Detailed Syllabus
Lecture-wise
Breakup

Subject Code	17M11CS112	**Semester Odd (specify Odd/Even)**	**Semester** I **Session** 2021-2022 **Month from** July to December
Subject Name	Machine Learning and Data Mining		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Archana Purwar
	Teacher(s)	Archana Purwar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Differentiate between Classification, Clustering and Association Rules techniques.	Level 4 (Analyze)
CO2	Understand working of classification techniques, e.g., k-Nearest Neighbours, Naïve Bayes, ID3 Decision Trees, Support Vector Machine, Ensemble methods.	Level-2- (Understanding)
CO3	Apply and compare different clustering techniques, e.g., k-means, k-mediods, etc.	Level-3 (Apply)
CO4	Evaluate different dimensionality reduction techniques e.g. PCA, SVD, Factor Analysis, Linear Discriminant Analysis, etc., in big data scenarios.	Level-5 (Evaluate)
CO5	Apply various Artificial Neural Network Models for classification and clustering	Level-3 (Apply)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1	Introduction	Introduction to Machine Learning, Data Mining and Knowledge Discovery in Data Bases, Data Types	2
2	Classification	Introduction to classification, k-Nearest Neighbours, Naïve Bayes, Decision Trees, Advanced classification techniques	6
3	Regression	Linear Regression with One Variable, Linear Regression with Multiple Variables, Logistic Regression	4
4.	Clustering	Introduction, Different type of Clustering Methods, Partitioning Clustering Methods, Hierarchical Clustering Methods, k-means, k-medoids, density based clustering, cluster validation	8
5.	Association Rules	Support, Confidence, Lift, Conviction; Apriori algorithm, Eclat algorithm, FP-growth algorithm	4
6.	Dimensionality Reduction	Introduction, Subset Selection, PCA, SVD, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis	6
7.	Artificial Neural Methods	Cost Function, Back propagation, Feed forward Network, Gradient Descent, Network training, Error Propagation, Application of Neural Networks, Introduction to quantum neural network	8
8.	Ensemble Methods	Ensemble methods of classification-Bagging, Boosting, and Random Forest	4

Total number of Lectures	42

Evaluation Criteria

Components	**Maximum**
Marks T1	**20**
T2	**20**
End Semester Examination	**35**
TA	**25 (Attendance (10), Mini-project/Assignment (15)**
Total	**100**

Project based learning: Each student in a group of 3-4 will have to develop a mini project based on association mining, classification and clustering approaches. The students can choose any real-world application that requires some decision-making. The students have to implement the mini-project using any open-source programming language. Project development will enhance the knowledge and employability of the students in IT sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc.)

1.	Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and techniques. Elsevier, 3rd edition ,2012
2.	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley, 3rd edition,2013
3.	Pujari, Arun K, Data mining techniques , Universities press, 3rd edition , 2013
4.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, second edition, 2019
5.	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
6.	Mitchell, Tom, and Machine Learning McGraw-Hill. "Edition." (1997).
7.	Wittek, Peter. Quantum machine learning: what quantum computing means to data mining. Academic Press, 2014.
8.	Anahory S. and Murray D, Data Warehousing in the Real World, Addison- Wesley
9.	Dunham, Margaret H. Data mining: Introductory and advanced topics. Pearson Education India, 2006.
10.	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw- Hill.
11.	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
12.	Transactions on Database Systems (ACM)
13	IEEE Transactions on Knowledge & Data Engineering
14	The VLDB Journal The International Journal on Very Large Data Bases

Detailed Syllabus
Lecture-wise Breakup

Course Code	18M12CS119	**Semester** ODD **(specify Odd/Even)**	**Semester** I **Session** 2021 -2022 **Month from** July 2021- December 2021
Course Name	E-Commerce and Social Web		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr.Sandeep Kumar Singh
	Teacher(s) (Alphabetically)	Dr. Sandeep Kumar Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
C120.1	Compare and categorize different commercial models of E-commerce.	Understand Level (Level 2)
C120.2	Design and develop marketing strategies based on interactions and insights from Social web to enhance revenue promote brand and reach out to customers.	Create Level (Level 6)
C120.3	Make Use of Open source API s from various social networking sites.	Apply Level (Level 3)
C120.4	Outline suggestions and recommendations for Social Shopping.	Understand Level (Level 2)
C120.5	Measure the effect of different Social media marketing strategies using Social Media metrics.	Apply Level (Level 3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction and overview of e-Commerce	Definition and models of e-Commerce and examples. Selection of an E-commerce type and business model. Business models based on (1) Transaction Parties (2) Transaction Types. Case Studies of Indian context.	3
2.	Introduction to Social Web	Social Media : An Overview, Social Media Analytics: An Overview, SOCIAL MEDIA TEXT ANALYTICS, Twitter as Marketing Tool	5
3.	Social Web Landscape	Social Web overview, data-types, format, Text cleaning, tagging and storage, Social media techniques, tools and platforms, data visualization of data, research, applications and challenges in social Web.	3
4.	Introduction to Social e- Commerce	Introduction to Social Commerce, Supporting Theories and Concepts for Social Commerce, Tools and Platforms for Social Commerce	3
5.	Social Web Analysis	Analyzing Social web, Nodes, Edges and Network measures, Centrality, Power and Bottlenecks, Concept of Cliques, Clusters and Components, Viral marketing, Graph data in real world, Business use of Social web, Privacy in Social web, Influencer Outreach	5
6.	Social Shopping and Social Marketing	Social Media Marketing, Social Shopping: Concepts, Benefits, and Models, Customer Engagement and Metrics, Basic Social Marketing Strategies- Physical goods, Digital goods, Services, Affiliate Marketing, Guerrilla Marketing	5

7.	Programming using API and RSS feeds	Introduction to OAuth protocol, Programming and Crawling Social media using Twitter 4j Facebook API, LinkedIn API , Google +, Reddit, API, Instagram API	6
8	Twitter and Face book Data Analytics for Viral Marketing	Topic-based Clusters in Egocentric Networks on Facebook, Changes in Tie Strength Through Site Use on Facebook, Patterns of Responses to Resource Requests on Facebook, Exploring requests for help on Facebook, Analysis of User-Generated Content on Facebook, Predicting Clicks on Ads,Predicting the quality of new contributors to theFacebook crowdsourcing system	8
9.	Social Search Engine Optimization	Optimizing for Web Search, Using Photo-Sharing Sites for SEO, Optimizing for Social Search Engines	6
10.	Creating Suggestions and Recommendations	Perform web-market segmentation, making recommendations: collaborative filtering and content based filtering approaches, creating suggestions and building recommendation engines, Understanding recommendation engines based on users, items, and content, Finding recommendations about friends, articles, and news stories, Creating recommendations for sites similar to Netflix	6
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (To be mapped from PBL components which will improve their social marketing skills and data analytics skills by making them Industry ready as they will be able to use lot of publicly available APIs, recommendation and search engine optimisation techniques)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Michael P Papazoglou and Pieter M.A. Ribbers, " e-Business- Organizational and technical foundation" , John Wiley and Sons, 2006.
2.	EfraimTurban , David King, Dennis Viehland, Jae Lee, "Electronic Commerce A Managerial Perspective 2006", 4ed, Pearson Education International edition, 2006.
3.	Stephen Chen, "Strategic management of e-business", second edition, John Wiley and Sons, 2005.
4.	RS Prasad, "Cyber crime: An Introduction", ICFAI Books, ICFAIUniversity, 2004.
5.	RS Prasad, "Cyber crime: Combat Strategies", ICFAI Books, ICFAIUniversity, 2004.
6.	RS Prasad, "CRM Present and Future", ICFAI Books, ICFAIUniversity, 2005.
7.	Elaine Lawrence et al, "Internet commerce – Digital models for Business", John Wiley and Sons, 2003.
8.	Abhijit Choudhury and Jean-Pierre Kuilboer, "E-business and E-Commerece Infrastructure – Technologies supporting E-Business Initiative", McGraw Hill, 2002.
9.	Henry Chan et al, E-Commerece – fundamentals and applications", John Wiley and Sons, 2001.
10.	Programming Collective Intelligence: Building Smart Web 2.0 Applications by Toby Segaran
11.	Algorithms of the Intelligent Web HaralambosMarmanis, Dmitry Babenko
12.	Recommender Systems: An Introduction DietmarJannach (Author), Markus Zanker (Author), Alexander Felfernig (Author), Gerhard Friedrich

13.	Recommender Systems Handbook Francesco Ricci (Editor), LiorRokach
14.	Recommendation Systems in Software Engineering Martin P. Robillard (Editor), WalidMaalej (Editor), Robert J Walker (Editor), Thomas Zimmermann
15.	Web Analytics 2.0 Avinash Kaushik
16.	Analyzing Social Web JeneffirGolbeg
17.	Predictive Analytics Eric Segel

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M22CS113	**Semester Odd (specify Odd/Even)**	**Semester I Session** 2021 -2022 **Month from Sep '21 to Dec '21**
Course Name	Soft Computing and Applications		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Shikha Jain
	Teacher(s) (Alphabetically)	Shikha Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
C130.1	Select defuzzification and other methods in fuzzy decision making	Apply Level (Level 3)
C130.2	Analyze different fuzzy inference systems for various real world problems.	Analyze Level (Level 4)
C130.3	Develop solutions for different problems using genetic algorithm and it's extensions	Apply Level (Level 3)
C130.4	Apply different neural network based algorithm	Apply Level (Level 3)
C130.5	Analyze the suitability of hybrid systems for a given problem	Analyze Level (Level 4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction to Soft Computing	Definition, Goals, Importance of Soft Computing and its applications	2
2.	Fuzzy Logic	Introduction to fuzzy logic, memberships functions, fuzzy relation, fuzzification and defuzzification, fuzzy inference System, fuzzy decision making: individual, multi objective, multi attribute and its applications to different branches of Science and Engineering.	12
3.	Genetic Algorithms in Problem Solving	introduction, Elements of Genetic Algorithms, Types of Genetic Algorithms, Multi objective Genetic algorithm , Problem solving using GA	10
4.	Artificial Neural Networks	Introduction to artificial intelligent network, network architectures , Back propagation networks, Learning Vector Quantization , Counter Propagation Networks, Auto encoders, RNN, LSTM and its applications	12
5.	Hybrid System	Integration of neural networks, fuzzy logic and genetic algorithms. Neuro-Fuzzy, Neuro-Genetic and Fuzzy-Genetic systems, Applications of Soft computing in different fields of research specially in Data Analysis and Communications.	6
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [Attendance (10 Marks), Assignment/Mini-project (15 Marks)]
Total	**100**

Project based learning: Each student in a group of 3-4 students will choose a real world problem where hybrid soft computing could be designed. The skills developed in mini-project will enhance their knowledge on various soft computing techniques used in hybrid system and helps their employability in IT industries **.**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Text Books	
1.	Sivanandam, S. N., and S. N. Deepa. Principles of soft computing , Third Edition John Wiley & Sons, 2019.
2.	Haykin, Simon. Neural Networks and Learning Machines, 3/E. Pearson Education India, 2019.
3.	Deb, Kalyanmoy. Multi-objective optimization using evolutionary algorithms. Vol. 16. John Wiley & Sons, 2010.
Reference Books	
1.	Ross, Timothy J. Fuzzy logic with engineering applications. Vol. 2. New York: wiley, 2010.(Third Edition)
2.	Wilusz, Tadeusz. "Neural networks—A comprehensive foundation: By Simon Haykin. Macmillan, pp. 696, ISBN 0-02-352761-7, 1994." (1995): 359-360.
3.	Jyh-Shing Roger Jang et al., Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, First Edition, Prentice Hall, 1997
4.	Hassoun, Mohamad H. Fundamentals of artificial neural networks. MIT press, 1995.
5.	Rajasekaran, Sanguthevar, and GA Vijayalakshmi Pai. Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). PHI Learning Pvt. Ltd., 2003.
6.	Mehrotra, Kishan, Chilukuri K. Mohan, and Sanjay Ranka. Elements of artificial neural networks. MIT press, 1997.
7.	Mitchell, Melanie. An introduction to genetic algorithms. MIT press, 1998.
8.	Klir, George, and Bo Yuan. Fuzzy sets and fuzzy logic. Vol. 4. New Jersey: Prentice hall, 1995.
9.	IEEE Transactions on Knowledge and Data Engineering Mitchell, Melanie. An introduction to genetic algorithms. MIT press, 1998.
10.	IEEE Transactions on Systems, Man and Cybernetics

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18M12CS117**	**Semester (Odd)**	**Semester** I **Session** 2021 -2022 **Month from July – December 2021**
Course Name	Blockchain Technology and Applications		
Credits	03	**Contact Hours**	(L+T) (3+1)

Faculty (Names)	**Coordinator(s)**	Dr. P. Raghu Vamsi
	Teacher(s) (Alphabetically)	Dr. P. Raghu Vamsi

COURSE OUTCOMES (NBA CODE: C141)		**COGNITIVE LEVELS**
C141.1	Define what is blockchain and cryptocurrency, and when and why blockchain is required with its application areas.	Remember Level (Level 1)
C141.2	Understand and describe how blockchain works. Explain the underlying technology of transactions, blocks, proof-of-work, and consensus building.	Understand Level (Level 2)
C141.3	Identify and analyze the real world problems that the blockchain is trying to solve.	Understand Level (Level 2)
C141.4	Examine and implement tools and techniques to build a blockchain application.	Apply Level (Level 3)
C141.5	Explore the platforms such as Bitcoin, Ethereum, and Hyperledger to create and evaluate the blockhain applications.	Apply Level (Level 3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Blockchain	Conventional business models, Industry 4.0, Advantages of intermediary in the business model, Conventional ledger model, Problems with the existing business models. Distributed ledger technology, Example games – 1) Average age of the customers, 2) rating a product, and 3) Secure donation. SWOT analysis of Games. Cryptographic primitives: CIA properties, Asymmetric key cryptography, Elliptic curve cryptography, Digital Signatures, Cryptographic hash function, Merkle Tree Distributed consensus: Network models, properties, advantages and limitations of distributed consensus, Byzantine generals problem, Various consensus protocols explored by Distributed Systems.	8
2.	Bitcoin Case study	Recap of cryptographic primitives, introduction to Bitcoin cryptocurrency. Mechanics of Bitcoin: Bitcoin transactions; Bitcoin scripts; Applications of Bitcoin scripts; Bitcoin blocks; Bitcoin network; Limitations and improvements Consensus without identity using Blockchain: Incentives and Proof of Work (PoW); Attacks on PoW. Advantages and Limitations of PoW; Bitcoin – NG Bitcoin Mining: Task of Bitcoin miners; Mining Hardware;	6

		Energy consumption and Ecology. Mining pools; Mining Incentives and strategies.	
3.	Blockchain Development	Blockchain categories, how to chose blockchain projects, Blockchain vs. Database. Blockchain frameworks, Blockchain application use cases, Python program for understanding Blockchain creation, Miscellaneous concepts in Blockchain	4
4.	Ethereum blockchain	Ethereum vs. Bitcoin, Introduction to smart contracts and Ethereum Virtual Machine, Introduction to Remix IDE, Solidity Programming, Decentralized applications (DApps), environment setup (web3js), Truffle development (UI and deployment), Application models and standards	10
5.	Other Blockchain Frameworks	IBM Hyperledger, Flow Blockchain, Corda Blockcahin, Stratis Blockchain, Deploying private Blockchain	10
9.	Research aspects in Blockchain	Consensus protocols, Identity management, Strong and weak synchronization, avoiding forks, Mining improvements. Research directions in Blockchain applications.	4
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (PBL(10)+Quiz(5)+Attendance(10))
Total	**100**

PBL : A blockchain use case to be identified by students and they can chose a blockchain platform studied in the course for design and implementation.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Drescher, Daniel. "Blockchain basics", Apress, 2017.
2.	Mougayar, William. "The business blockchain: promise, practice, and application of the next Internet technology", John Wiley & Sons, 2016.
3.	Dannen, Chris. "Introducing Ethereum and Solidity", Berkeley: Apress, 2017.
4.	Prusty, Narayan. "Building Blockchain Projects", Packt Publishing Ltd, 2017.
5.	Pilkington, Marc. "Blockchain technology: principles and applications" Research handbook on digital transformations, 2016.
6.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.
7.	Swan, Melanie, "Blockchain: Blueprint for a new economy", O'Reilly Media, Inc., 2015.
8.	Antonopoulos, Andreas M. "Mastering Bitcoin: unlocking digital cryptocurrencies", O'Reilly Media, Inc., 2014.

Detailed Syllabus

Subject Code	19M12CS111	**Semester odd**	**Semester: First Session: 2021- 2022** **Month from July to December**
Subject Name	Web Intelligence		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr. Niyati Aggrawal
	Teacher(s) (Alphabetically)	Dr. Niyati Aggrawal

Course Outcomes:

At the completion of the course, students will be able to,

CO#	CO Description	COGNITIVE LEVELS
C121.1	Outline the various web technologies, methods, and models used to design an intelligent web.	Understand (Level-2)
C121.2	Make use of web caching strategies at varied level: user, web server, and gateway server.	Apply Level (Level-3)
C121.3	Analyze and Model the users' browsing behavior on web.	Analyze (Level- 4)
C121.4	Evaluate various Web content mining algorithms, Web language models and learning to rank models to handle complex Web.	Evaluate Level (Level-5)
C121.5	Design and develop the computational intelligent web algorithms to handle complex real problems	Create Level (Level-6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Web Content Feature Engineering	Frequency Filter, POS Tag, Unigram, Ngram, Collocation, Levenstein Distance, KL-Divergence, T-Test.	4
2	Web Language Models	Vector Space Models: TF-IDF, SGRank, SGRank-IDF, Single Rank, Word-Word occurrence matrix; Word Embedding with GloVe, Word2Vec, CBoW, Skip Gram Model Probabilistic models: Bayes model, BM25 Ranking model;	8
3	Web Content Searching	Link Based Search Algorithm, Power Iteration Method for ranking nodes on web, Handling Spider Traps and Dead ends, Topic Sensitive Page Ranking.	4
4	Ranking Algorithm and performance measures	Point wise ranking, Pair wise Ranking, Listwise ranking.	4

		Metrics for Learning to rank: CG, DCG, NDCG, P@K, MAP, AP	
5	Web caching Algorithm	LRV, FIFO, LRU, Random, OPT, Size based, PSS	4
6	Matrix Factorization Techniques	Matrix decomposition, Eigenvalue decomposition, non-Negative matrix factorization, Singular value decomposition, objective functions, UV decomposition, CUR decomposition	5
7	Tensor Factorization	Multidimensional Matrix Factorization, Matricization, Tucker decomposition, High Order SVD, clustHOSVD, other methods	4
10	Collective Intelligence	Crowd Sourcing, Local-Global Behavioral Interactions, Self-Organizing Systems, Self-Adaptive Evolutionary Systems, Information Extraction from Deep W e b , Decision Making Under Uncertainty	4
11	Graph Structure in the Web	Social Network Analysis, Google Patent Algorithm, News Feed Algorithm, Edge Rank Algorithm, Web of Things, Situational Awareness	5
		Total number of Lectures	**41**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance/ Class Assignments/Quiz/ Internal assessment & Mini-Project)
Total	**100**

Project Based Learning: Students will develop small size project in order to build an intelligent web concept in a group of 2-3. Basically, small size projects are given to students in form of assignments to provide solution out of topics discussed in the course. Understanding usage of appropriate methodology, then implementation of those selected methodology to handle real scenario intelligent web problem and evaluation of applied methodology using various performance measures is the prime concept to enhance students' knowledge towards intelligent web.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1	Web Intelligence Journal: https://www.iospress.nl/journal/web-intelligence-and-agent-systems/
2.	Soumen Chakrabarti,. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.
3.	Scime, Anthony, ed. Web mining: applications and techniques. IGI Global, 2005.
4.	Hitzler, Pascal, Markus Krotzsch, and Sebastian Rudolph. Foundations of semantic web technologies. CRC Press, 2011.

5.	Sponder, M., & Khan, G. F. (2017). Advanced Web Analytics and Web Intelligence. In Digital Analytics for Marketing (pp. 115-144). Routledge.
6.	Symeonidis, P., & Zioupos, A. (2016). Matrix and Tensor Factorization Techniques for Recommender Systems (Vol. 1). New York: Springer International Publishing.
7.	Aggarwal Charu.C, Social Network Data Analytics, Springer Science+Business Media, LLC 2011
8.	Velásquez, J. D. (2010). Advanced techniques in web intelligence (Vol. 311). L. C. Jain (Ed.). Springer.
9.	Zhong, N., Liu, J., & Yao, Y. (2003). Web intelligence. Springer Science & Business Media.
10	Borgatti Stephon. P., Everett Martin G and Johnson Jeffery C , Analyzing Social Networks, Sage Publications, 2013

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M12CS113	**Semester** Odd **(specify Odd/Even)**	**Semester** I sem (M.Tech CSE) **Session** 2021 -2022 **Month** from **Jul'21** to **Dec'21**
Course Name	ADVANCED WIRELESS NETWORKS		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr K. RAJALAKSHMI
	Teacher(s) (Alphabetically)	Dr K. RAJALAKSHMI

COURSE OUTCOMES		**COGNITIVE LEVELS**
C143.1	Understand the fundamentals of Wireless Transmission Technology, and media access Technologies.	Understand (C2)
C143.2	Design a network using various protocols wireless networks WLAN, WiMAX	Create (C6)
C143.3	Analysethe GSM & UMTS Telecommunication Systems	Analyze (C4)
C143.4	Discuss the features of 4G and 5G networks	Apply (C3)
C143.5	Demonstrate the features of SDN framework	Apply (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Applications of Wireless Networks, history of wireless communication, open research topics, simplified reference model	3
2.	Wireless Transmission	Frequency for radio transmission, regulation, signals, antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular systems	3
3.	Medium Access Control	Specialized MAC, Hidden and exposed terminals, near and far terminals, SDMA, FDMA, TDMA, CDMA., comparison of S/T/F/CDMA	3
4.	Wireless LAN	Infra-red vs. radio transmission, Infrastructure and ad-hoc network, IEEE802.11: System architecture, protocol architecture, Physical Layer, Medium access control layer, MAC management, 802.11b, 802.11a, Bluetooth.	5
5	WiMAX	IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure	7
6.	Telecommunication Systems	GSM: Mobile Services, System Architecture, Radio Interface, Protocols, Localization and calling, Handover, Security, Data Services, GPRS,EDGE, UMTS and IMT-2000: UMTS releases and standardization, UMTS system architecture, UMTS radio interface, UTRAN, Core Network, Handover	7

7.	LTE, 4G, 5G	LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization - LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G	7
8.	Software Defined Networks	Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework	7
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance = 10, Quizzes /Assignments /Mini-Project = 15)
Total	**100**

Students form group of size 2-3 members. Each group will identify several wireless network issues in distributed applications in various thrust areas like healthcare, industrial, education, smart city, logistics, environment, governance and etc. Once problem has been identified, the group will analyze the problem and synthesize wireless network based solutions to the identified problem. Each group will apply different wireless network technology and concepts such as WIFI, Bluetooth, WiMAX, 4G/5G, and SDN. This approach will enhance skills of each student and increase the understanding of incorporating wireless networks in recent distributed applications. Moreover, candidate will gain the enough knowledge to provide the wireless network based solutions to enhance the scalability, mobility and coverage issues of any organization/company. After this course, a student will able to undertake any work in this area in the industry or research.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

	Reference Books
1.	Jochen Schiller, “Mobile Communications”, second edition, Addison-Wesley, 2004.
2.	Martin Sauter, From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband, Wiley, 2014.
3.	Savo G Glisic, Advanced Wireless Networks – 4G Technologies, John Wiley & Sons, 2007.
4.	Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, Wiley, 2015.
5	Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach, Morgan Kauffman, 2014.
6.	Naveen Chilamkurti, SheraliZeadally, HakimaChaouchi, Next-Generation Wireless Technologies‖, Springer, 2013.
7.	IEEE, ACM Transactions, Journals and Conference papers on “Advance Wireless Network”

Detailed Syllabus

Course Code	17M15CS112	**Semester: June-July 2021(Deferred)**	**Semester: I Session** 2021 -2022 Month from: June-July 2021 (deferred semester)
Course Name	Machine Learning and Data Mining Lab		
Credits	1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Dr.Dhanalekshmi Gopinathan
	Teacher(s) (Alphabetically)	Dr.Dhanalekshmi Gopinathan

COURSE OUTCOMES		**COGNITIVE LEVELS**
C173.1	Identify the programming languages for machine learning and data mining	Understanding (Level-2)
C173.2	Use Python to apply and evaluate Linear regression, Logistic regression, kNN , k Means, SVM and ID3 on different datasets	Apply Level-3)
C173.3	Implement apiori algorithm and Eclat algorithm in R	Apply (Level-3)
C173.4	Apply Neural networks to model object detection, video tagging, music genre detection etc.	Apply (Level-3)
C173.5	Evaluate different machine learning models on the basis of their performances	Evaluate (Level-5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Python for data sampling and Visualization	a. To write a program for writing the pixel values of an image b. Write programs for Data Sampling (given dataset).	1
2.	Python for text processing	Use IPython (a web version provided by Jupyter nootbook) to write a word count program. Your program should read a text document (download from https://raw.githubusercontent.com/python/cpython/master/	1
3.	Classification-1	Implement kNN algorithm using Python. Consider iris dataset and report the accuracy of classification. [May take help from : https://machinelearningmastery.com/tutorial-to-implement-k-nearest-neighbors-in-python-from-scratch/]	2

4.	Clustering	Clustering: Implement kMeans Algorithm	2
5.	Classification-2	Classify the wine dataset of UCI Repository by ID3.	2
6.	Data Mining-1	Implement Logistic Regression on a sample dataset	2
7.	Data Mining-2	Implement apriori and Eclat algorithm for association rule mining in R	3
8.	SVM-1	Apply Support Vector Machine on the dataset of question the Parkinson dataset given in https://archive.ics.uci.edu/ml/datasets/Parkinson+Dataset+with+replicated+acoustic+features+.	2
9.	Comparison of Classification algorithms	Compare the classification of Iris dataset by different algorithms namely kNN, ID3 and SVM. Report accuracy and other performance measures.Implement neural networks for Classification of *four* character patterns	5
10.	ANN	Apply Multi Layer Percepron for supervised learning (problem statement to be given individually)	4
11.	BPN	Use back propagation for supervised learning . For the data based on 1990 census data from California.Evaluate the accuracy of a model's predictions using RMSE.	4
12.	CNN	Implement CNN using TensorFlow for classifying MNIST images	4

Evaluation Criteria

Components	**Maximum Marks**
Lab Test1	20
Lab Test2	20
PBL/Miniproject /Assignment	45
Attendance	15
Total	100

PBL- Students in a group of 4-5 will be designing an efficient solution to a given problem / case-studies using appropriate Machine Learning and Data mining Technique studies in the course.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
2.	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley
3.	Pujari, Arun K,Data mining and statistical analysis using SQL, Universities press
4.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining
5.	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier

6.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
7.	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw-Hill.
8.	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
9.	Transactions on Database Systems (ACM)
10.	IEEE Transactions on Knowledge & Data Engineering
11.	The VLDB Journal The International Journal on Very Large Data Bases

Detailed Syllabus
Lab-wise Breakup

Course Code	17M15CS113	**Semester** **Odd 2021**	**Semester** ... **Session** 2021-22 **Month from** July to Dec, 2021
Course Name	**Cloud Technology Lab**		
Credits	1	**Contact Hours**	2 Hours

Faculty (Names)	**Coordinator(s)**	Dr Prakash Kumar
	Teacher(s) (Alphabetically)	Dr. Prakash Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C171.1	Demonstrate the architecture and layers of Cloud Service Models, Deployment models etc.	Understand (level 2)
C171.2	Understand the working of CloudSim and run different scheduling algorithms.	Apply (level 3)
C171.3	Analyze various Scheduling algorithms and compare their performances	Analyze (level 4)
C171.4	Apply and evaluate the energy aware algorithms for using DVFS techniques.	Evaluate (level 5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	CloudSim installations and Use	Create Virtual Machines (VMs) on CloudSim.	CO1
2.		Allocate different Cloudlets to VMs and Data Centers using different scheduling algorithms	CO2
3.	Analyze various Scheduling algorithms in different scenarios on cloudsim	Create different Data Centers and allocate the VMs to them and analyze the outcomes	CO3
4.		Assign the cloudlets and change the scheduling techniques for various scenarios	CO3
5.	Evaluate Energy Aware Simulations using DVFS	Apply and evaluate energy aware algorithms using DVFS techniques	CO4
n.	…	…	…

Evaluation Criteria

Components	**Maximum Marks**
Lab Test# 1	20
Lab Test# 2	20
D2D work	60 (D2D: 30 marks, PBL: 20 marks, Attendance: 10 marks)
Total	**100**

Project Based Learning: A group of maximum 2 students are to be formed. Each group shall choose a Cloud based project. The project shall be designed and/or modeled based on any Cloud Platform like AWS, Google cloud, Eucalyptus, CloudSim, iFogSim or any simulation tools. The project shall function and run as per the objective of the project. Live demonstration of the project shall be shown during their presentation. The project evaluation shall be done based on the quality, innovation, relevance and creativity involved.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	K. Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing- From Parallel Processing to the Internet of Things", Morgan Kauffman Publishers, Elsevier.
2	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'REILLY publication.
3	"Virtualization Overview", White paper, VM Ware.
4.	Rodrigo N. Calheiros, Rajiv Ranjan, Anton Beloglazov, Cesar A. F. De Rose, and Rajkumar Buyya, CloudSim: A Toolkit for Modeling and Simulation of Cloud Computing Environments and Evaluation of Resource Provisioning Algorithms, Software: Practice and Experience, Volume 41, Number 1, Pages: 23-50, ISSN: 0038-0644, Wiley Press, New York, USA, January 2011.
5.	Tom Guérout, Thierry Monteil, Georges Da Costa, Rodrigo Neves Calheiros, Rajkumar Buyya, Mihai Alexandru, Energy-aware Simulation with DVFS, Simulation Modelling Practice and Theory, Volume 39, No. 1, Pages: 76-91, ISSN: 1569-190X, Elsevier Science, Amsterdam, The Netherlands, November 2013.
6.	Rajkumar Buyya, Rajiv Ranjan and Rodrigo N. Calheiros, Modeling and Simulation of Scalable Cloud Computing Environments and the CloudSim Toolkit: Challenges and Opportunities, Proceedings of the 7th High Performance Computing and Simulation Conference (HPCS 2009, ISBN: 978-1-4244-4907-1, IEEE Press, New York, USA), Leipzig, Germany, June 21 - 24, 2009. **- Keynote Paper.**
***m*.**	…

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M12CS112	**Semester** Odd **(specify Odd/Even)**	**Session** 2021 -2022 **Month** from July to Dec
Course Name	Metaheuristics in Modelling and Optimization		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Anita Sahoo
	Teacher(s) (Alphabetically)	Dr. Anita Sahoo

COURSE OUTCOMES At the completion of the course, Students will be able to		**COGNITIVE LEVELS**
C131.1	Interpret and explain the concepts of Metaheuristics based optimization and it's application in a diverse range of applications.	Understand Level (C2)
C131.2	Model single solution and population based Metaheuristic algorithms to solve a given optimization problem.	Apply Level (C3)
C131.3	Model Metaheuristic algorithms to solve Multi-objective optimization problems.	Apply Level (C3)
C131.4	Model hybrid Metaheuristic algorithms to solve a given optimization problem.	Apply Level (C3)
C131.5	Explain algorithms and architectures for parallel implementation of Metaheuristics.	Understand Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Optimization Models, Approximate Algorithms, When to use Metaheuristics?, Methods and Application	4
2.	Fundamentals of Metaheuristics	Representation, Objective Functions; Constraint Handling; Parameter Tuning; Performance Analysis.	5
3.	Single-Solution Based Metaheuristics	Basic Concepts, Fitness Landscape Analysis; Local Search; Tabu Search; Iterated and Guided Local search; Variable Neighborhood Search; Smoothing Methods; Noisy Methods	6
4.	Population-Based Metaheuristics Methods	Basic Concepts; Evolutionary Algorithms, Swarm Intelligence, Stochastic diffusion search, Social cognitive optimization	6
5.	Metaheuristics for Multi-objective Optimization	Basic concepts; Multi-objective Continuous and Combinatorial Problems, Multi-criteria Decision Making; Design Issues	3
6.	Fitness Assignment Strategies and Evaluation of Multi-objective Optimization	Scalar approach, Criterion-Based Methods; Dominance-Based Approaches; Indicator based Approaches; Diversity Preservation; Performance Evaluation	7
7.	Hybrid Metaheuristics	Design and Implementation Issues; Mathematical Programming Approaches; Classical Hybrid Approaches;	7

		Hybrid Metaheuristics with Machine Learning and Data Mining; Hybrid Metaheuristics for Multi-objective Optimization	
8.	Parallel Metaheuristics	Parallel Design and Implementation of Metaheuristics; Parallel Metaheuristics for Multi-objective Optimization	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance(10), Assignments/Mini-project/Tutorials/Quiz (15)
Total	**100**

Project based learning: Each group of 3-4 students will be assigned an optimization problem at the beginning. They are required to apply the metaheuristic methods they study on the given problem.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Metaheuristics: From Design to Implementation by El-Ghazali Talbi, Wiley, June 2009.
2.	Sean Luke, 2013, Essentials of Metaheuristics, Lulu, second edition, available athttp://cs.gmu.edu/←sean/book/metaheuristics.
3.	Gandomi, Amir; Yang, Xin-She; Talatahari, Siamak; Alavi, Amir; "Metaheuristic Algorithms in Modeling and Optimization", Metaheuristic Applications in Structures and Infrastructures, Dec 2013.
4.	Kalyanmoy Deb; "Multi-Objective Optimization Using Evolutionary Algorithms:An Introduction"; https://www.egr.msu.edu/~kdeb/papers/k2011003.pdf
5.	Kalyanmoy Deb; "Single and Multi-Objective Optimization Using Evolutionary Algorithms"; https://www.iitk.ac.in/kangal/papers/2004002.pdf
6.	Paulo Cortez, Modern Optimization with R, Use R! series, Springer, September 2014, ISBN 978-3-319-08262-2.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17M11CS111	**Semester: ODD (specify Odd/Even)**	**Semester I Session 2021-2022 Month from July 21 to December 21**
Subject Name	Data structure & Algorithms for Big Data		
Credits	**3**	**Contact Hours**	**3(L) + 1 (T)**

Faculty (Names)	**Coordinator(s)**	Manish K Thakur
	Teacher(s) (Alphabetically)	Manish K Thakur

COURSE OUTCOMES		**COGNITIVE LEVELS**
C110.1	Define basic concepts of Big Data and relating them to them with various Big Data technologies (e.g., Hadoop, Spark)	Remember Level (Level 1)
C110.2	Explain Hadoop cluster architecture and its components and Differentiate Hadoop Distributed File System (HDFS) from other storage techniques, e.g., NFS and UNIX file system	Understand Level (Level 2)
C110.3	Construct data structure and algorithms for HDFS and MapReduce and further applying them to different Big Data problems.	Apply Level (Level 6)
C110.4	Apply hashing on large scale multi-dimensional data sets using Locality Sensitive Hashing.	Apply Level (Level 3)
C110.5	Analyze and apply advance data structures and algorithms (e.g., B and B+ Tree, R and R+ Tree, Matrix multiplication) for solving big data problems	Analyze Level (Level 4)
C110.6	Evaluate Streaming Algorithms, Sublinear optimization, Machine Learning, Hadoop systems	Evaluate Level (Level 5)

S.N.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**	
1.	Introduction to Big Data	Motivation, Application, Domains for Big Data, Various tools and services	2	
2.	Basics of Hadoop	Introduction to hadoop. Introduction to HDFS, Read and write operation, Fault Tolerance-Failures and Recovery,:	3	
3.	MapReduce	Introduction to MapReduce, Mapreduce Job scheduling	3	
4.	Basic data structures concepts	Array: searching, sorting, aggregation on BIG DATA	4	
5.	Basic Statistics	Various types of parametric and non-parametric test	2	
6.	Matrix Multiplication	Matrix Multiplication for BIG DATA	2	
7.	Concurrency Control	Concurrency-control mechanisms, Multithreading, Transactions, logging, ACID compliant, crash recovery	5	
7.	Graphs	Spanning Tree (Min/Max), Searching (BFS), Shortest Path etc.	6	

8.	Indexing strategies Trees	large Arrays, Hashing, AVL, B-tree, Tries, R and R+ Trees, Prefix Trees, Accumulo, Bigtable, bLSM, Cassandra, HBase,Hypertable, LevelDB are LSM trees, divide & conquer, mapreduce	6	
9.	Bloom filters, HyperLogLog, Count–2 min sketch	Bloom filters, HyperLogLog, Count–2 min sketch	4	
10	Applications (may use spark)	Streaming Algorithms, Sublinear optimization, Machine Learning Problems, Hadoop systems	2	
11	Mathematical Foundation	Sparse: Vector Spaces, Matrix algebra, LSI,SVD, PSD	3	
Total number of Lectures			**42**	

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester	35
TA	25 (Attendance = 05; Assignments/Projects in PBL mode = 20)
Total	**100**

Project based learning: Students in group of 3 to 4 students are required to develop mini-project based on the concepts taught in this course. In mini-project, students need to create the distributed environment either using Hadoop framework or multithreading using OpenMP. Problem statements need to be formulated in various applications domains of big data, proposing the solution approach and implemented over the created distributed environment.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Journals: IEEE Transactions on Knowledge and Data Engineering, ACM Transactions on Intelligent Systems and Technology (TIST), ACM Transactions on Knowledge Discovery from Data (TKDD)
2.	2. Tier-1 Conferences: SIGKDD, ICDE - International Conference on Data Engineering, CIKM - International Conference on Information and Knowledge Management, ICDM - IEEE International Conference on Data Mining, SDM - SIAM International Conference on Data Mining, PKDD - Principles of Data Mining and Knowledge Discovery, IEEE Big Data
3.	Online courses: http://grigory.us/big-data-class.html https://courses.engr.illinois.edu/cs598csc/fa2014/
4.	Book: Mahmoud Parsian, “Data Algorithms: Recipes for Scaling Up with Hadoop and Spark”, O'Reilly Media, July 2015.
5.	Probabilistic Data Structures and Algorithms in Big Data Applications by *Andrii Gakhov*
6.	Algorithms and Data Structures for Massive Datasets by Dzejla Medjedovic, Emin Tahirovic, and Ines Dedovic, MEAP began July 2020