Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

FACULTY OF SCIENCE AND TECHNOLOG, M.Sc. (Computer Science) PROGRAMME WEF 2023-24

Credit distribution structure for Two Years/One Year PG Degree

Year (2 Yr PG)	Level	Sem (2Yr)	Major (Core) Subjects		RM	OJT/FP	RP	Cumulative Credits	Degree
			Mandatory (DSC)	Elective(DSE)					
I	6.0	Sem-I	CS-411: Artificial Intelligence (4)(T) CS-412: Optimization of Algorithms (2)(T) CS-413: Current Computing Trends in Java (4)(T) CS-414: Lab on Artificial Intelligence (2)(P) CS-415: Lab on Current Computing Trends in Java (2)(P)	CSE-416 (A): Big Data Analytics (4)(T) **OR** CSE-416 (B): Cloud Computing (4)(T)	RM-417: Research Methodology (4)	---	---	22	PG Diploma (After 1 Yr PG Degree)
		Sem-II	CS-421: Data Warehousing and Data Mining (4)(T) CS-422: Angular JS (2)(T) CS-423: Compiler Construction (4)(T) CS-424: Lab on Data Warehousing and Data Mining (2)(P) CS-425: Lab on Angular JS (2)(P)	CSE-426 (A1): Web Analytics (2)(T) CSE-426 (A2): Lab on Web Analytics (2)(P) **OR** CSE-426 (B1): Soft Computing (2)(T) CSE-426 (B2): Lab on Soft Computing (2)(P)	---	--	CS-427: Field Project /On Job Training (4)	22	
Cum. Cr. For PG Diploma			**28**	**8**	**4**	**-**	**4**	**44**	
Exit option: PG Diploma(44Credits)after Three Year UG Degree									
II	6.5	Sem-III	CS-511: Network Programming (4)(T) CS-512: Design and Analysis of Algorithm (4)(T) CS-513: Digital Image Processing (2)(T) CS-514: Lab on Network Programming (2)(P) CS-515: Lab on Digital Image Processing (2)(P)	CSE-516 (A): Ethical Hacking (4)(T) **OR** CSE-516 (B): Internet of Things (4)(T) **OR** CSE-516 (C): Swayam/NPTEL Course (T)	---	---	CS-517: Research Project (4)	22	PG Degree (After 2-Yr PG)
		Sem-IV	CS-521: Advanced Operating System (4)(T) CS-522: Machine Learning with Python (4)(T) CS-523: Lab on Advanced Operating System (2)(P) CS-524: Lab on Machine Learning with Python (2)(P)	CSE-525 (A): Network Security & Firewall (4)(T) **OR** CSE-525 (B): Natural Language Processing (4)(T) **OR** CSE-525 (C): Swayam/NPTEL Course (T)	---	CS-526: Research Project (6)	--	22	
Cum. Cr. for 1 Yr PG Degree			**26**	**8**	**---**	**6**	**4**	**44**	
Cum. Cr. For 2 Yr PG Degree			**54**	**16**	**4**	**6**	**8**	**88**	

2 Years-4 Sem.PG Degree (88credits) after Three Year UG Degree or1Year-2Sem PG Degree (44credits) after Four Year UG

Abbreviations: Yr.: Year; Sem.: Semester; OJT: On Job Training: Internship/ Apprenticeship; FP: Field projects; RM: Research Methodology; ResearchProject:RP;CumulativeCredits:Cum.Cr.,CW:Coursework,T-TheoryCourse,P–Practicalcourse,DSC-DisciplineSpecificCoreCourse,DSE-DisciplineSpecificElective Course.

Note: The courses which do not have practical,'P'will be treated as'T'.

FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE M.Sc. (Computer Science) PROGRAMME

Credit distribution structure For Two Years/One Year PG M.Sc.(Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination Scheme, Master of Science M.Sc. (Computer Science) WEF 2023-24

M.Sc. (Level 6.0) Sem-I (Name of Courses for -Major, RM, OJT, RP courses)

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation(CIE) (CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-411: Artificial Intelligence [T]	4	60	4	--	40	60	3.00
		CS-412: Optimization of Algorithms [T]	2	30	2	--	20	30	2.00
		CS-413: Current Computing Trends in Java [T]	4	60	4	--	40	60	3.00
		CS-414: Lab on Artificial Intelligence [P]	2	60	--	4	20	30	2.00
		CS-415: Lab on Current Computing Trends in Java [P]	2	60	-	4	20	30	2.00
2	DSE (Any One)	CSE-416 (A): Big Data Analytics [T] **OR** CSE-416 (B): Cloud Computing [T]	4	60	4	--	40	60	3.00
3	Research	RM-417: Research Methodology	4	60	4	-	40	60	3.00
Total			22	390	18	8	220	330	---

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE (M.Sc.) PROGRAMME

Credit distribution structure for Two Years/One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.0) Sem-II (Name of Courses for-Major, RM, OJT, RP courses) **WEF 2023-24**

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-421: Data Warehousing and Data Mining [T]	4	60	4	--	40	60	3.00
		CS-422: Angular JS [T]	2	30	2	--	20	30	2.00
		CS-423: Compiler Construction [T]	4	60	4	--	40	60	3.00
		CS-424: Lab on Data Warehousing and Data Mining [P]	2	60	--	4	20	30	2.00
		CS-425: Lab on Angular JS [P]	2	60	--	4	20	30	2.00
2	DSE (**Any One Group**)	CSE-426 (A1): Web Analytics [T] CSE-426 (A2): Lab on Web Analytics [P] **OR** CSE-426 (B1): Soft Computing [T] CSE-426 (B2): Lab on Soft Computing [P]	2 2	30 60	2 --	-- 4	20 20	30 30	2.00 2.00
3	FP/OJT,RP	CS-427: Field Project /On Job Training	4	120	--	8	40	60	3.00
Total			22	480	12	20	220	330	

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE (M.Sc.) PROGRAMME
Credit distribution structure for Two Years/ One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.5) Sem-III (Name of Courses for-Major, RM, OJT, RP courses)

Sr. No.	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-511: Network Programming [T]	4	60	4	-	40	60	3.00
		CS-512: Design and Analysis of Algorithm [T]	4	60	4	-	40	60	3.00
		CS-513: Digital Image Processing [T]	2	30	2	-	20	30	2.00
		CS-514: Lab on Network Programming [P]	2	60	-	4	20	30	2.00
		CS-515: Lab on Digital Image Processing [P]	2	60	-	4	20	30	2.00
2	DSE **(Select Any One)**	CSE-516 (A): Ethical Hacking [T] **OR** CSE-516 (B): Internet of Things [T] **OR** CSE-516 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT,RP	CS-517: Research Project	4	120	-	8	40	60	3.00
Total			22	450	14	16	220	330	--

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
FACULTY OF SCIENCE AND TECHNOLOGY, PGDEGREE M.Sc. (Computer Science) PROGRAMME
Credit distribution structure for Two Years/One Year PG M.Sc. (Computer Science) Degree Programme

BoS: Computer Science

Teaching and Examination scheme, Master of Science M.Sc. (Computer Science)

M.Sc. (Level 6.5) Sem-IV (Name of Courses for -Major, RM, OJT, RP courses)

SrNo	Course Category	Name of the course(Title of the Paper)	Total Credit	Hours/ Semester	Teaching Scheme(hrs/week)		Evaluation Scheme		
					Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
					T	P			
1	DSC	CS-521: Advanced Operating System [T]	4	60	4	-	40	60	3.00
		CS-522: Machine Learning with Python [T]	4	60	4	-	40	60	3.00
		CS-523: Lab on Advanced Operating System [P]	2	60	-	4	20	30	2.00
		CS-524: Lab on Machine Learning with Python [P]	2	60	-	4	20	30	2.00
2	DSE (**Select Any One**)	CSE-525 (A): Network Security & Firewall [T] **OR** CSE-525 (B): Natural Language Processing [T] **OR** CSE-525 (C): Swayam/NPTEL Course	4	60	4	-	40	60	3.00
3	FP/OJT, RP	CS-526: Research Project	6	180	-	12	60	90	3.00
Total			22	480	12	20	220	330	--

Semester-I

Course Code: **CS-411** **Artificial Intelligence** *Clock Hours:* **60**
Total Marks: **100**

Course Objectives:

1. The primary objective of this course is to introduce the basic principles, techniques and applications of Artificial Intelligence.
2. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software or tools programming environments.

The student should be made to:

1. Gain a historical perspective of AI and its foundations.
2. Study the concepts of artificial intelligence.
3. Investigate applications of AI techniques in intelligent agents.
4. Learn the methods of solving problems using artificial intelligence.
5. Learn various peculiar search strategies for AI.

Unit I: Introduction **[10L] Max Marks: 18**

Overview and defining AI techniques, Turing test, Branches of Artificial Intelligence, Applications of Artificial Intelligence - Intelligent Agents - Structure, Types of Agents and Autonomous Agents.

Unit-II: State Space Search and Heuristic Search Techniques **[12L] Max Marks: 18**

Defining Problems as State Space Search, Production Systems And Characteristics, Hill Climbing, Breadth First And Depth First Search, Best First Search, AO*.

Unit-III: Knowledge Representation **[10L] Max Marks: 18**

Knowledge Management, Types Of Knowledge, Knowledge Representation-Bases And Structures - First Order Logic, Unification Algorithm, Frames, Conceptual Dependency, Scripts, Semantic Network.

Unit-IV: Reasoning **[8L] Max Marks: 10**

Types of Reasoning, Non-Monotonic Reasoning, Fuzzy Logic, Bayes Rule, Bayesian Networks.

Unit-V: Game Playing and Planning **[8L] Max Marks: 10**

Mini-max Algorithm, Alpha-beta Algorithm, Goal Stack Planning.

Unit – VI: Machine Learning **[12L] Max Marks: 16**

Why Machine Learning, Types of Machine Learning: Supervised Learning- Classification & Regression, K-NN Algorithm, Unsupervised Learning-Clustering & Association, Reinforcement Learning.

References:

1. Deepak Khemani (2013), A First Course in Artificial Intelligence, McGraw Hill Education (India), ISBN 9781259029981
2. Elaine Rich and Kevin Knight (1991), Artificial Intelligence, Tata McGraw Hill, ISBN 13:9780070087705
3. Stuart Russell and Peter Norvig (2009), Artificial Intelligence: A Modern Approach, 3rdEdition, Prentice Hall, ISBN-13: 978-0-13- 604259-4

Course Outcome:

At the end of the course, the student should be able to:

1. Identify problems that are amenable to solution by AI methods.
2. Identify appropriate AI methods to solve a given problem.
3. Design smart system using different informed search / uninformed search or heuristic approaches.
4. Apply the suitable algorithms to solve AI problems.

Course Code: **CS-412** **Optimization Algorithms** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. To introduce with the branch of Optimization and its role in decision making.
2. To list out various types of applications of Optimization Algorithms.
3. To explain Linear Programming Problem (LPP) and practice with techniques to solve various types of LPP (transportation problem, assignment problems, special cases of duality).
4. Describe the significance, concept of game theory and algorithms to solve game theory problems.

Unit-I Introduction to Optimization and Linear Programming [10L] Max Marks: 15

Optimization: Introduction, Applications, Feasible and optimal Solutions, Linear Programming: Special Types: Transportation Problem as LPP, Initial Basic Feasible Solution, North West corner Rule, Lowest Cost Method, Vogel's Approximation Method, MODI method for optimization, Degeneracy. Assignment problem, Hungarian Method, Special cases of assignment problem.

Unit-II Linear Programming Problems [12L] Max Marks: 18

Linear Programming Problems: Introduction, Formulation of Mathematical model of LPP, Standard form of linear programming problems, Solving LPP using Graphical method, Infeasible LPP, Unbounded LPP, Basic feasible solutions, Simplex method for solving LPP, augmentation using Slack and artificial variables, Degeneracy, Duality: concept, applications and example.

Unit-III Game Theory [8L] Max Marks: 12

Game Theory: Concept, Two persons zero sum game, Pay off matrix, Pure and mixed strategy games, Rule of Dominance, Subgame method.

References:

1. Hamdy Taha (2010), Operations Research: An Introduction. Pearson Education, ISBN: 978-0132555937
2. L C Jhamb, Quantitative Techniques for Managerial Decisions Vol. I, Vol. II. Everest Publishing House, ISBN: 8186314628
3. Jasbir Arora (2016), Introduction to Optimum Design. 4th Edition. Elsevier. Hardback ISBN: 9780128008065 eBook ISBN: 9780128009185.
4. Panneer Selvan R (2006), Operations Research. Prentice Hall of India. ISBN: 978-8120329287

Course Outcome:

After completion of this course students shall be able to

1. Write about Optimization and decision making.
2. Differentiate between feasible and optimal solution
3. Apply solving techniques to all types of LPP.
4. Apply solving techniques to game theory problems.

Course Code: **CS-413** **Current Computing Trends in Java** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. Understand the fundamentals of the Spring framework and its core concepts.
2. Develop and deploy web applications using Spring Boot and Hibernate.
3. Build RESTful APIs and secure them using Spring Security.
4. Perform data access operations using Hibernate ORM.
5. Gain knowledge of advanced topics such as caching, asynchronous programming, and microservices architecture.
6. Apply best practices for designing and implementing scalable and maintainable Java applications.

Unit-I Introduction to Spring Boot **[10L] Max Marks: 15**

Introduction to Spring framework, Features and advantages of Spring Boot, Setting up a Spring Boot project, Building and running a basic Spring Boot application, Configuring Spring Boot with application properties.

Unit-II: Spring Boot Data Access with Hibernate **[10L] Max Marks: 15**

Introduction to Hibernate ORM, Setting up Hibernate with Spring Boot, Configuring database connection properties, Mapping entities and relationships with Hibernate annotations, Performing CRUD operations with Hibernate.

Unit-III: **Spring Boot RESTful Web Services** **[10L] Max Marks: 15**

Introduction to RESTful architecture, Creating RESTful APIs with Spring Boot, HandlingHTTP methods (GET, POST, PUT, DELETE), Request and response serialization with Jackson, Handling exceptions and error responses.

Unit-IV: Spring Boot Security **[10L] Max Marks: 15**

Introduction to Spring Security, Configuring Spring Security with Spring Boot, User authentication and authorization, Securing RESTful APIs with role-based access control, Implementing JWT (JSON Web Tokens) for authentication.

Unit-V: Advanced Spring Boot Topics **[10L] Max Marks: 15**

Caching data with Spring Boot, Asynchronous programming with Spring Boot, Handling file uploads and downloads, Integration with external services (e.g., email, payment gateways), Deploying Spring Boot applications to a server.

Unit-VI: Introduction to Microservices with Spring Boot [10L] Max Marks: 15

Microservices architecture principles and benefits, Building microservices with Spring Boot, Service discovery and load balancing, Inter-service communication with REST and messaging, Monitoring and logging microservices, Application of Spring JPA.

References:

1. Craig Walls, Spring Boot in Action, ISBN-9781617292545.
2. John Carnell, Spring Micro services in Action, ISBN-13 978-1617293986
3. Felipe Gutierrez, Pro Spring Boot 2: An Authoritative Guide to Building Micro services, Web and Enterprise Applications, ISBN-13 978-1484236758
4. Christian Bauer & Gavin King, Java Persistence with Hibernate, ISBN-9781617290459
5. Laurentiu Spilca, Spring Security in Action, ISBN-9781617297731
6. Thorben Janssen, Hibernate Tips: More than 70 solutions to common Hibernate Problems ISBN-13 978-1544869179
7. Alex Soto Bueno & Jason Porter, Testing Java Micro services, ISBN-9781617292897
8. Petri Kainulainen, Spring Data JPA: Modern Data Access for Enterprise Java, ISBN-13 978-1449323950

Course Outcome:

After completion of this course students shall be able to

1. Develop high performance applications.
2. Acquire knowledge of secure and flexible framework.
3. Learn ease of use of databases in projects.
4. Define HTTP GET and POST operations.
5. Use a REST Client to make POST and GET requests to an API
6. Build self-contained and ready to run applications.

Course Code: **CS-414** **Lab on Artificial Intelligence (AI)** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

1. Understand and learn.
2. To convert the algorithms to code.
3. To measure the complexities at run time.
4. To modify the algorithms for efficiency.
5. To debug and test the programs.
6. To conclude using profile of outcome OS: windows, programming language: python.

Laboratory Assignments:

1) Implement simple program for Chabot.
2) Implement programs in problem solving and state space search in AI missionary and cannibals.
3) Implement programs in problem solving and state space search in AI tic-tac-toe.
4) Implement programs in problem solving and state space search in AI tower of Hanoi.
5) Implement programs in problem solving and state space search in AI water-jug.
6) Implement algorithms in depth first search.
7) Implement algorithms in breadth first search.
8) Implement A* algorithm.
9) Implement program for travelling salesman problem.

Course Outcome:

1. Able to construct logic for the algorithms designed using designing techniques.
2. Able to do posterior analysis of the algorithms.
3. Able to debug the algorithms.
4. Modify to improve performance of the algorithms.
5. Able to test and profile the algorithms.

Course Code: **CS-415** **Lab on Current Computing Trends in Java** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

1. To learn Object Serialization.
2. To learn mapping of JAVA classes to database tables.
3. To learn sending and retrieving data across the network.
4. To learn to interact with databases without any SQL.
5. To learn to handle different HTTP requests.

Laboratory Assignments:

1. Build a blog management system where users can create, read, update, and delete blog posts. Use Hibernate to map the "Blog" entity and its relationships with other entities suchas "User" and "Comment." Implement CRUD operations to manage blog posts.

2. Develop an e-commerce product catalog where users can browse and search for products. Use Hibernate to map the "Product" entity and its relationships with entities like "Category" and "Supplier." Implement CRUD operations to manage products and perform searches based on various criteria.

3. Build an employee management system where administrators can add, update, and delete employee records. Use Hibernate to map the "Employee" entity and its relationships with entities like "Department" and "Role." Implement CRUD operations to manage employee records and perform searches based on different criteria.

4. Develop a library management system where users can borrow and return books. Use Hibernate to map the "Book" and "User" entities and their relationship as a many-to-many association. Implement CRUD operations to manage books and user records, as well as handling book borrowing and returning operations.

5. Create a RESTful API for managing user data. Implement endpoints for retrieving a list of users, getting a specific user by ID, creating a new user, updating an existing user, and deleting a user. Handle different HTTP methods (GET, POST, PUT, DELETE) for user-related operations.

6. Develop a RESTful API for managing a product catalog. Implement endpoints for retrieving a list of products, getting a specific product by ID, adding a new product,updating an existing product, and deleting a product. Handle appropriate HTTP methods and serialization of request/response objects.

7. Create a RESTful API that provides weather forecast data for different locations. Implement endpoints for retrieving weather information by location, handling different HTTP methods, and serializing response objects with appropriate weather data.

8. Build a RESTful API for uploading and downloading files. Implement endpoints for uploading a file, retrieving a list of uploaded files, downloading a specific file by ID, and deleting a file. Handle appropriate HTTP methods and handle file serialization and deserialization.

9. Build a microservice responsible for user registration. Implement endpoints for user registration, validation, and retrieval. Use Spring Boot and Spring JPA to persist user data in a database.

10. Develop a microservice for order management. Implement endpoints for placing new orders, retrieving order details, and updating order status. Utilize Spring Boot and Spring JPA to store and retrieve order data.

Course Outcome:

After successful completion of the course students are able to

1. Implement object serialization.
2. Implement mapping of JAVA classes to database tables.
3. Implement sending and retrieving the data across the network.
4. Implement interaction with databases without SQL.
5. Implement handling of different HTTP requests.

Select any one Elective form CSE-416 (A) and CSE-416 (B)

Course Code*: CSE-416 (A)** **Big Data Analytics** *Clock Hours:* ***60
Total Marks: ***100***

Course Objectives:

1. To understand the Big Data challenges & opportunities, its applications
2. Understanding of concepts of map and reduce and functional programming
3. Gain conceptual understanding of Hadoop Distributed File System.
4. To solve the case studies related to real life situations
5. To bridge the gap between academics and industry needs.

Unit-I: Introduction to Big Data **[10L] Max Marks: 14**

Data Storage and Analysis, Characteristics of Big Data, Big Data Analytics, Typical Analytical Architecture, Requirement for new analytical architecture, Challenges in Big Data Analytics, Need of big data frameworks.

Unit-II: Hadoop Framework **[14L] Max Marks: 20**

Hadoop – Requirement of Hadoop Framework, Design principle of Hadoop – Comparison with other system - Hadoop Components – Hadoop 1 vs. Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining Map Reduce jobs.

Unit-III: HDFS (Hadoop Distributed File System) **[6L] Max Marks: 12**

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces.

Unit-IV: Map Reduce **[10L] Max Marks: 12**

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit-V: Hadoop Eco System **[14L] Max Marks: 20**

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction.

Unit-VI: Data Analytics with R Machine Learning **[6L] Max Marks: 12**

Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with Big R.

References:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
6. ArvindSathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", MC Press, 2012
7. Paul Zikopoulos, Dirk DeRoos, Krishnan Parasuraman, Thomas Deutsch, JamesGiles, David Corigan , "Harness the Power of Big Data The IBM Big Data Platform",Tata McGraw Hill Publications, 2012.

Course Outcomes:

After completion of this course students shall be able to

1. Recognize the characteristics, applications of big data that make it useful to real-world problems.
2. Process available data using big data tools hadoop file system and predict outcomes to solve given problem.
3. Study & Design various case studies using big data tools/commands and analyze it.
4. Discuss the challenges and their solutions in Big Data
5. Understand and work on Hadoop Framework and eco systems.
6. Explain and analyze the Big Data using Map-reduce programming in Hadoop.

Course Code*: CSE-416 (B)** **Cloud Computing** *Clock Hours: **60

*Total Marks: **100***

Course Objectives:

2. Understand the fundamental concepts, principles, and components of Cloud Computing.
3. Learn the general comparative study on different types of cloud architecture.
4. Analyse and understand the basics of cloud architecture.
5. Evaluate cloud architecture in terms of comparative study on various cloud architecture available.
6. Critique cloud architecture and various components in cloud architecture.

Unit-I: Introduction to Cloud Architecture [10L] Max Marks: 14

Introduction to Cloud Computing Architecture, Private, public and hybrid cloud, Types of cloud architecture, Cloud types; IaaS, PaaS, SaaS, Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud, Business Agility: Benefits and challenges to Cloud architecture.

Unit-II: Server Architectures [08L] Max Marks: 12

Introduction to server, Stand-alone, blades, Stateless server, Clustering and scaling, Optimization and virtualization, Limitation of traditional server deployments, Modern solutions, Applications: database, finance etc., Redundant Layer 2 and Layer 3 designs, Case studies.

Unit-III: Data Centre Architectures [10L] Max Marks: 15

Network connectivity optimization evolution, Top of rack (TOR), end of rack (EOR), Scale up vs scale up, solutions that reduce power and cabling, Data Centre standards; TIA/EIA-942, Structured cabling standards, fibre and copper cabling characteristics, Cable management, bandwidth requirements, I/O connectivity.

Unit-IV: Virtualized Data Center Architecture [10L] Max Marks: 15

Cloud infrastructures; public, private, hybrid, Service provider interfaces; Saas, Paas, Iaas, VDC environments; concept, planning and design, business continuity and disaster recovery principles, Managing VDC and cloud environments and infrastructures.

Unit-V: Storage Network Design [08L] Max Marks: 12

Architecture of storage, Analysis and planning, Storage network design considerations; NAS and FC SANs, Hybrid storage networking technologies (iSCSI, FCIP, FCoE), Design for storage virtualization in cloud computing, Host system design considerations.

Unit-VI: Security Concepts **[14L] Max Marks: 22**

Introduction to cloud Security, Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defense in depth, least privilege, How these concepts apply in the cloud, What these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud;

Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key Cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

References:

1. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.
3. Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739], 2011
4. Cloud Computing Protected: Security Assessment Handbook (John Rhoton, Jan De Clercq, David Graves) ISBN: 9780956355621, 0956355625
5. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching:Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010

Course Outcomes:

After successful completion of this course, student will be able to

1. Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2. Apply the fundamental concepts in datacentres to understand the trade-offs in power, efficiency and cost.
3. Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
4. Analyze various cloud programming models and apply them to solve problems on the cloud.

Semester-II

Course Code: **CS-421** **Data Warehousing and Data Mining** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To comprehend evolution of decision making, operational vs. decision support system and the concept of data warehouse.
2. To understand transactional and analytical processing.
3. Significance of analytical processing and importance of data pre-processing.
4. Learn various data pre-processing techniques, methods.
5. Understand and apply various techniques/algorithms to obtain meaningful patterns from data (Association mining, classification and clustering).

UNIT-I: Fundamentals of Data Warehousing **[10L] Max Marks: 12**

Failure Of Past Decision Support System, Operational V/S Decision Support Systems, Data Warehousing Lifecycle, Architecture, Building Blocks, Components Of DW, Data Marts And Metadata.

UNIT-II: Data Pre-processing **[10L] Max Marks: 12**

Need for Pre-Processing of the Data, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization And Concept Hierarchy Generation.

UNIT-II: OLAP **[10L] Max Marks: 14**

OLAP In Data Warehouse, Demand For Online Analytical Processing, Need For Multidimensional Analysis, Limitations Of Other Analysis Methods, OLAP Definitions And Rules, OLAP Characteristics, Major Features And Functions, OLAP Models-ROLAP, MOLAP, HOLAP, Differentiation, Data Cubes And Operations On Cubes.

UNIT-IV: Data Mining **[06L] Max Marks: 10**

Introduction-Data Mining functionalities, Classification of Data Mining Systems, Basic Data Mining task, Data Mining Issues.

Unit-V: Association Rule Mining **[08L] Max Marks: 12**

Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules-Mining multilevel association rules- Mining multidimensional association rule(Association Mining to Correlation Analysis, Constraint-Based Association Mining).

Unit-VI: Classification and Prediction **[08L] Max Marks: 18**

Issues Regarding Classification and Prediction, Classification by Decision Tree Introduction, Bayesian Classification, Rule Based Classification, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods – Prediction – Accuracy and Error Measures.

Unit-VII: Cluster Analysis **[08L] Max Marks: 12**

Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods –Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods, Clustering High-Dimensional Data, Outlier Analysis.

References:

1. Jiawei Hanand Micheline Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier, Reprinted 2008.
2. M. H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson Education, 2001.
3. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann, 2000.
4. D.Hand, H.Mannila and P.Smyth, Principles of Data Mining, Prentice-Hall, 2001
5. Tan Steinbach,Vipin Kumar,IntroductiontoDatamining, Pearson Eduction
6. JarkeVassiliou, Fundamentals of DataWarehouses, IInd Edition,Springer
7. Anahory Murray, Data Warehousing in Real World, Pearson Education

Course Outcomes:-

After this course students shall be able to –

1. Explain organization of data warehousing and data marts.
2. Differentiate between OLTAP and OLAP.
3. Apply data pre-processing techniques.
4. Write basic algorithms for extracting patterns from data (association mining, classification and clustering).
5. Solve problems related with various aspects of data mining.

Course Code: **CS-422** **Angular JS** *Clock Hours:* ***30***
Total Marks: ***50***

Course Objectives:

1. Reduce the amount of code you write to build rich user interface applications.
2. Increase the reliability and maintainability of UI by using data binding.
3. Retrieve data from back-end server, manipulate it and display it with ease.
4. Modularize your code with the custom services and directives.
5. Providing two ways binding of data.
6. Create Single Page Applications (SPA).

UNIT- I: Introduction to Angular JS [06L] Max Marks: 08

What is Angular JS? Advantages and Disadvantages of Angular JS, Features of Angular JS, Angular JS Directives, Angular CLI and Troubleshooting, Node JavaScript Introduction, Setup Node JS with angular, Typescript Introduction, What is bootstrap, How AngularJS Integrates with HTML, Creating AngularJS Application.

UNIT –II: Modules and Components, Data Binding in Angular JS [10L] Max Marks: 12

What is Component in Angular JS, what is Module in Angular JS, Create and Start Component, Why Components are important. How we create a component, Create Component using CLI, What is nesting Component, What is Component Template, Component Styles and Selectors. What is Data Binding? Splitting Application into Component, String Interpolation, What is Property Binding, Difference between Property Binding and String Interpolation, What are Binding Properties and Events, Two Way binding, Combine Forms with Data binding.

UNIT –III: Dependency Injection in Angular JS [06L] Max Marks: 10

What is Dependency Injection, What is Services, Logging Service and Injection, Create Data Service, Instance of Services, Insert Service into Services, How to use service in Cross Component, What is Hierarchical Injector.

UNIT-IV: Forms in Angular JS [08L] Max Marks: 15

What is Forms and how do we handle it? Reactive Approach, Template Driven, Create Template Driven Forms, What is Registering Control, Use and Submit of Forms, Access of Forms, How to add validation in use input, Build-In Validation, HTML5 Validation, Output Validation and Error Messages, Two Way Binding, Grouping, Radio Button Handling,

Patch Forms Values, Resetting Templates form Forms, Reactive Forms, What is Reactive Forms, Create Reactive form through code.

References:

1. Istvan Novak, Unraveling AngularJS 1.5: With Over 140 Complete Samples (Unraveling series), ISBN-978-1532916144
2. Brad Green and Shyam Seshadri, Angular JS: Up and Running - Enhanced Productivity with Structured Web Apps, ISBN- 978-9351108016
3. Pawel Kozlowski, Mastering Web Application Development with Angular JS, ISBN-978-1-78216-182-0
4. Andrew Grant, Beginning Angular JS, ISBN- 978-1484201619

Course Outcomes:

After this course students shall be able to –

1. Understand the fundamentals of Angular Forms and its architecture.
2. Present data in beautiful, interactive lists.
3. Build forms and setting pages.

Course Code: **CS-423** **Compiler Construction** *Clock Hours:* ***60***
Total Marks: ***100***

Course Objectives:

1. To learn the various phases of compiler.
2. To learn the various parsing techniques.
3. To understand intermediate code generation and run-time environment.
4. To learn to implement code generator.

Unit-I: Compiler Structure **[07L] Max Marks: 08**

Analysis-synthesis model of compilation, various phases of a compiler, tool-based approach to compiler construction.

Unit-II: Lexical Analysis **[08L] Max Marks: 12**

Interface with input, parser and symbol table, token, lexeme and patterns, Difficulties in lexical analysis, Error reporting, Implementation, Regular definition, Transition diagrams, LEX.

Unit-III: Syntax Analysis **[15L] Max Marks: 25**

CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC. Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators.

Unit-IV: Run Time System **[10L] Max Marks: 15**

Storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.

Unit-V: Intermediate Code Generation **[10L] Max Marks: 15**

Intermediate representations, Translation of declarations, Assignments, Control flow, Boolean expressions and procedure calls. Implementation issues.

Unit-VI: Code Generation and Instruction Selection [10L] Max Marks: 15

Issues, basic blocks and flow graphs, register allocation, code generation, DAG representation of programs, code generation from DAGs, peep-hole optimization, code generator generators, specifications of machine.

References:

1. Aho A.V., R. Sethi and J.D. Ullman, Compiler Principle, Techniques and Tools: Addison Wesley, ISBN 0-321-48681-1
2. Barret, Couch. Compiler Construction Theory and Practice: Computer Science series, Asian Student Ed, ISBN 978-0574213358
3. Dhamdhere D.M. Compiler Construction Principle and Practice: McMillan India, ISBN 9780333904060
4. Gres D. Compiler Construction for Digital Computer: Wiley, ISBN 047132776X. 5. David Galles (2009). Modern Compiler Design: Pearson Education, ISBN 9788131709412

Course Outcome:

After this course students shall be able to –

1. Understanding of basic structure of compiler, concepts and terminology in programming languages, lexical analysis, finite state techniques, scanner generator, parsing, kinds of parsers, designing lexical analyzer, scanner and parsers, principal ideas with intermediate code generation, optimizations.
2. Understanding of all concepts essential to design compiler in general for programming languages.

Course Code: **CS-424** **Lab on Data Warehousing and Data Mining** *Clock Hours*: **60**
Total Marks: **50**

Course Objectives:

- To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Laboratory Assignments:

1. Demonstrate the data preprocessing dataset using: Student .arff.
2. Demonstration of association rule process on dataset test.arff using apriori algorithm.
3. Demonstration of association rule process on dataset employee .arff using j 48 algorithm.
4. Demonstration of Clustering rule process on dataset Student. arff Using Simple K-means.
5. Demonstration of classification rule process on dataset employee. arff Using naïve bayes algorithm.
6. Demonstration of Clustering rule process on our own dataset Using Simple K-means.
7. Demonstration of Clustering algorithms.

Course Outcomes:

- Organize strategic data in an enterprise and build a data Warehouse.

Course Code: **CS-425** **Lab on Angular JS** *Clock Hours:* **60**

Total Marks: **50**

Course Objectives:

1. Reduce the amount of code you write to build rich user interface applications.
2. Increase the reliability and maintainability of UI by using data binding.
3. Retrieve data from back-end server, manipulate it and display it with ease.
4. Modularize your code with the custom services and directives.
5. Create Single Page Applications (SPA).

Laboratory Assignments:

1. Write a program to print "Hello world!" using angular js script.
2. Write an Angular JS script to demonstrate arithmetic expressions.
3. Write an Angular JS script to add Modules and Controller.
4. Write an Angular JS script to print first name and last name using angular js controller.
5. Write an Angular JS script to demonstrate the use of services.
6. Write an Angular JS script to demonstrate the use of Tables.
7. Write an Angular JS script to create select box using options.
8. Design a simple form using Angular JS Script.
9. Design a simple form and apply validation to it.

Course Outcomes:

After completing this course, you will be able to:

- Get familiar with client-side Javascript frameworks and the Angular framework.
- Use various Angular features including directives, components, and services.
- Implement a functional front-end web application using Angular.

Select Elective any one group form CSE-426(A) and CSE-426 (B)

Course Code: **CSE-426 (A1)** **Web Analytics** *Clock Hours:* **30**
Total Marks: **50**

Course Objectives:

- Understand social media, web and social media analytics, and their potential impact.
- Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics.
- Use various data sources and collect data relating to the metrics and key performance indicators.
- Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

UNIT-I: Introduction **[05L] Max Marks: 08**

What is web Analytics, Importance of web Analytics, Web Analytics process, Types of web analytics, Web analytics technical requirements, Web analytics 2.0 framework.

UNIT-II: Qualitative Analysis **[06L] Max Marks: 08**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations, Site Visits: Conducting a site visit, Benefits of site visits, Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys.

UNIT-III: Web Metrics **[08L] Max Marks: 14**

Key metrics, Dashboard: Implementation, metrics, Types of metrics, Conversion: goals, funnels, Data sources: server log, visitors data, search engine statistics and conversion funnels, Data segmentation, Analysis, Emerging analytics: e –commerce, mobile analytics, A/B testing, Social Media Analytics: Sentimental Analysis, Text Analysis, Annotation and Reporting: Automated, Actionable.

UNIT-IV: Web Analytics **[07L] Max Marks: 10**

Introduction to analytic 2.0, Competitive intelligence analysis, CI data sources: Toolbar data, Panel data, ISP data, Search engine data, Hybrid data Website traffic analysis, Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

UNIT-V: Google Analytics **[04L] Max Marks: 05**

Audience analysis, Acquisition analysis, Behavior analysis, Conversion analysis, Google website optimizer, Implementation technology, Privacy issues.

References:

1) Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd Edition
2) Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st Edition
3) Kaushik A., Web Analytics: An Hour a Day, 1st Edition
4) Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

Course outcomes:

After this course students shall be able to –

1. Determine the likelihood that a given customer will repurchase a product after purchasing it in the past.
2. Personalize the site to customers who visit it repeatedly.
3. Monitor the amount of money individual customers or specific groups of customers spend.
4. Observe the geographic regions from which the most and the least customers visit the site and purchase specific products.

Course Code: **CSE-426 (B1)** **Soft Computing** *Clock Hours:* **30**

Total Marks: **50**

***Course Objectives**:*

1. Understand the fundamental concepts, principles, and components of Soft Computing.
2. Gain knowledge of Fuzzy Logic, Neural Networks, and Genetic Algorithms, and their applications.
3. Develop skills in designing and implementing Fuzzy Logic systems, Neural Networks, and Genetic Algorithms.
4. Learn to integrate different Soft Computing techniques to solve complex real-world problems.
5. Enhance problem-solving abilities using practical exercises and hands-on implementation.
6. Foster critical thinking and analytical skills in the field of Soft Computing.

UNIT- I: Introduction to Soft Computing **[6L] Max Marks: 08**

Introduction to Soft Computing: Definition, characteristics, and significance, Comparison of Soft Computing with traditional computing techniques, Components of Soft Computing: Fuzzy Logic, Neural Networks, Genetic Algorithms, Applications and benefits of Soft Computing in various domains, Challenges and limitations of Soft Computing techniques.

UNIT- II: Fuzzy Logic **[6L] Max Marks: 10**

Introduction to Fuzzy Logic: Principles and concepts, Fuzzy Sets and Membership Functions: Definition and properties, Fuzzy Logic Operations: Union, Intersection, Complement, Fuzzy Rules and Rule-based Systems: Construction and inference mechanisms, Fuzzy Inference Systems: Mamdani and Sugeno models, Fuzzy Control Systems: Design and implementation.

UNIT-III: Neural Networks **[12L] Max Marks: 15**

Fundamentals of Artificial Neural Networks (ANN): Architecture and working principles, Single-layer and Multi-layer Perceptrons: Structure and training algorithms, Activation functions: Types and their impact on network performance, Training algorithms: Backpropagation, Gradient Descent, and variants, Supervised and Unsupervised learning in neural networks, Deep Learning and Convolutional Neural Networks (CNN): Concepts and applications, Neuro-Fuzzy Systems: Architecture and learning algorithms.

UNIT-IV: Genetic Algorithms **[6L] Max Marks: 12**

Introduction to Genetic Algorithms (GA): Basic concepts and principles, Chromosomes, Genes, and Fitness Function: Representation and evaluation, Genetic Operators: Selection, Crossover, and Mutation, Encoding and decoding strategies for problem-solving, Fitness evaluation and selection mechanisms, Fuzzy Genetic Algorithms, Applications of Genetic Algorithms in optimization and search problems.

References:

1. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011
2. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017

Course outcomes:

After this course students shall be able to –

1. Understanding the basic soft computing with its applications and benefits.
2. Understanding basic principles of fuzzy logic with its control system designing and implementing.
3. Understanding architecture of neural network with its activation functions and deep learning.

Course Code: **CSE-426 (A2)** **LAB on Web Analytics** *Clock Hours:* **60**
Total Marks: **50**

Course Objectives:

1. Understand social media, web and social media analytics, and their potential impact.
2. Determine how to Leverage social media for better services and Understand usability metrics, web and social media metrics.
3. Use various data sources and collect data relating to the metrics and key performance indicators.
4. Identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

Laboratory Assignments:

1. **Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More**: Why Is Twitter All the Rage?, Exploring Twitter's API, Fundamental Twitter Terminology, Creating a Twitter API Connection, Exploring Trending Topics, Searching for Tweets, Analysing Tweets and Tweet Entities with Frequency Analysis.
2. **Mining Facebook: Analyzing Fan Pages, Examining Friendships:** and More Overview, Exploring Facebook's Social Graph API, Understanding the Social Graph API, Understanding the Open Graph Protocol, Analyzing Social Graph Connections, Analysing Facebook Pages, Examining Friendships
3. **Mobile Analytic: Analyze the your site on mobile device**: In last 30 days, how many new users come from mobile, What was the bounce rate of visitors on mobile device, What was the average session duration?
4. **Segment traffic:** Which social channel is sending the most engaged new users, Which pageof your Website have been shared most, Which URL has the best engagement matrix.
5. **Use Google Analytics to measure the various metrics for E-commerce site amazon.**

- **On-site** − It measures the users' behavior once it is on the website. For example, measurement of your website performance.
- **Off-site** − It is the measurement and analysis irrespective of whether you own or maintain a website. For example, measurement of visibility, comments, potential audience, etc.

Course Outcomes:

1. Gain a deep understanding of Web analytics as well as data about customer interactions with your organization online.
2. Identify and interpret conventional and emerging Web analytics measurements.
3. Understand the Web data collection and integration techniques and their potential applications and limitations.

Course Code: **CSE-426 (B2)** **Lab on Soft Computing** *Clock Hours:* **60**

Total Marks: **50**

Course Objectives:

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing.

Upon completion of this course, the student should be able to get an idea on:

1. Artificial Intelligence, Various types of production systems, characteristics of production systems.
2. Neural Networks, architecture, functions and various algorithms involved.
3. Fuzzy Logic, Various fuzzy systems and their functions.
4. Genetic algorithms, its applications and advances.

Laboratory Assignments:

1. Design a command-line calculator that performs arithmetic operations (addition, subtraction, multiplication, division) on fuzzy numbers. Implement fuzzy arithmetic operations using appropriate fuzzy logic rules and membership functions. Test the calculator with different fuzzy numbers and evaluate the accuracy of the results.

2. Develop a simulation of a fuzzy traffic light controller for a busy intersection. Define fuzzy sets and membership functions for traffic flow (e.g. low, medium, high) and waiting time. Design fuzzy rules to determine the duration of green, yellow, and red lights based on traffic flow and waiting time. Simulate the traffic light controller and analyze its performance in terms of traffic congestion and waiting times.

3. Design a fuzzy logic controller for a washing machine that adjusts the wash cycle based on the level of dirtiness and fabric type. Define fuzzy sets and membership functions for dirtiness level (e.g. low, medium, high) and fabric type (e.g., delicate, cotton, heavy-duty). Create fuzzy rules to determine the wash cycle duration, water temperature, and detergent amount based on dirtiness level and fabric type. Implement the fuzzy logic controller and evaluate its effectiveness in achieving clean and undamaged clothes.

4. Design and implement a single-layer perceptron from scratch using Python. Train the perceptron on a binary classification problem.

5. Develop a Multi-Layer Perceptron (MLP) for any real world problem.

6. Application of genetics algorithm to real world problems.

Course Outcomes:

At the end of the course the student should be able to:

1. Learn about soft computing techniques and their applications.
2. Analyze various neural network architectures.
3. Understand perceptron's and counter propagation networks.
4. Define the fuzzy systems.
5. Analyze genetic algorithms and their applications.

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