Detailed Syllabus
Lecture-wise Breakup

Course Code	14M1NCI339	**Semester:** ODD	**Semester:** M.Tech. Dual Degree, Sem IX **Session:** 2023-24 **Month:** July to December
Course Name	Wireless Sensor and Actuator Networks		
Credits	3	**Contact Hours**	3-0-0 (3 hours per week)

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C140.1	Understand sensor network applications and radio propagation challenges	Understand Level (Level 2)
C140.2	Demonstrate communication protocols for wireless sensor and actuator network standards	Apply Level (Level 3)
C140.3	Apply mathematical models for computation of energy consumption	Apply Level (Level 3)
C140.4	Analyse medium access mechanisms, routing protocols, and clustering	Analyze Level (Level 4)
C140.5	Performance evaluation of sleep scheduling, coverage, and connectivity with data prediction and aggregation methods	Evaluation Level (Level 5)

COs	**PO1:** An ability to independently carry out research/ investigation and development work to solve practical problems	**PO2:** An ability to write and present a substantial technical report/document	**PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program	**PSO 1:** Students should be able to develop and implement the solution of real-life computing problems using contemporary technologies	**PSO2:** Students should be able to apply ethical principles and commit to professional and social responsibilities
C140.1	**2** Basics of sensor network and radio propagation	**2** Study on sensor challenges to prepare technical survey	**2** Explore different radio propagation schemes		
C140.2	**1** Determine suitable communication standards using network simulators	**3** Explanation of levels of transmissions in sensor network	**2** Apply suitable error handling techniques for sensor & actuator	**1** Apply suitable communication techniques for domain specific problems	**1** Knowledge of wireless channel impediments in real scenarios
C140.3	**1** Apply energy computation for sensor nodes	**1** Apply energy models for actuators in sensor networks	**1** Derive energy consumption and energy hole problem	**1** Apply energy modelling for real-world applications	
C140.4	**3** Analyze medium access mechanisms	**1** Study sensor clustering techniques	**2** Demonstrate routing and broadcasting	**3** Implement access control for real-life network scenarios	**2** Emphasis on implementing routing for sensor network
C140.5	**3** Evaluate overall sensor network performance	**3** Evaluate performance of sleep cycles and data aggregation	**3** Explore several energy constraints of sensor node	**3** Assess coverage and connectivity of sensor and actuator nodes	**3** Explore load balancing techniques in sensor network
AVG.	**2**	**2**	**2**	**2**	**2**

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, Introduction radio spectrum, Applications, Challenges, Radio 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, Sensor components and characteristics, Energy Models, Energy Harvesting, Data communication standards	6
3.	Technologies and Simulators	Network Simulator, Glomosim, Matlab, Python-based Simulators	4
4.	Sensor Network Architectures & Standards	IEEE Sensor Network Standard/ZigBee, Single-hop and Multi-hop communication, Mobility models, Transmission Power Control, In-Network Data Processing, MAC protocols-Low duty cycle	6
5.	Routing in Wireless Sensor and Actuator Networks	Overview of broadcasting techniques, backbone and broadcasting in sensor actuator networks, coverage and connectivity concepts, Routing models	7
6.	Issues and Challenges	Sleep scheduling Models & Analysis, Clustering, Load balancing, Energy Hole and Connectivity Gap problem, Poisson and Gaussian distributed network	7
7.	Designing Goals and Protocols	Network Lifetime Maximization, Scheduling & Coverage Optimization. Cross layer issues & methods – Optimizing number of Clusters & Cluster Head rotations, Data and Flow Aggregation	7
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
Test-1	20
Test-2	20
End Semester Examination	35
TA	25 (Class Tests (5), Attendance (5), Mini-project/Assignments (15))
Total	**100**

Project based learning: Each student in a group of 2/3/4 will have to develop a mini project based on radio propagation, medium access, and clustering models. The students can choose any real-world application that requires some decision-making and perform energy consumption analysis. The students have to implement the mini-project using any open-source programming language. Project development will enhance knowledge and employability of students in IT sector.

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.	Concepts, applications, experimentation and analysis of wireless sensor networks. Hossam Mahmoud Ahmad Fahmy, Springer Nature, 2020.
2.	Feng Zhao, Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Morgan Kauffman Publication, 2004
3.	Energy-efficient wireless sensor networks. Sharma, Vidushi, and Anuradha Pughat, eds. CRC Press, 2017.
4.	Algorithms for Sensor Systems, Chrobak, Marek, Antonio Fernández Anta, Leszek Gąsieniec, and Ralf Klasing, LNCS, Vol. 10050. Springer, 2017.
5.	QoS in Wireless Sensor/Actuator Networks and Systems. Alves, Mário, MDPI, 2018.
6.	Wireless Sensor and Actuator Networks Algorithms and Protocols for Scalable Coordination and Data Communication, Amiya Nayak and Ivan Stojmenovic, John Wiley & Sons, Inc.,2010.

7.	Wireless sensor networks. Hossam Mahmoud Ahmad Fahmy, Berlin/Heidelberg, Germany: Springer International Publishing, 2020.
8.	William Stallings, Wireless Communications & Networks, 2nd Edition, Pearson Education India, 2009
9.	Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley-Blackwell; 1st edition, 2007
10.	High Performance Wireless Sensor-Actuator Networks for Industrial Internet of Things. Gunatilaka, Dolvara, Washington University Publishing, vol. 13806315, St. Louis, 2019.
11.	Andrea Conti, Davide Dardari, and Roberto Verdone, Wireless Sensor and Actuator Networks Technologies, Analysis and Design, Academic Press, Elsevier, 2008
12.	Wu W, Zhang Z, Lee W, Du D. Optimal coverage in wireless sensor networks, Springer Optimization and Its Applications (SOIA), volume 162, Springer, 2020

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M17CS121	**Semester** Odd **(specify Odd/Even)**	**Semester** 10th Session 2023 -2024 **Month** from July to Dec
Course Name	Project Based Learning-II		
Credits	4	**Contact Hours**	0-0-8
Faculty (Names)	**Coordinator(s)**	Dr. Amit Mishra	
	Teacher(s) (Alphabetically)	Dr. Archana Purwar, Dr. Indu Chawla, Dr Amit Mishra	

	COURSE OUTCOMES At the completion of the course, Students will be able to	**COGNITIVE LEVELS**
C210.1	Identify live problems that would be solved through automated software development process.	Apply Level (C3)
C210.2	Confront the issues related to development of project which includes team work, test driven design, data collections, implementations etc.	Apply Level (C3)
C210.3	Develop oral communication skill and prepare a technical report	Apply Level (C3)
C210.4	Critically review the projects and can skilfully map each stage in software development cycle.	Apply Level (C3)

CO-PO Mapping:

COs	PO1	PO2	PO3	PSO1	PSO2
C210.1	3	1	3	2	2
C210.2	3	1	2	3	2
C210.3	2	3	2`	0	2
C210.4	2	1	3	2	2
Avg.	2	2	2	2	2

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M17CS212	**Semester Odd 2023 (specify Odd/Even)**	**Semester 3rd Session** 2023 -2024 **Month from July, 2023 to Dec., 2023**
Course Name	Seminar and Term Paper		
Credits	4	**Contact Hours**	

Faculty (Names)	**Coordinator(s)**	Dr. Kavita Pandey
	Teacher(s) (Alphabetically)	Dr. Kavita Pandey

COURSE OUTCOMES		**COGNITIVE LEVELS**
C212.1	Identify the relevant research problem and its associated literature in the field of computer science.	Understand (level 2)
C212.2	Examine the research gaps by analyzing the research articles.	Analyze (level 4)
C212.3	Appraise their communication and presentation skills by delivering the research findings through a seminar presentation.	Evaluate (level 5)
C212.4	Create a comprehensive report by compiling the research findings, ensuring both accuracy and clarity in the presented information.	Create (level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	…	…	…
2.	…	…	…
3.	…	…	…
4.	…	…	…
5.	…	…	…
6.	…	…	…
7.	…	…	…
...	…	…	…
***n*.**	…	…	…
			…

Evaluation Criteria

Components	**Maximum Marks**
Day to day work prior to Midterm	20
Mid term Seminar and Report	20
Day to day work after Midterm	20
End term Seminar	20
Term Paper	20
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.	…
2.	…
3.	…
4.	…
...	…
m.	…

CO-PO-PSO Mapping: new CSE

COs	PO1	PO2	PO3	PSO1	PSO2
C212.1	Identify the relevant research problem and its associated literature in the field of computer science.				
Mapping and Justification	3 Identify the problem and will carry out the research independently	1 Summarize the papers			1 Take care of ethical principles while critiquing the associated literature
C212.2	Examine the research gaps by analyzing the research articles.				
Mapping and Justification	3 Do the investigation independently	2 Write the integrated summary	1 Knowledge gained by reading the articles	1 Assimilate the probable research gaps if found in literature survey	2 Take care of ethical principles while finding the research gaps
C212.3	Appraise their communication and presentation skills by delivering the research findings through a seminar presentation.				
Mapping and Justification		3 Present the seminar	2 Demonstrate their study in the form of seminar		2 Present their findings by considering the ethical principles in a professional manner
C212.4	Create a comprehensive report by compiling the research findings, ensuring both accuracy and clarity in the presented information.				
Mapping and Justification	2 Present their investigations independently	3 Write and present the report	2 Demonstrate their study in form of a report		3 Develop the report having minimum plagiarism considering ethical principles
Avg.	3	2	2	1	2

CO-PO-PSO Mapping: new DD same as CSE

COs	PO1	PO2	PO3	PSO1	PSO2
C212.1	Identify the relevant research problem and its associated literature in the field of computer science.				
Mapping and Justification	3 Identify the problem and will carry out the research independently	1 Summarize the papers			1 Take care of ethical principles while critiquing the associated literature
C212.2	Examine the research gaps by analyzing the research articles.				
Mapping and Justification	3 Do the investigation independently	2 Write the integrated summary	1 Knowledge gained by reading the articles	1 Assimilate the probable research gaps if found in literature survey	2 Take care of ethical principles while finding the research gaps
C212.3	Appraise their communication and presentation skills by delivering the research findings through a seminar presentation.				
Mapping and Justification		3 Present the seminar	2 Demonstrate their study in the form of seminar		2 Present their findings by considering the ethical principles in a professional manner
C212.4	Create a comprehensive report by compiling the research findings, ensuring both accuracy and clarity in the presented information.				
Mapping and Justification	2 Present their investigations independently	3 Write and present the report	2 Demonstrate their study in form of a report		3 Develop the report having minimum plagiarism considering ethical principles
Avg.	3	2	2	1	2

CO-PO-PSO Mapping: new DA

COs	PO1	PO2	PO3	PSO1	PSO2
C212.1	Identify the relevant research problem and its associated literature in the field of computer science.				
Mapping and Justification	3 Identify the problem and will carry out the research independently	1 Summarize the papers		2 Choose the problem according to recent developments	1 Take care of ethical principles while critiquing the associated literature
C212.2	Examine the research gaps by analyzing the research articles.				
Mapping and Justification	3 Do the investigation independently	2 Write the integrated summary	1 Knowledge gained by reading the articles	2 Find the gaps in existing solutions by doing research analysis	2 Take care of ethical principles while finding the research gaps
C212.3	Appraise their communication and presentation skills by delivering the research findings through a				

	seminar presentation.				
Mapping and Justification		**3 Present the seminar**	**2 Demonstrate their study in the form of seminar**		**2 Present their findings by considering the ethical principles in a professional manner**
C212.4	Create a comprehensive report by compiling the research findings, ensuring both accuracy and clarity in the presented information.				
Mapping and Justification	**2 Present their investigations independently**	**3 Write and present the report**	**2 Demonstrate their study in form of a report**		**3 Develop the report having minimum plagiarism considering ethical principles**
Avg.	**3**	**2**	**2**	**2**	**2**

CO-PO-PSO Mapping: new AI-ML

COs	PO1	PO2	PO3	PSO1	PSO2
C212.1	Identify the relevant research problem and its associated literature in the field of computer science.				
Mapping and Justification	**3 Identify the problem and will carry out the research independently**	**1 Summarize the papers**		**2 Choose problems that may have AI-ML based Solutions**	**1 Take care of ethical principles while critiquing the associated literature**
C212.2	Examine the research gaps by analyzing the research articles.				
Mapping and Justification	**3 Do the investigation independently**	**2 Write the integrated summary**	**1 Knowledge gained by reading the articles**	**2 Develop an understanding regarding the gaps in existing literature**	**2 Take care of ethical principles while finding the research gaps**
C212.3	Appraise their communication and presentation skills by delivering the research findings through a seminar presentation.				
Mapping and Justification		**3 Present the seminar**	**2 Demonstrate their study in the form of seminar**		**2 Present their findings by considering the ethical principles in a professional manner**
C212.4	Create a comprehensive report by compiling the research findings, ensuring both accuracy and clarity in the presented information.				
Mapping and Justification	**2 Present their investigations**	**3 Write and present the**	**2 Demonstrate their study in**	**1 Report various AI-ML solutions**	**3 Develop the report having minimum**

	independently	report	form of a report	studied in numerous literature	plagiarism considering ethical principles
Avg.	**3**	**2**	**2**	**2**	**2**

Detailed Syllabus

Subject Code	19M12CS111	**Semester odd**	**Semester: First Session: 2023- 2024** **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	Understand the core concepts and algorithms in developing intelligent we system	Understand (Level-2)
C121.2	Apply social network concepts to interpret personalised content delivery on socia media based on users' interaction	Apply (Level-3)
C121.3	Apply intelligence into web development using recommendation algorithms an predictive analytics	Apply (Level-3)
C121.4	Analyse various Web content mining algorithms, Web language models an learning to rank models to handle complex Web.	Analyze (Level-4)
C121.5	Design and develop the computational intelligent web algorithms to handl complex real problems	Create (Level-6)

CO-PO-PSO Mapping:

COs	**PO1:** An ability to independently carry out research/ investigation and development work to solve practical problems	**PO2:** An ability to write and present a substantial technical report/document	**PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program	**PSO1:** Students should be able to develop and implement the solution of real-life computing problems using contemporary technologies	**PSO2:** Students should be able to apply ethical principles and commit to professional and social responsibilities
C121.1	**2** Moderately mapped to understand the fundamentals of Web Intelligent systems		**1** Slightly mapped to explain the approaches and algorithms to build an intelligent web	**1** Slightly mapped to make use of intelligent web techniques to solve real life computing problems.	
C121.2	**1** Slightly mapped as applying social network concepts to solve social media domain related problems		**1** Slightly mapped as applying the learned social network techniques/algorithms to develop an intelligent social web		**1** Slightly Moderated to applying the social media web provided API usage ethical practices
C121.3	**2**	**2**	**1**	**2**	**1**

	Moderately mapped to investigate the user preferences behavior to develop an effective recommendation application	Moderately mapped to present the intelligent web outcome in a technical report.	Slightly mapped to apply the effectiveness measures of recommendation of an intelligent web system	Moderately mapped to develop and design the recommendation system for a real-life web application.	Slightly moderated to Apply suitable pre-processing task for the given application
C121.4	**2** Moderately mapped to analyze and develop an intelligent web using language models to solve complex research issues	**2** Moderately mapped to showcase results of content mining for domain specific knowledge and performance evaluation	**1** Slightly mapped to solve a domain specific problem and evaluate its performance	**1** Slightly mapped to provide complete solution to domain specific real-life problem through contemporary solutions	**1** Slightly moderated to provide ethical and professional practices to handle domain specific problem
C121.5	**2** Moderately applied to propose a solution for real time problem	**2** Moderately applied to present a solution in technical report/ research paper for real time intelligent web system	**2** Moderately applied to propose a solution for an intelligent web and measured its efficacy over existing systems	**2** Moderately applied to develop the learnt intelligent web algorithms and approaches to build a real-life computing solution	**2** Moderately applied to provide proper credits and citations to the work referred in the developed intelligent web system
AVG.	**2**	**2**	**1**	**2**	**1**

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;	6
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: P@K, PR curve, Interpolation Precision CG, DCG, NDCG, MAP, AP	4
5	Graph Structure in the Web	Social Network concepts, Network formation, web network, Graph based Search algorithms- Page rank, HITS Algorithm, Graph based recommendation - Link	6

		Prediction, Timeline design algorithms- News Feed Algorithm, Edge Rank Algorithm	
6	Recommendation Algorithms	Collaborative filtering: User Based CF, Item Based CF, Content Based Recommendation, Machine learning based recommendation, hybrid recommendation	6
7	Matrix Factorization Techniques	Matrix decomposition, Eigenvalue decomposition, non-Negative matrix factorization, Singular value decomposition, objective functions, UV decomposition, CUR decomposition	4
8	Tensor Factorization	Multidimensional Matrix Factorization, Matricization, Tucker decomposition, High Order SVD, clustHOSVD, other methods	3
9	Collective Intelligence	Crowd Sourcing, Local-Global Behavioral Interactions, Self-Organizing Systems, Self-Adaptive Evolutionary Systems, Information Extraction from Deep Web, Decision Making Under Uncertainty	3
		Total number of Lectures	**40**

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.	Borgatti Stephon. P., Everett Martin G and Johnson Jeffery C , Analyzing Social Networks, Sage Publications, 2013
2.	Symeonidis, P., & Zioupos, A. (2016). Matrix and Tensor Factorization Techniques for Recommender Systems (Vol. 1). New York: Springer International Publishing.
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.	Soumen Chakrabarti,. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.
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.	Web Intelligence Journal: https://www.iospress.nl/journal/web-intelligence-and-agent-systems/
11.	Aggrawal, N., & Anand, A. (2022). Social Networks: Modelling and Analysis. CRC Press.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**19M12HS211**	Semester: Odd (specify Odd/Even)	Semester: III (MTech) Session: 2023 -2024 Month: from July to December
Course Name	**Cost Accounting for Engineering Projects**		
Credits	03	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Purwa Srivastava
	Teacher(s) (Alphabetically)	Dr. Purwa Srivastava

COURSE OUTCOMES		**COGNITIVE LEVELS**
C201.1	Understand basic concepts of Cost Accounting	Understand (C2)
C201.2	Apply concepts of cost in project management	Apply (C3)
C201.3	Analyze cost behavior for decision making	Analyze (C4)
C201.4	Evaluate different budgets for controlling the cost	Evaluate (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction & Overview of Strategic Cost Management Process	2
2.	Cost Concepts	Relevant Cost, Differential Cost, Incremental Cost, Opportunity Cost, Objectives of a costing system, Inventory Valuation, Provision of data for decision making	4
3.	Project execution	Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities.	5
4.	Project Execution & Quantitative	Pre project execution main clearances and documents Project team: Role of each member. Importance Project site	7

	techniques for cost management	Data required with significance, Project contracts, Types and contents, Project execution, Project cost control, bar charts, Project commissioning, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory	
5.	Cost Behavior	Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.	6
6.	Profit Planning Marginal Costing	Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach,	6
7.	Material Planning	Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card & value chain analysis.	6
8.	Budgetary Control	Flexible budgets, Performance budgets, zero based budgets, Measurements of divisional profitability pricing decisions including transfer pricing.	6
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+ project)
Total	**100**

Project based learning: students will form a group of four to five students. To make subject application based, students will apply various concepts such as Cost management and various types of Costing, project execution & quantitative techniques for cost management, cost behavior and profit planning. Students will apply these concepts on organization, or in any ongoing project or interdisciplinary base research project or any innovative idea in any particular industry along with feasibility.

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.	S. M. Datar and M. Rajan, *Horngren's Cost Accounting: A Managerial Emphasis. 16th ed*. Pearson Education, 2018.

2.	B. M. L. Nigam and I. C. Jain, *Cost Accounting: Principles And Practice*, PHI Learning Pvt. Ltd. PHI Learning Pvt. Ltd., 2010.
3.	R. S. Kaplan and A. A. Atkinson, *Advanced management accounting*. PHI Learning, 2015.
4.	A. K. Bhattacharyya, *Principles and practice of cost accounting*. PHI Learning Pvt. Ltd., 2004.
5.	N. D. Vohra, *Quantitative Techniques in Management, 3e*. Tata McGraw-Hill Education, 2006.
6.	C. Drury, *Management and Cost Accounting ,10th edition, Cengage Learning*. 2017.
7.	P. Chandra, *Projects-Planning Analysis, Selection, Implementation & Review 9e, Tata McGraw Hill, New Delhi.* 2019.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**19M13HS211**	Semester: Odd	Semester: M.Tech III and M.Tech Integrated X Session: 2023 -2024 Month from: August-December 2023
Course Name	**Constitution of India**		
Credits	2	Contact Hours	2-0-0

Faculty (Names)	Coordinator(s)	Dr. Namreeta Kumari
	Teacher(s) (Alphabetically)	Dr. Namreeta Kumari

COURSE OUTCOMES		**COGNITIVE LEVELS**
C202.1	Demonstrate an understanding of the historical inheritances and institutional legacies of Indian Constitution	Understand (C2)
C202.2	Demonstrate an understanding of the powers and functions of the Indian executive, legislature and judiciary	Understand (C2)
C202.3	Assess the devolution of powers and authority of governance of the Union government and the local government	Evaluate (C5)
C202.4	Assess the nature of the Indian constitution and its applicability in the study of politics in India	Evaluate (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	History of Making of the Indian Constitution	• History • Drafting Committee-Composition & Working	2
2.	Philosophy of the India Constitution	• Preamble • Salient Features	2

		• Federalism	
3.	Fundamental Rights and Directive Principles	• Right to Equality • Right to Freedom • Right against Exploitation • Right to Freedom of Religion • Cultural and Educational Rights • Right to Constitutional Remedies • Directive Principles of State Policy • Conflict between DPSP and FR • Fundamental Duties	5
4.	Organs of Governance	• Parliament-Composition, Qualifications & and Disqualification, Powers and Functions • Executive- President, Governor Council of Ministers • Judiciary-Appointment and Transfer of Judges, Qualifications, Power and Functions	8
5.	Local Administration	• District's Administration head: Role and Importance • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation • Panchayati raj: Introduction, PRI: Zila Panchayat. • Elected officials and their roles, CEO Zila Panchayat: Position and role • Block level: Organizational Hierarchy (Different departments) • Village level: Role of Elected and Appointed officials • Importance of Grass root democracy	8
6.	Election Commission	• Election Commission: Role and Functioning	3
Total number of Lectures			**28**
Evaluation Criteria **Components** **Maximum Marks**			

Mid Term:	30
End Semester Examination	40
TA	30 (Attendance,Quiz, Project)
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.	Austin, G. (1996). *The Indian Constitution: Corner Stone of a Nation*. Oxford: Oxford University Press
2.	Bakshi, P.M.(2015). *The Constitution of India*. Delhi: Universal Law Pub. Co. Pvt. Ltd
3.	Bhuyan, D. (2016). *Constitutional Government and Democracy in India*. Cuttack:Kitab Mahal..
4.	Busi, S.N. (2016). *Dr. B. R. Ambedkar framing of Indian Constitution*. Hyderabad*:*Ava Publishers
5.	Basu, D.D. (2018). *Introduction to the Constitution of India*. Nagpur: Lexis Nexis
6.	Jayal, N.G. & Mehta, P.B. (eds.)(2010). *The Oxford Companion to Politics in India*. New Delhi: Oxford University Press.
7.	Constitution series by Rajya Sabha Television and discussion on Indian Constitution by Rajya Sabha Television

Project: Projects based on the different aspects of the Indian Constitution have to be submitted by the students as a part of the project-based learning. This would help the students learn about the nitty gritty of the Constitution, their rights and duties which would later on help them not only in their work place but in their general life.

Detailed Syllabus

Course Code	21B12CS417	**Semester:** ODD	**Semester: VII Session:** 2023-24 **Month from:** JULY-DEC
Course Name	Machine Learning and Big Data (C431-12)		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Shailesh Kumar, Tarun Agarwal
	Teacher(s) (Alphabetically)	Shailesh Kumar, Tarun Agarwal

COURSE OUTCOMES: At the end of the course, students will be able to		**COGNITIVE LEVELS**
C431-12.1	Identify the characteristics of datasets and the types of machine learning techniques.	Understand Level (Level 2)
C431-12.2	Utilization of online learning methods in the context of big data applications	Apply Level (Level 3)
C431-12.3	Select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.	Apply Level (Level 3)
C431-12.4	Implement parallel learning algorithms using OpenMP/ CUDA/ OpenCL.	Apply Level (Level 3)
C431-12.5	Evaluate and validate different problems associated with big data characteristics for high dimensionality, and in scalability issues.	Evaluate (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to ML and Big data	Representation of data and exploration. Modeling of machine learning techniques. Application of big data computing technologies.	4
2.	Machine learning techniques	Three phases of machine learning, types of learning, Support vector machine, Decision trees and Random forests. Deep learning.	6
3.	Online methods for linear and nonlinear models	Online linear learning, 2nd order methods and analysis of convergence, LBGFS: BFGS and Limited Storage BFGS, Online learning for non-linear/non-convex models, Non-Convex Optimization in Machine Learning	6
4.	Big data computing environment	Hadoop; Map-reduce/All-reduce; Hadoop Distributed File System, map reduce, Linear Learning with All-Reduce	7
5.	Parallelization of learning algorithms	Introduction to parallel learning algorithms and implementation using OpenMP/ CUDA/ OpenCL.	7
6.	Scaling up machine learning-I	Inverted Indices & Predictive Indexing; Feature Hashing; Locally-sensitive Hashing & Linear Dimensionality Reduction; Nonlinear Dimensionality Reduction; Feature Learning; PCA, LDA, SVD.	6
7.	Scaling up machine learning-II	Handling Many Classes, class embedding; Active Learning; Concepts, Scenarios, Clustering based active learning, Semi-supervised active learning, Exploration and Learning.	6

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 leaning: Groups of 3-4 students will choose a project topic. They will use a suitable computing environment and machine learning technique to solve a real time big data problem. In a team, they will learn how to apply the concepts for problem solving in a meaningful way.

Text Books:

1	Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman, 3rd edition, Cambridge University Press, 2019 (http://infolab.stanford.edu/~ullman/mmds/book0n.pdf)
2	Machine Learning - A Complete Exploration of Highly Advanced Machine Learning Concepts, Best Practices and Techniquesby Peter Bradley, Draft2digital, 25 June 2019

Reference Books:

1	Data-Intensive Text Processingwith MapReduce by Jimmy Lin and Chris Dyer, Morgan publishers, 2010. (http://www.iro.umontreal.ca/~nie/IFT6255/Books/MapReduce.pdf)
2	Guoqiang Zhong, Li-Na Wang, Xiao Ling, Junyu Dong, "An overview on data representation learning: From traditional feature learning to recent deep learning",The Journal of Finance and Data Science,Vol. 2 (4), pp. 265-278, 2016,ISSN 2405-9188,https://doi.org/10.1016/j.jfds.2017.05.001.
3	Active Learning (Synthesis Lectures on Artificial Intelligence and Machine Learning) by Burr Settles, Morgan & Claypool Publishers, 30 July 2012

Course Code	23M12CS115	Semester: ODD	**Semester** : 10th (For Int-CSE) **Session**: 2023-2024 Month: July to December
Course Name	Design Engineering		
Credits	3-0-0	Contact Hours	3

Faculty (Names)	**Coordinator(s)**	Shivendra Vikram Singh
	Teacher(s)	Vikas Saxena, Shivendra Vikram Singh

Course Outcomes		Cognitive Level
CO1	(Level 2: Understand) To explain different engineering design principles and techniques	2
CO2	(Level 3: Apply) To apply advanced theoretical and computational tools to optimize designs, considering factors such as performance, efficiency, durability, and reliability	3
CO3	(Level 5: Evaluate) To collaborate effectively across the teams, incorporating insights from various fields to create comprehensive and innovative solutions.	5
CO4	(Level 6: Create) To critically analyze complex engineering problems and develop holistic solutions to prototype creation that address not only technical aspects but also economic, social, ethical, and relevant aspects.	6

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the Module**
1	Introduction	Introduction to Engineering, Introduce Fields of Engineering, Engineering in teams and collaborative working of Engineers, Principles for Soft. Engg	8
2	Pre Design	Read, Design, and Sketch Cycle, Introduce Prototypes, Prototype Examples, Design and Build Prototypes, Testing the prototype design, Redesign, TDD, Principles for Soft.Design	8

3	Requirement Engg.	Introduction to Systems Engineering, System and Systems life cycle, Needs and Relevance of Systems Engineering, Requirements Elicitation and engineering	8
4	Design	Conceptual Design, Preliminary and Detailed Design, Construction and production of the system, Principle of Design	8
5	Case Study	Case Studies and Real World Scenarios & its evaluation	8
		Total	40

Evaluation Criteria	
Components	Max.Marks
T1, T2	20 Marks each
End Term	35 Marks
TA	25 [Attendence, PBL, Quizes, Viva, Submissions]
Total	100

References:

1. Norman, D. (2013). *The design of everyday things: Revised and expanded edition*. Basic books.
2. McElroy, K. (2016). *Prototyping for designers: developing the best digital and physical products*. " O'Reilly Media, Inc.".
3. Kossiakoff, A., Biemer, S. M., Seymour, S. J., & Flanigan, D. A. (2020). *Systems engineering principles and practice*. John Wiley & Sons.
4. Ghosh, S. K.(1988). Engineering design: A materials and processing approach (First metric edition): by GE Dieter McGraw-Hill, London, 1986. ISBN 0-07-016902-0, xiv+ 592 pages, illustrated.
5. Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). *Design patterns: elements of reusable object-oriented software*. Pearson Deutschland GmbH.
6. Fang, C., Huang, Q., Liu, Z., Ding, R., & Blanton, R. D. (2023). Efficient Test Chip Design via Smart Computation. *ACM Transactions on Design Automation of Electronic Systems*, *28*(2), 1-31.
7. Gupta, V. (2021). Requirement Engineering Challenges for Social Sector Software Development: Insights from Multiple Case Studies. *Digital Government: Research and Practice*, *2*(4), 1-13.

Machine Learning and Data Mining Lab (17M15CS112)
Detailed Syllabus

Course Code	17M15CS112	**Semester:** Odd 2023	**Semester: I Session** 2023 -2024 Month from: July – December 2023
Course Name	Machine Learning and Data Mining Lab		
Credits	1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Ms. Kirti Jain
	Teacher(s) (Alphabetically)	Ms. Kirti Jain

COURSE OUTCOMES: Students will be able to		**COGNITIVE LEVELS**
C173.1	Perform data preprocessing, data sampling and visualization.	Understanding (Level-2)
C173.2	Apply Linear regression, Logistic regression, kNN, k Means, SVM and ID3 on different datasets.	Apply (Level-3)
C173.3	Implement Apriori algorithm and Eclat algorithm in R.	Apply (Level-3)
C173.4	Apply neural networks such as ANN, BPN and CNN to different datasets.	Apply (Level-3)
C173.5	Evaluate and analyze 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 notebook) 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 the 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
D2D	50
Attendance	10
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:

Text Books:

1.	Jiawei Han, Micheline Kamber, Data Mining, Morgan Kaufmann Publishers,Elsevier,2005
2.	Pujari, Arun K,Data mining and statistical analysis using SQL, Universities press

Reference Books:

1.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining
2.	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
3.	Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Prentice Hall,2003
4.	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw-Hill.
5.	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
6.	Transactions on Database Systems (ACM)
7.	IEEE Transactions on Knowledge & Data Engineering
8.	The VLDB Journal The International Journal on Very Large Data Bases
9.	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley

Detailed Syllabus
Lab-wise Breakup

Course Code	**17M15CS111**	**Semester** ODD	**Semester I Session** 2023 -2024 **Month from** July to Dec 2023
Course Name	Advanced Algorithms Lab		
Credits	1	**Contact Hours**	2

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

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.	Fundamentals of 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**

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 like Greedy algorithms, dynamic programming, network flow, etc. The solution approach for the identified problem statements should include the usages of advanced data structures including string data structures. The problem statements may be a puzzle-based games, graph-based problems, string-based problems, etc. The developed mini project will enhance the algorithmic thinking and problem-solving approaches of students which are highly desirable to excel in software 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)

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
Lab-wise Breakup

NOTE: All the entries (…) must be in Times New Roman 11.

Course Code	17M15CS113	**Semester** **Odd 2023**	**Semester** ... **Session** 2023-24 **Month from** July to Dec, 2023
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	Provisioning of Data Centers, Virtual Machines (VMs) and cloudlet allocations on CloudSim using various scheduling algorithms.	Apply (level 3)
C171.3	Analyze various Scheduling techniques and resource allocations, compare their performances on different Cloud Platforms, like, CloudSim, Amazon Web Services (AWS).	Analyze (level 4)
C171.4	Evaluate the various Cloud Services provisioning and their performances using AWS platforms, Containers and Dockers.	Evaluate (level 5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	CloudSim installations, VM creation and usage	Understand the Cloud Service Models, Deployment Models, Various Cloud Layers, Data Centers, Virtualization Technology, Virtual Machines (VMs), Virtual Machine Monitors (VMMs).	CO1
2.		Provisioning of Data Centers, Virtual Machines (VMs) on CloudSim. Allocate different Cloudlets to VMs and Data Centers using different scheduling algorithms.	CO2
3.	Analyze various Scheduling algorithms in different scenarios on cloudsim, AWS	Create different Data Centers and allocate the VMs to them and analyze the outcomes	CO3
4.		Analyze various Scheduling techniques and resource allocations supported by Cloud Platforms, e.g. CloudSim and AWS., Their performance evaluations on different Cloud Platforms, like, CloudSim and Amazon Web Services (AWS).	CO3
5.	Evaluate Cloud Service provision on AWS, Containers and Dockers.	Evaluate the various Cloud Services provisioning and their performance evaluations using AWS like EC2, RDS, Simple Storage Service, Containers and Dockers.	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 Cloud Platform like AWS, Google cloud, Eucalyptus, CloudSim, iFogSim or any other Cloud Platform, preferably open source platforms and 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.**
7.	https://www.docker.com
***m*.**	…

COs	PO 1	PO 2	PO 3	PSO1	PSO2
C171.1	2	2	2	1	1
C171.2	2	2	2	1	2
C171.3	2	1	1	1	1
C171.4	1	1	2	2	2
AVG.	2	2	2	1	2

1. CO-PO and CO-PSO Mapping (M. Tech- CSE) I sem:

COs	PO 1	PO 2	PO 3	PSO1	PSO2
C171.1	2 Basics of Cloud services demonstrated	2 Basic principles and architectures of Cloud model is demonstrated	2 Various Cloud Service types and deployment models are demonstrated	1 Role of Virtualization Technology in Cloud Model is demonstrated	1 Data Center, Virtual Machine creation and usage is demonstrated
C171.2	2 Provisioning of Data Center and VMs on CloudSim platform	2 Allocation of Virtual Machines to Data Centers and Hosts	2 Applying various scheduling algorithms for VM provisioning and cloudlet allocations	1 Allocate Cloudlets to VM and Data Centers	2 Applying various scheduling algorithms for Cloudlet allocations on VMs
C171.3	2 Creating VMs and Instances on Amazon Web Services (AWS)	1 Analysing the behaviour of scheduling techniques	1 Analysis of instances on AWS, Elastic Compute Cloud (EC2) etc.	1 Analysis of Simple Storage Service (S3)	1 Analysis of other AWS Services, viz, Relational Database Service (RDS).
C171.4	1 Evaluation of AWS, Elastic Compute Cloud (EC2) features	1 Evaluation of AWS storages and their features, namely, Simple Storage Service (S3), Relations Database Services (RDS)	2 Performance evaluations of instances on AWS, EC2, storage and other services.	2 Performance Evaluation of Containers and their benefits over Virtual Machines.	2 Performance Evaluation of Dockers and their applications.
AVG.	2	2	2	1	2

Detailed Syllabus
Lecture-wise Breakup

Course Code	19M12CS112	**Semester** Odd **(specify Odd/Even)**	**Session** 2023 -2024 **Month** from July to Dec
Course Name	Meta-heuristics Modelling and Optimization		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Parul Agarwal
	Teacher(s) (Alphabetically)	Dr. Parul Agarwal

COURSE OUTCOMES At the completion of the course, Students will be able to		**COGNITIVE LEVELS**
C131.1	Understand the concepts of Meta-heuristics based optimization and it's utility in a diverse range of applications.	Understand Level (L2)
C131.2	Apply a single solution and population based Meta-heuristic algorithms to solve a given optimization problem.	Apply Level (L3)
C131.3	Apply Meta-heuristic algorithms to solve Multi-objective optimization problems.	Apply Level (L3)
C131.4	Apply hybrid and quantum based Meta-heuristic algorithms to solve a given optimization problem.	Apply Level (L3)
C131.5	Analyze the performance of any Meta-heuristic algorithm for a real world problem.	Analyze Level (L4)

Module No.	**Title of the Module**	**Topics in the Module**	**CO Mapping**	**No. of Lectures for the module**
1.	Introduction	Optimization Models, Approximate Algorithms, When to use Metaheuristics?, Methods and Application	CO1	3
2.	Fundamentals of Metaheuristics	Representation, Objective Functions; Constraint Handling; Parameter Tuning; Performance Analysis.	CO1	3
3.	Single-Solution Based Metaheuristics	Basic Concepts, Fitness Landscape Analysis; Local Search; Tabu Search; Iterated and Guided Local search;	CO2	6
4.	Population-Based Metaheuristics Methods	Basic Concepts; Evolutionary Algorithms (Genetic Algorithm, Differential Evolution), Swarm Intelligence: Stochastic diffusion search (Ant Colony Optimization), Social cognitive optimization (Particle Swarm Optimization, GWO)	CO2	8
5.	Metaheuristics for Multi-objective Optimization	Basic concepts; Multi-objective Continuous and Combinatorial Problems, Multi-criteria Decision Making; Many objectives and large scale optimization, Design Issues.	CO3	5
6.	Fitness Assignment	Scalar approach, Criterion-Based Methods; Dominance-Based Approaches; Indicator based	CO3, CO5	8

	Strategies and Evaluation of Multi-objective Optimization	Approaches; Diversity Preservation; Performance Evaluation MOPSO, NSGA-2, NSGA-3, SPEA.		
7.	Hybrid Metaheuristics	Design and Implementation Issues; Mathematical Programming Approaches; Classical Hybrid Approaches; Hybrid Metaheuristics with Machine Learning and Data Mining; Hybrid Metaheuristics for Multi-objective Optimization. Understanding Quantum based multi-objective optimization and its applications.	CO4, CO5	9
		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]	E.-G. Talbi, Metaheuristics: From design to implementation. Hoboken, New Jersey, USA: John Wiley & Sons, 2009.
[2]	G. Z¨apfel, R. Braune, and M. B¨ogl, Metaheuristic search concepts: A tutorial with applications to production and logistics. Heidelberg: Springer Science & Business Media, 2010.
[3]	M. Gendreau and J.-Y. Potvin, Handbook of metaheuristics. New York, USA: Springer, 2010.
[4]	S. Luke, Essentials of Metaheuristics. Lulu, 2013. Available for free at http://cs.gmu.edu/∼sean/book/metaheuristics/.
[5]	C. C. Ribeiro and P. Hansen, Essays and surveys in metaheuristics. New York, USA: Springer Science & Business Media, 2012.
[6]	F. Glover and G. A. Kochenberger, Handbook of metaheuristics. Dordrecht: Kluwer Academic Publishers, 2003.
[7]	I. H. Osman and J. P. Kelly, Meta-heuristics: Theory and applications. Norwell, Massachusetts, USA: Kluwer Academic Publishers, 2012. 41
[8]	S. Voß, S. Martello, I. H. Osman, and C. Roucairol, Meta-heuristics: Advances and trends in local search paradigms for optimization. New York, USA: Springer Science & Business Media, 2012.
[9]	T. F. Gonzalez, Handbook of approximation algorithms and metaheuristics. Boca Raton, FL, USA: CRC Press, 2007.
[10]	J. Dr´eo, A. Petrowski, P. Siarry, and E. Taillard, Metaheuristics for hard optimization: Methods and case studies. Berlin Heidelberg: Springer Science & Business Media, 2006
[11]	P. Siarry and Z. Michalewicz, Advances in metaheuristics for hard optimization. Berlin Heidelberg: Springer Science & Business Media, 2007.
[12]	K. F. Doerner, M. Gendreau, P. Greistorfer, W. Gutjahr, R. F. Hartl, and M. Reimann, Metaheuristics: Progress in complex systems optimization. New York, USA: Springer Science & Business Media, 2007.

[13]	X.-S. Yang, Nature-inspired optimization algorithms. London, UK: Elsevier, 2014.

1. CO-PO and CO-PSO Mapping:

COs	PO1	PO2	PO3	PSO 1	PSO2
C131.1	**1** Basic concepts of meta-heurstics are introduced	**1** Explanation of terminologies used in algorithms	**1** Understanding utility of meta-heurtistic algorithms	**1** For applying meta-heuristic, basic terms are explained	
C131.2	**3** Apply algorithms to solve practical problems independently	**2** Understanding algorithm application to write a technical document	**2** Mastery over application of single and population based algorithms	**3** Apply algorithms to real life computing problems independently	**1** Follow the rules of comparing the algorithm's performance
C131.3	**3** Apply algorithms to solve practical problems independently	**2** Understanding algorithm application to write a technical document	**2** Mastery over application of multiobjective algorithms	**3** Apply algorithms to real life computing problems independently	**1** Follow the rules of comparing the algorithm's performance
C131.4	**3** Apply algorithms to solve practical problems independently	**2** Understanding algorithm application to write a technical document	**2** Mastery over application of hybrid and quantum based algorithms	**3** Apply algorithms to real life computing problems independently	**1** Follow the rules of comparing the algorithm's performance
C131.5	**3** Anlayze practical problems and apply suitable algorithms	**2** Analyze algorithm performance write a technical document	**3** Mastery over application of metaheuristic algorithms by analyzing its performance	**3** Analyze algorithms on real life computing problems	
Avg.					

Programme Outcomes:

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program.

Programme Specific Outcomes: M.Tech (CSE)

PSO 1: Students should be able to develop and implement the solution of real life computing problems using contemporary technologies.

PSO 2: Students should be able to apply ethical principles and commit to professional and social responsibilities.