Detailed Syllabus
Lecture-wise Breakup

Course Code	14M1NCI339	**Semester Odd (specify Odd/Even)**	**Semester** M.Tech (I) **Session** 2020-21 **Month from** Jul-Dec
Course Name	Wireless Sensor and Actuator Networks		
Credits	3	**Contact Hours**	3-1-0 (4hrs per week)

Faculty (Names)	**Coordinator(s)**	Dr. Adwitiya Sinha
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha

COURSE OUTCOMES		**COGNITIVE LEVELS**
C140.1	Develop distribution models for deterministic or stochastic network deployment	Understand Level (Level 2)
C140.2	Designing communication protocols for wireless sensor network standards	Apply Level (Level 3)
C140.3	Develop mathematical models for energy consumption	Creation Level (Level 6)
C140.4	Analyse medium access mechanisms, routing protocols	Analyze Level (Level 4)
C140.5	Analyse cross layer schemes, including load balancing and node clustering	Analyze Level (Level 4)
C140.6	Performance evaluation of sleep scheduling strategy with data prediction and aggregation methods	Evaluation Level (Level 5)
C140.7	Develop Coverage Maximization models for optimizing network lifetime	Creation Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of Wireless sensor and actuator networks	Introduction to wireless networks and mainly on sensor and actuator networks, Terminology, Introductin radio spectrum, Applications, Propagation mechanism-Free space and Two Ray model, Functions: aggregation, dissemination and management	5
2.	Wireless Sensor Network Requirements	Network scenarios, Types of deployment strategies, Challenges, Sensor components and characteristics, Energy Harvesting, Distributed sensor network	5
3.	Technologies and simulators used	Network Simulator, Glomosim, Qualnet	4
4.	Sensor Network Architectures & Standards	IEEE Sensor Network Standard/ZigBee, Single-hop and Multi-hop communication, Sink mobility, Transmission Power Control (levels of transmission), In-Network Data Processing	5
5.	Broad casting & Routing in Wireless Sensor and Actuator Networks	Overview of broadcasting techniques, backbone and broadcasting in sensor actuator networks, coverage and connectivity criteria,Routingalogs	7
6.	Issues and Challenges	Sleep scheduling Models & Analysis, Clustering, Load balancing, Energy Hole and Connectivity Gap problem, Poissonian and Gaussian distributed network	6

7.	Designing Goals and Protocols	Energy Models, Network Lifetime Maximization, Scheduling & Coverage Optimization. MAC protocols-Low duty cycle and Wake up concepts, Cross layer issues & methods – Optimizing number of Clusters & Cluster Head rotations, Data and Flow Aggregation with analysis	6
8.	Case Studies	Case study of Internet of things applications & open source projects	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
Test-1	20
Test-1	20
End Semester Examination	35
TA	25 (Quiz + Evaluative Assignment + Class Test + Attendance)
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.	Wireless Sensor and Actuator Networks Algorithms and Protocols for Scalable Coordination and Data Communication, Edited by Amiya Nayak and Ivan Stojmenovic John Wiley & Sons, Inc.,2010.
2.	Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Morgan Kauffman Publication, 2004
3.	William Stallings, Wireless Communications & Networks, 2nd Edition, Pearson Education India, 2009
4.	Kazem Sohraby, Daniel Minoli, TaiebZnati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley-Blackwell; 1st edition, 2007
5.	Andrea Conti, Davide Dardari, and Roberto Verdone, Wireless Sensor and Actuator Networks Technologies, Analysis and Design, Academic Press, Elsevier, 2008

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17M11CS112	**Semester Odd (specify Odd/Even)**	**Semester** Odd **Session** 2020-2021 **Month from** July to December
Subject Name	Machine Learning and Data Mining		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Satish Chandra
	Teacher(s)	Satish Chandra

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 Linear Algebra for Machine Learning	4
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	6
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	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), Quiz performance (15))**
Total	**100**

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

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.	Alex, Berson,Stephen J.Smith, Data Warehousing, data mining and OLAP , McGraw-Hill,2004
7.	Inmon W.H.,Building the Data Warehouse ,4th Edition, Wiley
8.	Anahory S. and Murray D, Data Warehousing in the Real World, Addison-Wesley
9.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
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

Course Code	17M15CS112	**Semester: June-July 2021(Deferred)**	**Semester: I Session** 2020 -2021 **Month from: June-July**
Course Name	Machine Learning and Data Mining Lab		
Credits	1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Dr Chetna Dabas (First Half), Dr K Vimal Kumar(Second Half)
	Teacher(s) (Alphabetically)	Dr Chetna Dabas, Dr Archana Purwar (First Half), Dr K. Vimal Kumar(Second Half)

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 on Following dataset (download it from here).	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 (download it from here):	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
Mini Project, Regularity, performance	60
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.	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
Lecture-wise Breakup

Course Code	17M11CS121	**Semester** ODD **(specify Odd/Even)**	**Semester** I **Session** 2020 -2021 **Month from** July 2020- December 2020
Course Name	E-Commerce and Social Web		
Credits	4	**Contact Hours**	3-1-0

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

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.	5
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 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
6.	Social Web Analysis	Analyzing Social web, Nodes, Edges and Network measures, Centrality, Power and Bottlenecks, Concept of Cliques, Clusters and Components, Viral marketing, Privacy in social web.	4

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	4
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.	4
9.	Social Search Engine Optimization	Optimizing for Web Search, Using Photo-Sharing Sites for SEO, Optimizing for Social Search Engines	4
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.	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments and Attendance) Attendance = 07 Internal assessment &Assignments in PBL mode = 18
Total	**100**

Recommended Reading material:

Text Books

1.	Programming Collective Intelligence: Building Smart Web 2.0 Applications by Toby Segaran Oreilly 2013
2.	Algorithms of the Intelligent Web Haralambos Marmanis, Dmitry Babenko Manning Publications; 2nd edition (September 8, 2016)
3.	Recommender Systems: An Introduction Dietmar Jannach (Author), Markus Zanker (Author), Alexander Felfernig (Author), Gerhard Friedrich Cambridge University Press; 1 edition (30 September 2013)
4.	Recommender Systems Handbook Francesco Ricci (Editor), Lior Rokach Springer 2013
5.	Recommendation Systems in Software Engineering Martin P. Robillard (Editor), Walid Maalej (Editor), Robert J Walker (Editor), Thomas Zimmermann Springer 2014
6.	Web Analytics 2.0 Avinash KaushikSybex; 1 edition (October 26, 2013)
7.	Analyzing Social Web Jeneffir GolbegMorgan Kaufmann; 1 edition (March 26, 2013)
8.	Predictive Analytics Eric SegelWiley; Revised and Updated edition (January 20, 2016)

Reference Books

1.	Michael P Papazoglou and Pieter M.A. Ribbers, " e-Business- Organizational and technical foundation" , John Wiley and Sons, 2006.
2.	Efraim Turban , 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.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M12CS113	**Semester** Odd **(specify Odd/Even)**	**Semester** I sem (M.TechCSE)/DD **Session** 2020 -2021 **Month** from **Jul'20** to **Dec'20**
Course Name	ADVANCED WIRELESS NETWORKS		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	DrK. RAJALAKSHMI
	Teacher(s) (Alphabetically)	DrK. RAJALAKSHMI

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the fundamentals of Wireless Transmission Technology, and media access Technologies.	Understand (C2)
CO2	Design a network using various protocols wireless networks WLAN, WiMAX	Create (C6)
CO3	Analysethe GSM & UMTS Telecommunication Systems	Analyze (C4)
CO4	Discuss the features of 4G and 5G networks	Apply (C3)
CO5	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 = 07, Class Test, Quizzes, etc = 07, Internal assessment= 05, Assignments in PBL mode = 06)
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)

	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
Lecture-wise Breakup

Course Code	17M22CS113	**Semester Odd (specify Odd/Even)**	**Semester I Session** 2020 -2021 **Month from July '20 to Dec '20**
Course Name	Soft Computing and Applications		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Archana Purwar
	Teacher(s) (Alphabetically)	Kavita Pandey

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Select defuzzification and other methods in fuzzy decision making	Apply Level (Level 3)
CO2	Analyze different fuzzy inference systems for various real world problems.	Analyze Level (Level 4)
CO3	Develop solutions for different problems using genetic algorithm and it's extensions	Apply Level (Level 3)
CO4	Apply different neural network based algorithm	Apply Level (Level 3)
CO5	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
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)

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

Research Methodology & Intellectual Property Rights (18M11GE111)

Course Description

Course Code	**18M11GE111**	**Semester** Odd	**Semester** I **Session** 2020-21 **Month from** Aug 2020 - Dec 2020
Course Name	Research Methodology & Intellectual Property Rights		
Credits	2	**Contact Hours**	2-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES:		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C101.1	explain the basic concepts and types of research	Understanding Level (C2)
C101.2	define a research problem, its formulation, methodologies and analyze research related information	Analyzing Level (C4)
C101.3	explain research ethics, understand IPR, patents and their filing related to their innovative works.	Understanding Level (C2)
C101.4	explain and analyzethe statistical data and apply the relevant test of hypothesis in their research problems	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Research	What is research? Types of research. What is not research? How to read a Journal paper?	3
2.	Report writing	How to write report? Use of Mendeley in report writing. How to write a research paper? Problem identification and solving.	4
3.	Ethics, IPR and Research methodologies	Research ethics, patents, intellectual property rights, plagiarism regulation 2018. Steps in research process and common methodologies to attempt solution to research paper.	8
4.	Basics of statistics and probability distributions	Basic statistical concepts. Handling of raw data, Some common probability distributions.	7
5.	Test of hypothesis and regression analysis	Hypothesis testing. Parametric and non-parametric data, Introduction to regression analysis.	8
		Total number of Lectures (Course delivery method: open ended discussion, guided self-study, lectures)	**30**

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Examination	30
End Semester Examination	40
Assignments	30 (Quiz, Assignments)
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.	**Stuart Melville and Wayne Goddard**, Research Methodology: An Introduction for Science & Engineering Students, Kenwyn, South Africa: Juta & Co. Ltd., 1996.

2.	**Kothari, C.R.,** Research Methodology: Methods and Techniques, New Age International, New Delhi, 2009.
3.	**Kumar, Ranjit,** Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, Sage Publications Ltd., 2005.
4.	**Ramappa, T.,** Intellectual Property Rights Under WTO, S. Chand, New Delhi, 2008.
5.	**Wayne Goddard and Stuart Melville,** Research Methodology: An Introduction, Kenwyn, South Africa: Juta & Co, 2001.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M12CS112	**Semester** Odd **(specify Odd/Even)**	**Semester ISession** 2020 -2021 **Month** from July to Dec
Course Name	Metaheuristics in Modelling and Optimization		
Credits	3	**Contact Hours**	3

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 Methiods	Basic Concepts; Evolutionary Algorithms, Swarm Intelligence,Stochastic diffusion search, Social cognitive optimization	6
5.	Metaheuristics for Multiobjective Optimization	Basic concepts; MultiobjectiveContinuous and Combinatorial Problems, Multicriteria Decision Making;Design Issues	3
6.	Fitness Assignment Strategies and Evaluation ofMultiobjective 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 Multiobjective Optimization	
8.	Parallel Metaheuristics	Parallel Design and Implementation of Metaheuristics; Parallel Metaheuristics for Multiobjective Optimization	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
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.	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 (specify Odd/Even)**	**Semester Odd Session 2020-2021 Month from July 20 to December 20**
Subject Name	Data structure & Algorithms for Big Data		
Credits	**3**	**Contact Hours**	**3(L)**

Faculty (Names)	**Coordinator(s)**	Vikas Hassija
	Teacher(s) (Alphabetically)	Vikas Hassija

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**	**Remarks**
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		
Total number of Lectures			**42**	

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.	3. Online courses: http://grigory.us/big-data-class.html https://courses.engr.illinois.edu/cs598csc/fa2014/
4.	4. Book: Mahmoud Parsian, "Data Algorithms: Recipes for Scaling Up with Hadoop and Spark", O'Reilly Media, July 2015.

Detailed Syllabus
Lab-wise Breakup

Course Code	**17M15CS111**	**Semester** ODD (Due to Covid19, conducted as SepcialSemEVEN2021)	**Semester I**(M.Tech), X (DD) **Session** 2020 -2021 **Month from** July to Dec 2020
Course Name	Advanced Algorithms Lab		
Credits	1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Manish Kumar Thakur, Suma Dawn
	Teacher(s) (Alphabetically)	Manish Kumar Thakur, Suma Dawn

COURSE OUTCOMES		**COGNITIVE LEVELS**
C170.1	Implement algorithms and use appropriate advanced data structures for solving computing problems.	Level 3: Apply
C170.2	Design algorithms using divide-and-conquer, greedy and dynamic programming strategies, and further recite algorithms that employ these strategies.	Level 3: Apply Level 5: Evaluate
C170.3	Illustrate the mathematical foundation of network flows and some important flow algorithms.	Level 2: Understand Level 3: Apply
C170.4	Implement randomized algorithms to solve various problems, and validate their correctness and complexity.	Level 3: Apply Level 4: Analyze
C170.5	Understand P, NP, polynomial reduction, NP-hardness, and NP-Completeness.	Level 2: Understand Level 4: Analyze
C170.6	Comprehend and select algorithm design approaches in a problem specific manner.	Level 6: Create

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Fundamentalsof data structures and algorithmic problem solving	Searching, Sorting, time complexity, Heaps, Arrays, Linked List, Trees, Fibonacci heaps, splay trees, dynamic trees.	CO1
2.	Divide and Conquer Technique	Solving Matrix multiplication problem and subset- sum problem using divide-and-conquer approach	CO2
3.	Greedy Algorithms	Greedy Approximation algorithms- Set Cover Problem,K Centers Problem,Fractional and 0/1 Knapsack, Coinage problem; Bin packing; Job scheduling, Graph coloring; and Text compression using Huffman coding and Shannon-Fanon coding.	CO2
4.	Dynamic Programming Technique	Fundamentals of Dynamic programming based solution approach, Printing Shortest Common Super sequence, Dynamic Programming on Trees, Maximum sum rectangle in a 2D matrix.	CO2
5.	Graph Algorithms	Solve and analyze Graph problems, Algorithms. All Pair Shortest Problem, Subset-sum problem. Minimum Spanning Trees (Prim's and Kruskal algorithms); Shortest Path using Dijkstra's algorithm, K-clique problem, Graph Coloring problem.	CO1, CO2

6.	Flows in Network	Network flows - max flow and min-cost flow/circulation, Edmonds-Karp algorithm	CO3
7.	Tractable and Non- Tractable Problems	One Way of Coping with NP-Hardness. Randomized Rounding. Vertex Cover and Travelling Salesman Problem.	CO4, CO5
8.	Mini-Project	Mini-Project	CO6

Evaluation Criteria

Components	**Maximum Marks**
Lab Test# 1	20
Lab Test# 2	20
D2D work	60
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.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein , Introduction to Algorithms, MIT Press, 3rd Edition, 2009
2.	Hochbaum “Approximation Algorithms for NP-Hard Problems”, 1996.
3.	Ahuja, Magnanti and Orlin, “Network Flows: Theory, Algorithms and Applications”, 1993.
4.	Horowitz and Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978
5.	Study material on //fileserver2

Detailed Syllabus

Subject Code	19M12CS111	**Semester odd**	**Semester I Session 2020- 2021** **Month from July to December**
Subject Name	Web Intelligence		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	1. Dr. Anuja Arora
	Teacher(s) (Alphabetically)	Dr. Anuja Arora

Course Outcomes:

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

- Outline the various web technologies, methods, and models used to design an intelligent web. [understanding Level 2]
- Make use of web caching strategies at varied level: user, web server, and gateway server. [Apply Level 3]
- Analyze and Model the users' browsing behavior on web. [Apply and Analyse-3,4]
- Evaluate various Web content mining algorithms, Web language models and learning to rank models to handle complex Web. [Evaluate Level 5]
- Design and develop the computational intelligent web algorithms to handle complex real problems [Create 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, Metrics for Learning to rank : CG, DCG, NDCG, P@K, MAP, AP	4

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, 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 Web, 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	**40**

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