credit is equal to 15 learning hours.

(ii) There will be one practical per batch for all but one courses per semester. The duration of each practical will be of 4 hours, i.e. of 240 minutes.

For practical component the value of One Credit is equal to 30 learning hours.

(iii) Thus in a week, a student will study 16 hours of theory and 16 hours of practical for semester I & II.

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the M.Sc. Computer Science, the learners should be enriched with knowledge and be able to-

PSO1: Train students with widespread knowledge and understanding of advanced theoretical fundamentals in computer science.

PSO2: Ready the students to take up an occupation in the extremely competitive ICT industry with research and development expertise acquired through Internship major project.

PSO3: An aptitude to take on innovative research at the cutting edge of computer science and its associated zones.

PSO4: Cultivate proficiency in innovative areas of computer science - Algorithms, Machine Learning, Cryptography, Natural Language Processing to name a few.

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.

Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	**Details**	**Marks**
Component 1 (CA-1)	Class Test/Research Paper Review/ Assignment/ Presentation/ Mini Project	15 marks
Component 2 (CA-2)	Assignment/ presentation/mini project, etc	10 marks

Minimum 2 component of Continuous Assessment need to be conducted per course.

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	**Description**	**Marks**	**Total Marks**
Q.1 to Q.4	(A) Answer any 1 out of 2 Questions (B) Compulsory question 5 Marks	10 + 05 x 1	(10+5) x 4 = 60
Q.5	Answer Any 3 out of 4 questions	05 x 3	24
		Total Marks	75

Evaluation for practical papers

In the Practical exams, there will be 20% assessment for the journal and laboratory work and 80% as term end mponent to be conducted as a semester end exam per course. For each course there will be one examiner per batch who will evaluate the practical.

Signature

HOD

Signature

Approved by Vice –Principal

Signature

Approved by Principal

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: M.Sc . Computer Science (2021-22)				**Semester: I**	
Course: Analysis of Algorithms and Research Methodology				**Course Code: PSMACS101**	
Teaching Scheme				**Evaluation Scheme**	
Lecture	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
(Hours per week)				**(Marks - 25)**	**(Marks- 75 in Question Paper)**
4	4	-	4+2	**25**	**75**

Learning Objective:

To understand algorithm analysis techniques and create foundation for research aptitude.

Course Outcomes:

After completion of the course, learners would be able to:

CO1:	To apply mathematical foundation and advanced algorithm principles.
CO2:	To identify, analyze and solve complex algorithms.
CO3:	To grow understanding of the elementary background of research process.
CO4:	To develop an understanding of numerous research designs and practices.
CO5:	To be capable to select and define suitable research problems and parameters.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	Advanced Design and Analysis Techniques	15
2	Number-Theoretic Algorithms and NP – Completeness	15
3	Introduction to Research Methodology	15
4	Sampling, Problem Identification and Report Writing	15
	Total	**60**

Practical: To be implemented in Java/Python/R

1.	Write a program to implement Huffman's code algorithm	**5**
2.	Write a program to implement Kruskal's algorithm	**5**
3.	Write a program to implement Dijkstras's algorithm	**5**
4.	Write a program to implement Euclid's algorithm to implement gcd of two non negative integers a and b. Extend the algorithm to find x and y such that gcd(a,b) = ax+by. Compare the running time and recursive calls made in each case.	**5**
5.	Write a program to implement greedy set cover algorithm to solve set covering problem	**5**
6.	Given an array of numbers of length l. Write a program to generate a random permutation of the array using (i) permute-by-sorting() and(ii) permute-by-cyclic().	**5**

4	Sampling-sampling frame, importance of probability sampling, simple random sampling, systemic sampling, stratified random sampling, cluster sampling Collection of data, classification & tabulation-diagrammatic & graphical representation. Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance Reporting and thesis writing Presentation of algorithms, Environment of Algorithms, Asymptotic Cost. Graphs. Technical Reports- Structuring General format.	15

Suggested Reading

1. Introduction to Algorithms, Third Edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI Learning Pvt. Ltd-New Delhi (2009).
2. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, Algorithms, 1st Edition, 2017, Tata McGraw Hill.
3. J. Kleinberg and E.Tardos, Algorithm Design, 1st Edition 2013., Pearson Education India
4. Research Methodology – C.R.Kothari
5. Researching Information Systems and Computing, Brinoy J Oates, Sage Publications India Pvt Ltd (2006)

Program: M.Sc . Computer Science (2021-22)				**Semester: I**	
Course: Machine Learning				**Course Code: PSMACS105**	
Teaching Scheme				**Evaluation Scheme**	
Lecture	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
(Hours per week)				**(Marks - 25)**	**(Marks- 75 in Question Paper)**
4	4	-	4+2	**25**	**75**

Learning Objective:

- To introduce various machine learning concepts and methods.
- To introduce machine learning algorithms to regression, classification and clustering problems
- To evaluate and interpret the results of machine learning algorithms

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Students will be able to apply the techniques of data pre-processing techniques on standard datasets pertaining to machine learning

CO2: Apply, Design and implement supervised and unsupervised machine learning algorithms for real-world applications, while understanding the strengths and weaknesses.

CO3: Competent to evaluate Machine Learning models efficiency and accuracy using suitable metrics.

CO4: Apply dimensionality reduction for analysis of large dataset.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	Introduction to Machine Learning and Regression Models	15
2	Supervised Algorithms	15
3	Unsupervised Learning Models	15
4	Dimensionality Reduction	15
	Total	**60**

Practical: To be implemented in Java/Python/R

1.	Demonstration of the working of Python Libraries	**6**
2.	Simple Linear Regression from Scratch	**6**
3.	Linear Regression Models using Python Libraries	**6**
4.	Implementation of K-Nearest Neighbor Algorithm	**6**
5.	Implementation of Logistic Regression	**6**
6.	Implementation of Decision Tree	**6**
7.	Implementation of Random Forest	**6**
8.	Implementation of K-Means Clustering	**6**

9.	Implementation of Density based Clustering	**6**
10.	Feature Reduction using PCA and SVD	**6**

Module	**Topic**	**No. of Hours/Credits**
1	**Introduction to Machine Learning –** How machines learn, Basic structure of a Machine Learning Model and comparison to traditional programming, Goals and Applications of Machine Learning, Types of Data related to Machine Learning, Introduction to standard machine learning datasets and interpreting the data, Correlation between data, Supervised and Unsupervised Learning algorithms. **Regression –** Linear Regression, Feature Selection using Correlation Co-efficient, Polynomial Regression, Multivariate Regression, Logistic Regression	**15**
2	**Classification** problems – Decision Tree Algorithm, Role of Entropy and Information gain in Decision Tree Algorithm, CART, Random Forest, Classification Metrics – Type I and Type II Errors and Confusion Matrix, Methods to avoid over-fitting in Decision Trees – Pruning, Naïve Bayes Classifier, Support vector Machines, Problem of Over-fitting and Under-fitting in Linear Regression, Bias-Variance Tradeoff, Model Evaluation	**15**
3	**Clustering Problems** – Hierarchical Clustering (AGNES & Divisive), K-Means Clustering, Expectation Maximization, Partition around medoids, CLARA and CLARANS, Density-Based Clustering Model, Goodness of a clustering solution using metrics like Silhouette Co-efficient	**15**
4	**Dimensionality Reduction –** Components - Feature Selection, Feature Extraction, Common Methods of Dimensionality Reduction, Types of Dimensionality Reduction techniques– Singular Value Decomposition, Principal Component Analysis, Linear Discriminant Analysis.	15

Suggested Reading

1. E. Alpaydin, Introduction to Machine Learning, 3rd Edition, MIT Press, 2015
2. T Hastie, R Tibshirani and J Friedman, The Elements of Statistical Learning Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009.
3. C.Bishop, "Pattern Recognition and Machine Learning, Springer
4. A.F..Vermeulen,"Practical Data Science", APress, 2018
5. S.Ozdemir,"Principles of Data Science", Packt, 2016.

Program: M.Sc . Computer Science (2021-22)				**Semester: I**	
Course: Business Intelligence				**Course Code: PSMACS106**	
Teaching Scheme				**Evaluation Scheme**	
Lecture	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
(Hours per week)				**(Marks - 25)**	**(Marks- 75 in Question Paper)**
4	4	-	4+2	**25**	**75**

Learning Objective:

To understand applications of business intelligence, Give foundation of modelling concepts and introduce data mining.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand the necessity and applications of business intelligence

CO2: Able to apply various modelling concepts on enormous data.

CO3: Acquire the knowledge of various processes for construction of data warehouse.

CO4: Understand the concept of data mining.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	Introduction to Business Intelligence	15
2	Introduction to Business Data Warehouse	15
3	Designing Business Data Warehouse	15
4	Introduction to Data Mining	15
	Total	**60**

Practical: To be implemented in Python/R/Weka/Microsoft SQL Server – Analysis Service

1.	Create tables using different applications.	**6**
2.	Develop an application to design a warehouse by importing various tables from external sources	**6**
3.	Develop an application to creating a fact table and measures in a cube	**6**
4.	Develop an application to create dimension tables in a cube and form star schema	**6**
5.	Develop an application to create dimension tables in a cube and form snowflake schema	**6**
6.	Develop an application to create a dimension table from Parent-Child schema.	**6**
7.	Develop an application to demonstrate operations like roll-up, drill-down, slice, and dice.	**6**

8.	Develop an application to demonstrate processing and browsing data from a cube	**6**
9.	Develop an application to pre process data imported from external sources.	**6**
10.	Create association rules by considering suitable parameters	**6**

Module	**Topic**	**No. of Hours/Credits**
1	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	**15**
2	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).	**15**
3	Designing Business Data Warehouse OLTP and OLAP systems, Designing business information warehouse: Principles of dimensional modeling, Data cubes, Data cube operations, data cube schemas	**15**
4	Introduction to Data Mining Data mining definitions and process: business and data understanding. 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.	15

Suggested Reading

1. Business Intelligence (2nd Edition), Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Pearson (2013)
2. Paulraj Ponniah, **Data Warehousing Fundamentals**, John Wiley & Sons, Inc. 2001.
3. Data Mining: Introductory and Advanced Topics, Dunham, Margaret H, Prentice Hall (2006)
4. Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Witten, Ian and Eibe Frank, Morgan Kaufmann (2011)

Program: M.Sc . Computer Science (2021-22)				Semester: I	
Course: System Security & Digital Forensics				Course Code: PSMACS107	
Teaching Scheme				Evaluation Scheme	
Lecture	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examinations (SEE)
(Hours per week)				(Marks - 25)	(Marks- 75 in Question Paper)
4	4	-	4+2	25	75

Learning Objective:

- To introduce Access Control, Program & OS Security
- To introduce Wireless Security & Legal Ethical issues.
- To introduce Application security and its concepts.
- To create an awareness of digital forensics and e-discovery

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Explored to Access Control, Program & OS Security

CO2: Apply Wireless Security & Legal Ethical issues for ensuring security.

CO3: To explore Application security concepts.

CO4: Knowledge of digital forensics and e-discovery.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	Introduction, Access Control, Program & OS Security	15
2	Securing the Application	15
3	Wireless Security & Legal Ethical issues	15
4	Digital Forensics & Basics of E-Discovery	15
	Total	**60**

Practical:

1.	Static code analysis using open source tools like RATS, Flawfinder etc.	**6**
2.	Vulnerability scanning using Nessus, Nikto (Kali Linux)	**6**
3.	Explore web-application vulnerabilities using open source tools like Wapiti, browser exploitation framework (BeEf), etc.	**6**
4.	Exploring Router and VLAN security, setting up access lists using Cisco Packet tracer(student edition)	**6**
5.	Study of SQL Injection and Cross-Site Scripting (XSS)	**6**
6.	Study of Insecure Direct Object References and Cross-Site Request Forgery (CSRF)	**6**
7.	Study of Brute force attack and a program to create virus	**6**

8.	Write a program to take backup of mysql database and restore mysql database	**6**
9.	Create forensic images of digital devices from volatile data such as memory using Imager for: (i) Computer System; (ii) Server; (iii) Mobile Device	**6**
10.	Access and extract relevant information from Windows Registry for investigation process using Registry View, perform data analysis and bookmark the findings with respect to: (i) Computer System; (ii) Computer Network; (iii) Mobile Device; (iv) Wireless Network	**6**

Module	**Topic**	**No. of Hours/Credits**
1	Cyber-attacks, Vulnerabilities, Defence Strategies and Techniques, Authentication Methods and Protocols, Defence in Depth Strategies. Access Control Policies: DAC, MAC, Multi-level Security Models: Biba Model, Bell La Padula Model, Single Sign on, Federated Identity Management. Malicious and Non-Malicious programming errors, Targeted Malicious codes: Salami Attack, Linearization Attack, Covert Channel, Control against Program threats. Operating System Security: Memory and Address protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security.	**15**
2	Malware: Types of Malware, Virus, Trojan, Key logger, Password Cracking and Prevention: Introduction, Password Cracking Techniques, Dictionary Based Attack, Brute force Attack, Password reset flaws, Countermeasures for users, Countermeasures for System Administrators. Authentication & Authorization vulnerabilities: Authentication concepts, scenarios, bypassing weak CAPTCHA mechanisms, Login without SSL, Authorization: RBAC, Authorization bypassing, Parameter tampering, Forceful browsing, Rendering based Authorization, Client side validation attacks, Insecure direct object reference. Input vulnerabilities: SQL injection, Common implementation mistakes - authentication bypassing using SQL Injection, Cross Site Scripting, and Reflected VS. Stored XSS Command injection, Session & browser manipulation.	**15**
3	Mobile and Wireless Security Issues, Approaches to Security: Physical Limitations, Encryption, Integrity Codes, IPSEC, AAA Wi-Fi Security, WLAN Security - WEP, WPA, WPA-2, radius, CHAP , Mobile Device Security- Security Threats, Device Security, GSM and UMTS Security, VPN Security, Bluetooth security Cybercrime and its types, Intellectual property, Privacy, Ethical issues. Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, case studies of ethics.	**15**

4	Computer Forensics Investigation Process, Understanding hard disks and file systems. Data acquisition and duplication, defeating anti-forensics techniques Operating system forensics, Network forensics, investigating web attacks, Database forensics, Cloud forensic, Malware forensics, Investigating email crimes, Mobile forensic, Forensics report writing and presentation, Wireless Networks and Internet Forensics. History and development of e-discovery, Overview of technology at issue in e-discovery matters, including distinction between data and metadata, General framework of e-Discovery, Legal aspects of e-Discovery, E-discovery industry, Electronic Discovery Reference Model Project, developing "data maps" for enterprises, Technology tools for archiving and retrieving Electronically Stored Information.	15

Suggested Reading

1. Cryptography Theory and Practice, 3rd Edition, Douglas R. Stinson, 2005.
2. Bryan Sullivan and Vincent Liu, Web Application Security, A Beginner's Guide, Mc Graw Hill
3. Incident Response and Computer Forensics, Chris Prosise and Kevin Mandia, 2003 Edition, McGraw-Hill
4. Wireless security: Models, threats and solutions, R. K. Nichols, P. C. Lekkas, Tata-Mc Graw Hill
5. Network Security and Cryptography, Atul Kahate, McGraw Hill, 2003.
6. Cryptography and Network Security: Principles and Practices, William Stalling, Fourth Edition, Prentice Hall, 2013.
7. Introduction to Cryptography with coding theory, second edition, Wade Trappe, Lawrence C. Washington, Pearson, 2005.

Program: M.Sc . Computer Science (2021-22)	**Semester: II**
Course: Compiler Construction & Design	**Course Code: PSMACS202**

Teaching Scheme				**Evaluation Scheme**	
Lecture	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
(Hours per week)				**(Marks - 25)**	**(Marks- 75 in Question Paper)**
4	4	-	4+2	**25**	**75**

Learning Objective:

To understand different phases of compiler work and implement parsing algorithms

Course Outcomes:

After completion of the course, learners would be able to:

CO1: To appreciate and design the model of compiler construction.

CO2: To identify tokens, define regular expressions and implement scanner generator.

CO3: To comprehend the principles and procedures used to perform translation and the vital concepts of translator construction.

CO4: To be familiar with the role of semantic analyzer and create a syntax-directed definition.

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	Introduction to Compilers	15
2	Automatic Construction of Efficient Parsers	15
3	Advanced syntax analysis and basic semantic analysis	15
4	Introduction to System Software	15
	Total	**60**

Practical: To be implemented in Python/Java/C/C++

1.	Introduction to System Software	**6**
2.	To check the syntax of looping statements of C/C++ program	**6**
3.	To identify whether given problem is NFA or DFA .	**6**
4.	To check the syntax of identifier using LEX	**6**
5.	To check the syntax of RE using LEX	**6**
6.	To generate 3 address code of given expression.	**6**
7.	To generate triple and quadruple of given expression.	**6**
8.	To implement code generation.	**6**
9.	To implement DAG.	**6**

10.	Write a program to demonstrate loop unrolling and loop splitting for the given code sequence containing loop	**6**

Module	**Topic**	**No. of Hours/Credits**
1	Introduction to Compilers The structure of a compiler, A simple approach to the design of lexical analyser, Introduction to Programming languages, 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, Parsers, Shift-reduce parsing, Operator-precedence parsing, Top- down parsing, Predictive parsers. , Lex and YACC	**15**
2	Automatic Construction of Efficient Parsers LR parsers, The canonical collection of LR(0) items, Constructing SLR parsing tables, Constructing canonical LR parsing tables, Constructing LALR parsing tables, Using ambiguous grammars, An automatic parser generator, Implementation of LR parsing tables, Constructing LALR sets of items.	**15**
3	Advanced syntax analysis and basic semantic analysis Syntax-directed translation schemes, Implementation of syntax directed translators, symbol tables, The principle sources of optimization, Loop optimization, DAG, 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, alias analysis	**15**
4	Introduction to System Software Introduction-Systems Programming-Language Translators. System software and SIC/XE machine architecture. Basic assembler functions Machine dependent assembler features Machine independent assembler features Assembler Design Options-One pass assemblers. Multi pass assemblers Implementation example -MASM Assembler Basic Macro processor functions Concept of Parameters in Macros. Conditions in Macro Definitions. Macro Programming Techniques Design Issues of Macro Processors. Principles of Loading Operation Different Loading Schemes. Principles of Linking- Relocation and Code Modification Linking Methods. Design of Linkers	15

Suggested Reading

1. Principles of Compiler Design Alfred Aho and Jeffrey Ullman, Addison-Wesley
2. Compilers: Principles, Techniques, and Tools , Alfred Aho and Jeffrey Ullman, Monica S Lam, Ravi Sethi, PERSON publication
3. Moder Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J.H. Jacobs, Springer, 2016.

Program: M.Sc . Computer Science (2021-22)	Semester: II
Course: Cloud Computing	Course Code: PSMACS205

Teaching Scheme				Evaluation Scheme	
Lecture	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examinations (SEE)
(Hours per week)				(Marks - 25)	(Marks- 75 in Question Paper)
4	4	-	4+2	25	75

Learning Objective:

- To introduce architecture and significance of cloud computing
- To introduce various Cloud computing mechanisms.
- To introduce cloud computing security
- To create and work with the cloud environment

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Exploit the cloud computing in the IT environment.

CO2: Practice cloud computing mechanisms and apply security aspects to it.

CO3: Generate and work with different clouds.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	Cloud Reference Architectures and Security	15
2	Cloud Computing Mechanisms	15
3	Cloud Computing Architecture	15
4	Working with Clouds	15
	Total	**60**

Practical:

Note:

Recommended Open Source Technologies for completing practical:

• FOSS-Cloud

• Try Stack

• Apache CloudStack

• OpenStack

• Canonical's OpenStack Autopilot

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

1.	Develop a private cloud using an open source technology	**6**
2.	Develop a public cloud using an open source technology.	**6**
3.	Explore Service Offerings, Disk Offerings, Network Offerings and Templates.	**6**
4.	Explore Working of the following with Virtual Machines • VM Lifecycle	**6**

	• Creating VMs • Accessing VMs • Assigning VMs to Hosts	
5.	Explore Working of the following with Virtual Machines • Changing the Service Offering for a VM • Using SSH Keys for Authentication	**6**
6.	Explore the working of the following: Storage Overview • Primary Storage • Secondary Storage	**6**
7.	Explore the working of the following: Storage Overview • Working with Volumes • Working with Volume Snapshots	**6**
8.	Explore managing the Cloud using following: • Tags to Organize Resources in the Cloud • Reporting CPU Socket	**6**
9.	Explore managing the Cloud using following: • Changing the Database Configuration • File encryption type	**6**
10.	Explore managing the Cloud using following: • Administrator Alerts • Customizing the Network Domain Name	**6**

Module	**Topic**	**No. of Hours/Credits**
1	The NIST definition of Cloud Computing, Cloud Computing reference architecture, Cloud Computing use cases, Cloud Computing standards. Cloud Computing Security Basic Terms and Concepts, Threat Agents, Cloud Security Threats. Cloud Security Mechanisms, Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images.	**15**
2	Cloud Infrastructure Mechanisms, Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication Ready-Made Environment. Specialized Cloud Mechanisms, Automated Scaling Listener, Load Balancer, SLA Monitor, Pay-Per-Use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi-Device Broker, State Management Database. Cloud Management Mechanisms, Remote Administration System, Resource Management System, SLA Management System, Billing Management System.	**15**
3	Fundamental Cloud Architectures, Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. Advanced Cloud Architectures, Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic	**15**

	Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management	
4	Cloud Delivery Model Considerations, Cloud Delivery Models: The Cloud Provider Perspective, Building IaaS Environments, Equipping PaaS Environments, Optimizing SaaS Environments, Cloud Delivery Models: The Cloud Consumer Perspective. Cost Metrics and Pricing Models, Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations. Service Quality Metrics and SLAs, Service Quality Metrics, Service Availability Metrics, Service Reliability Metrics, Service Performance Metrics, Service Scalability Metrics, Service Resiliency Metrics. Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture.	15

Suggested Reading

1. Cloud Computing Concepts, Technology & Architecture, Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, Prentice Hall, 2013.
2. Cloud Security - A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley Publishing, Inc., 2010.
3. Open Stack Cloud Computing Cookbook, Kevin Jackson, Cody Bunch, Egle Sigler, Packt Publishing, Third Edition, 2015.
4. Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe, Topjian,OpenStack Operations Guide, O'Reilly Media, Inc, 2014.
5. NIST Cloud Computing Standards Roadmap, Special Publication 500-291,Version 2, NIST, July 2013, http://www.nist.gov/itl/cloud/upload/NIST_SP-500-291_Version-2_2013_June18_FINAL.pdf
6. https://www.openstack.org
7. http://cloudstack.apache.org
8. http://www.foss-cloud.org/en/wiki/FOSS-Cloud
9. http://www.ubuntu.com/cloud/openstack/autopilot

Program: M.Sc . Computer Science (2021-22)	Semester: II
Course: Neural Network and Fuzzy Logic	Course Code: PSMACS206

Teaching Scheme				Evaluation Scheme	
Lecture	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA)	Semester End Examinations (SEE)
(Hours per week)				(Marks - 25)	(Marks- 75 in Question Paper)
4	4	-	4+2	25	75

Learning Objective:

The objective is to Conceptualize the working of human brain using ANN and introduce the ideas of fuzzy sets, fuzzy logic.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Ability to design, analyze and perform experiments on real life problems using various Neural Learning Algorithms.

CO2: Analyze performance of neural networks and tune various hyper-parameters.

CO3: To conceptualize fuzzy logic and its implementation for various real world applications.

Outline of Syllabus: (per session plan)

Module	Description	No. of Hours
1	Fundamentals of neural network and	15
2	Principle component analysis and Self-organizing Map	15
3	Associative Memory	15
4	Fuzzy logic	15
	Total	**60**

Practical: To be implemented in Python/R

1.	Implementation of AND, OR gate using perceptron	6
2.	Perceptron to classify odd and even numbers.	6
3.	Implementation of XOR gate using MLP.	6
4.	Implementation of XOR gate using backpropagation.	6
5.	NN for alphabet recognition using backpropagation.	6
6.	Hopfield network for recognizing patters such as '+' and '-'.	6
7.	Implementation of RDF.	6
8.	Practical based on principle component analysis	6
9.	Practical on self-organizing map	6

10.	Implementation of fuzzy logic.	**6**

Module	**Topic**	**No. of Hours/Credits**
1	Fundamentals of neural network- Biological neurons and Artificial neuron, models of a neuron, learning process, single-layer perceptron, multilayer perceptron Radial-basis function network Cover's Theorem on the Separability of Patterns - Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks Applications: XOR Problem – Image Classification.	**15**
2	Principle components Analysis-principles of self-organization, principle component analysis, Hebbian-based maximum Eigenfilter, Hebbian-based principle component analysis-Two classes of PCA Self-organizing Map – Maximal Eigenvector Filtering – Sanger's Rule – Generalized Learning Law – Competitive Learning - Vector Quantization – Mexican Hat Networks - Self-organizing Feature Maps – Applications	**15**
3	Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory), Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem	**15**
4	Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods, applications: Simple applications of Fuzzy knowledge based controllers like washing machines, home heating system, and train break control	15

Suggested Reading

1. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2ed., Addison Wesley Longman (Singapore) Private Limited, Delhi, 2001
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI
3. Satish Kumar, Neural Networks: A classroom Approach, Tata McGraw-Hill
4. Bart Kosko, Neural networks and Fuzzy Systems, Pearson Education
5. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.

Program: M.Sc . Computer Science (2021-22)	**Semester: II**
Course: Blockchain Technology	**Course Code: PSMACS207**

Teaching Scheme				**Evaluation Scheme**	
Lecture	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA)**	**Semester End Examinations (SEE)**
(Hours per week)				**(Marks - 25)**	**(Marks- 75 in Question Paper)**
4	4	-	4+2	**25**	**75**

Learning Objective:

- To Understand how Blockchain systems work,
- To securely interact with them,
- To Design, build, and deploy smart contracts and distributed applications

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Understand cryptographic building blocks and reason about their security

CO2: able to assess Blockchain applications in a structured manner

CO3: Understand and implement consensus mechanism in blockchain technology

CO4: understand the applications and limitations of Blockchain technology

Outline of Syllabus: (per session plan)

Module	**Description**	**No. of Hours**
1	Overview of Blockchain technology	15
2	Bitcoin cryptocurrency and hyperledger	15
3	Mechanics of Bitcoin and Alternate cryptocurrencies	15
4	Applications, research aspects and Limitations of Blockchain technology	15
	Total	**60**

Practical:

1.	Demo on the working of node.js	**6**
2.	Demo on the working of postman	**6**
3.	Create new block with data and test the block	**6**
4.	Create a new transaction	**6**
5.	Hash block and Hash function Genesis block	**6**
6.	Proof of work	**6**
7.	Genesis block	**6**
8.	Building APIs to interact with BC	**6**
9.	Block chain end points	**6**

10.	Mining Blocks via API	**6**
Module	**Topic**	**No. of Hours/Credits**
1	Overview of Blockchain - Basics of Blockchain, History of Blockchain, Blockchain vs distributed databases, Role of Blockchain in the landscape of digitalization, Introduction to cryptographic concepts Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure	**15**
2	Introduction to Bitcoin - Mining explained, The bitcoin network, The bitcoin Mining Process, Mining Developments, Task of bitcoin miners, Mining incentives and strategies Overview of Hyperledger, Hyperledger Projects, Hyperledger Architecture, Consensus model for permissioned Blockchains, Consensus and its interaction with architectural layers in bitcoin, Distributed consensus, Proof of work consensus, Architecture of Enterprise level Blockchain applications	**15**
3	Mechanics of Bitcoin – Bitcoin script, Bitcoin block, Bitcoin network, Limitations and improvements in Bitcoin network, How to store and use bitcoins – Hot and cold storage, splitting and sharing keys, Payment services, transaction fees, Currency exchange markets Bitcoin and anonymity – Anonymity basics, how to de-anonymize Bitcoin, Mixing, De-centralized mixing. Alternative coins – Altcoins and cryptocurrency ecosystem, Ethereum and smart contracts, Alternative mining puzzles	**15**
4	Applications, Limitations and Use cases of Blockchain – Applications of Blockchain in cyber security, finances, integrity of information, supply chain, government ,Limitations of Blockchain as a technology, myth vs reality of Blockchain technology, Business use case , technology use case, legal and governance use case, private block chain use case. Technical challenges, business model challenges Research aspects of Blockchain - Future of Bitcoin, Blockchain and Big data, Blockchain and Artificial Intelligence	15

Suggested Reading

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
3. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System