

Course Description

Course Code	15B19CI791	Semester ODD (specify Odd/Even)	Semester VII Session 2021 -2022 Month from July to Dec 2021
Course Name	Project Part – 1 (CSE)		
Credits	4	Contact Hours	

Faculty (Names)	Coordinator(s)	Dr. Mukesh Saraswat (JIIT128)and Dr. Prashant Kaushik (JIIT62)
	Teacher(s) (Alphabetically)	Entire Department

COURSE OUTCOMES		COGNITIVE LEVELS
C450.1	Summarize the contemporary literatureand explore tools for hands-on in the respective project area	Understand Level (Level 2)
C450 .2	List out the specific requirements to develop the workable solution for the identified computing problem	Analyze Level (Level 4)
C450 .3	Develop a working model for the identified problem	Apply Level (Level 3)
C450 .4	Inspect the developed solution using exhaustive test cases and evaluate its performance using statistical methods and relevant metrics	Evaluate Level (Level 5)
C450 .5	Report the results and findings of the project in written and verbal formats	Create Level (Level 6)

Module No.	Title of the Module	List of Experiments	CO
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Evaluation Criteria	
Components	Maximum Marks
Mid Semester Viva	20
Final Viva	30
Project Report	20
Day to Day Work	30
Total	100

Project based learning: Each student in a group of 2-3 will have to develop a Major Project based on different real-world problems using any open-source programming language. Students have to study the state-of-the-art methods before finalizing the objectives. Project development will enhance the knowledge and employability of the students in IT sector.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B19CI793	Semester Odd (specify Odd)	Semester VII Session 2021 -2022 Month from July to Dec
Course Name	Summer Training & Viva NBA Code: C455		
Credits	Qualifying	Contact Hours	6-8 Weeks Industrial Training

Faculty (Names)	Coordinator(s)	K Vimal Kumar
	Teacher(s) (Alphabetically)	ALL FACULTY

COURSE OUTCOMES		COGNITIVE LEVELS
C455.1	Summarize the contemporary activities with respect to their module, and explored tools for hands-on in the respective project area	Understand Level (Level 2)
C455.2	Analyze industry requirements and work culture	Analyze Level (Level 4)
C455.3	Apply technical knowledge to construct computing-based solution with respect to the identified problem at industry/institute.	Apply (Level 3)
C455.4	Interpret and critically evaluate the solution for the problem.	Analyze Level (Level 4)
C455.5	Create written discourse for presentation of work done at industry/institute	Understand Level (Level 2)

Evaluation Criteria

The Industrial Training of students will be evaluated on the basis of Viva and Report. They will be graded either as satisfactory or unsatisfactory

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NCI648	Semester -Odd (specify Odd/Even)	Semester VII Session 2021 -2022 Month from: Aug 21- Dec 21
Course Name	Information Retrieval and Semantic Web		
Credits	3	Contact Hours	3 – 0 -- 0

Faculty (Names)	Coordinator(s)	Dr. Neetu Sardana, Dr Devpriya Soni	
	Teacher(s) (Alphabetically)	Dr Devpriya Soni, Dr. Neetu Sardana	

COURSE OUTCOMES		COGNITIVE LEVELS
C330-15.1	Design and implement information retrieval systems for unstructured data.	Apply Level (Level 3)
C330-15.2	Apply query processing techniques for tolerant retrieval.	Apply Level (Level 3)
C330-15.3	Analyze Information retrieval models and their metrics.	Analyze Level (Level 4)
C330-15.4	Analyze the searching algorithms for Information Retrieval.	Analyze Level (Level 4)
C330-15.5	Demonstrate the web crawling , taxonomy and ontology of web applications	Apply Level (Level 3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Information Retrieval	Theory of information retrieval, Information retrieval on Data and information retrieval on the Web Information retrieval tools and their architecture.	4
2.	Boolean Retrieval & Index Construction	An example information retrieval problem, Processing Boolean queries, The extended Boolean model versus ranked retrieval, Blocked sort based, single pass in Memory, Distributed and dynamic Indexing.	6
3.	Dictionary and tolerant retrieval	Wild card queries, Spelling correction , Phonetic correction	4
4.	Scoring Term weighting and the vector space model	Term frequency and weighting, Vector space model, Variant TF-IDF Scoring, Probabilistic Model, Evaluation of IR System	4
5.	Link analysis	Web as graph, Page Rank	4
6.	Information retrieval tools	Web directory, Search engine, Meta search engines, Web searching and search engine architecture, Searching Algorithms (Fish, Shark etc...), and Page ranking algorithms.	6
7.	Web Crawling	Web Crawler architecture and Web crawling (parallel, distributed and focused web crawling).	6
8.	Taxonomy and Ontology	Creating domain specific ontology, Ontology life cycle Semantic Web: Resource description Framework (RDF),	8

		Turtle format, Storing RDF in Databases/files, Language Tags and labels in RDF files, RDF schema and web ontology language (OWL).	
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	
Project Based Learning: Each student in a group of 3-4 will choose any issue related to Information Retrieval system. Each group will identify recent research related to the problem area. Group will analyse the solution proposed in the articles and implement on real dataset.			

Recommended Reading material:	
Text Books	
1.	Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, “An introduction to Information Retrieval”, 2013 Cambridge University Press UP.
2.	Rijsbergen C. J. 2012, “Information Retrieval”, 2 nd edition.
Reference Books	
1.	Salton, G. and McGill, M.J., “ <i>Introduction to Modern Information Retrieval</i> ”, Computer Series. McGraw-Hill, New York, NY.
2.	ACM Transaction on Internet Technology.

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NHS831	Semester: Odd (specify Odd/Even)	Semester: VII Session 2021 -2022 Month: Aug 2021 -Dec 2021
Course Name	Gender Studies		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Ms. Shikha Kumari
	Teacher(s) (Alphabetically)	Ms. Shikha Kumari

COURSE OUTCOMES		COGNITIVE LEVELS
C401-19.1	Demonstrate knowledge of the construct of gender and the way it intersects with other social and cultural identities of race, class, ethnicity and sexuality	Understand (C2)
C401 - 19.2	Apply feminist and gender theory in an analysis of gender including an examination of the social construct of femininity and masculinity	Apply (C3)
C401- 19.3	Analyze the ways in which societal institutions and power structures such as the family, workplace impact the material and social reality of women's lives	Analyze (C4)
C401-19.4	Assess the need for Gender Sensitization and Gender Inclusivity and its practice in contemporary settings	Evaluate (C5)
C401- 19.5	Evaluate and interpret information from a variety of sources including print and electronic media, film, video and other information technologies	Evaluate (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introducing Gender Issues	<ul style="list-style-type: none"> • Sex and Gender • Types of Gender • Gender Roles • Gender Division of Labor • Gender Stereotyping and Gender Discrimination 	9
2.	Gender Perspectives of Body & Language	<ul style="list-style-type: none"> • Socio-Cultural Perspectives of body • Body as a Site and Articulation of Power Relations • Cultural Meaning of Female Body and Women's Lived Experiences • The Other and Objectification 	6
3.	Social Construction of Femininity & Feminism	<ul style="list-style-type: none"> • Bio-Social Perspective of Gender • Gender as Attributional Fact • Feminine & Feminist • Major Theorists of Feminism Challenging Cultural Notions of Femininity • Feminism Today: Radical, Liberal, Socialist, Cultural, Eco feminism & Cyber feminism • Images of Women in Sports, Arts, Entertainment, Media and Fashion Industry ;Cultural Feminism & 	9

		Celebrating Womanhood <ul style="list-style-type: none"> • Analysis of role women have played across cultures 	
4.	Social Construction of Masculinity	<ul style="list-style-type: none"> • Definition and Understanding of Masculinities • Sociology of Masculinity & its Types • Social Organization of Masculinity and Privileged Position of Masculinity • Politics of Masculinity and Power • Major Theorists of Masculinity • Masculine Identities in Literature, Cinema & Media. 	9
5.	Gender Sensitization Empowerment & Gender Inclusivity	<ul style="list-style-type: none"> • Women & Women Rights In India • From Women's Studies to Gender Studies: A Paradigm Shift • Gender Sensitization & Gender Inclusivity • Gender Studies & Media: Creating New Paradigms in Gender & Culture 	9
Total number of Lectures			42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Project/ Assignment)
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	Davis K., et al, " <i>Handbook of Gender and Women's Studies</i> . London: Sage. (2006)
2	Helgeson, Vicki S., " <i>The Psychology of Gender</i> ", Pearson(2012)
3	Friedan B., " <i>The Feminine Mystique</i> ", Penguin. (1971/1992)
4	Debeauvoir S. , " <i>The Second Sex</i> ", Vintage (1953/1997)
5	Wharton Amy S., " <i>The Sociology of Gender: An Introduction to Theory & Research</i> ", Wiley-Blackwell (2005)
6	Pachauri G., " <i>Gender, School & Society</i> ", R.Lall Publishers(2013)
7	Connell R.W, " <i>Masculinities</i> ", Cambridge: Polity. (1985)
8	MacInnes J., " <i>The End of Masculinity</i> ". Buckingham: Open University Press. (1998)
9	Kaul A.& Singh M., " <i>New Paradigms for Gender Inclusivity</i> ", PHI Pvt Ltd (2012)

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT732	Semester Odd (specify Odd/Even)	Semester VII Session 2021-22 Month from July-December
Course Name	Healthcare Marketplace		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Shweta Dang
	Teacher(s) (Alphabetically)	Prof. Indira P. Sarethy, Dr. Shweta Dang

COURSE OUTCOMES		COGNITIVE LEVELS
C401-14.1	Explain healthcare market, drugs and devices, role of various stakeholders	Understand Level (C2)
C401-14.2	Apply related intellectual property laws and regulatory approvals for healthcare sector	Apply Level (C3)
C401-14.3	Analyze the various business models/ innovations in the healthcare industry	Analyze Level (C4)
C401-14.4	Compare and examine economic aspects pertaining to the sector	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Healthcare markets	About the various Regulatory bodies for approval of new medical innovations	02
2.	Clinical Pharmacokinetics and Clinical trials for new Drugs	Biologic sampling techniques, analytical methods for the measurement of drugs and metabolites, and procedures that facilitate data collection and manipulation. Clinical Trials: PhI, II, III and IV	05
3.	Regulatory approval pathways	Preclinical studies US and EU filings IND submissions, NDA and BLA Submissions, Non-patent exclusivities, data and market exclusivities cost analysis	06
4.	Patents of drugs and devices, Entry for generics in health care markets	Role of patents on new drugs and devices, Ever-greening of patents, Product and Process patents. Hatch Waxman act and Introduction of generics and resulting cost reduction, Orange book (FDA) and related case studies.	08
5.	Economics of healthcare	Stakeholders in healthcare- doctors, hospitals and insurers and their roles, technology and human capital	7
6.	Medical technology and insurance	For medical devices, pharmaceuticals, genetic diagnostic tests and their regulations	4
7.	Indian hospital sector	Various players – government, private, PPP models, strategic perspectives, case studies	4
8	Innovations in the marketplace	Health to market innovations	4

9	Healthcare informatics	e-health, collection of health data, data processing, evaluation, health information systems, case studies	2
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Assignments 1, 2, 3, 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.	Research papers and online resources		

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NCI731	Semester ODD (specify Odd/Even)	Semester VII Session 2021 -2022 Month from July 2021 to Dec 2021
Course Name	Machine Learning and Natural Language Processing		
Credits	3	Contact Hours	3-1-0
Faculty (Names)	Coordinator(s)	Dr. K. Vimal Kumar (J-62), Dr. Arti Jain (J-128)	
	Teacher(s) (Alphabetically)	Dr. Arti Jain, Dr. K. Vimal Kumar	

COURSE OUTCOMES		COGNITIVE LEVELS
C430-2.1	Explain different syntax and semantics approaches in NLP	Understand Level [Level 2]
C430-2.2	Understand the fundamental mathematics applied in the field of NLP	Understand Level [Level 2]
C430-2.3	Apply different models like Hidden Markov Model, SVM, CRF, RNN, LSTM in parts of speech tagging	Apply Level [Level 3]
C430-2.4	Apply different probabilistic parsing techniques in NLP	Apply Level [Level 3]
C430-2.5	Apply different supervised and unsupervised techniques for document classification	Apply Level [Level 3]
C430-2.6	Analyze and apply appropriate Machine Learning techniques to solve the real world problem in NLP	Apply Level [Level 3]

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Introduction to Machine Learning & NLP, Challenges	3
2.	Mathematical Foundation	Probability Theory, Vector Spaces, Matrix algebra, Probability, Data representation, Tokenization, Lemmatization	5
3.	Parts of Speech Tagging	Various Models: Hidden Markov Model, SVM, CRF, RNN, LSTM	11
4.	Parsing	Linguistic Essentials, Markov Models, Applications of tagging, Probabilistic parsing - CFG, CSG, PCFG	8
5.	Document classification	Supervised: Bayesian, Naive Bayes, N-gram model, sentiment analysis, text classification, Unsupervised: K-means, Expectation-Maximization (EM) algorithm, MaxEnt classifier	8
6.	Topic Modelling	Topic Modelling: Latent Dirichlet Allocation (LDA) and its Variants	2

7.	Applications	Document summarization, Co-referencing, noun phrase chunking, named entity recognition, co- reference resolution, parsing, information extraction, Machine Translation, Spell Correction, News Article Title Generation, Code Categorization, Question Answering (Eliza).	5
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Total number of Lectures **42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
i) Attendance	= 07
ii) Class Test, Quizzes, etc	= 07
iii) Internal Assessment	= 05
iv) Assignments in PBL mode	= 06
Total	100

Project based learning: Each student in a group of 2-3 will apply Machine Learning and Natural Language Processing models to solve day-to-day problems. To make subject application based, the student applies ML & NLP technologies to the task of document summarization, information extraction, question answering, spell correction and many more. Applicability of part-of-speech tagging, parsing, document classification and topic modelling enhance the students' knowledge and help their employability into real-time application domains.

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

Recommended Textbooks: Author(s), Title, Edition, Publisher, Year of Publication etc.

1	Daniel Jurafsky and James H. Martin: Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Third Edition, Prentice Hall Series, 2000.
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Recommended Reference Books: Author(s), Title, Edition, Publisher, Year of Publication etc.

1	Pramod Singh, Machine Learning with PySpark: With Natural Language Processing and Recommender Systems, First Edition, Apress, 2018.
2	Joseph Olive, Caitlin Christianson, and John McCary (Eds.): Handbook of Natural Language Processing and Machine Translation: DARPA Global Autonomous Language Exploitation, 2011th Edition, Springer, 2011.
3	Steven Bird, Ewan Klein, and Edward Loper: Natural Language Processing with Python, O'Relly, 2009.
4	Philipp Koehn: Statistical Machine Translation, Cambridge University Press, 2009.
5	Sergei Nirenburg, Harold L. Somers, and Yorick A. Wilks, Readings in Machine Translation, MIT Press, 2003.
6	James Allen: Natural Language Understanding, Second Edition, Pearson, 2002.
7	Christopher D. Manning and Hinrich Schtze: Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS731	Semester: Odd	Semester VII Session 2021 -2022 Month from September 2021 to December 2021
Course Name	Customer Relationship Management		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Shirin Alavi
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi

COURSE OUTCOMES		COGNITIVE LEVELS
C401-17.1	Apply the financial, social and electronic aspects of the Customer Relationship in business situations.	Apply Level (C3)
C401-17.2	Appraise the role of customer share and customer centricity in organizations.	Apply Level (C3)
C401-17.3	Develop the skills to understand customization, innovation and co-creation in organizations and apply them in business contexts.	Analyze Level (C4)
C401-17.4	Analyze the role of interactive technology for customer engagement, customer retention and customer experience management in organizations.	Analyze Level (C4)
C401-17.5	Evaluate the technological solutions and their applications for effective Customer Relationship Management across different functions in organizations.	Evaluate Level (C5)
C401-17.6	Develop specific models for response modelling and consumer profiling in organizations.	Create Level (C6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	CRM-The Strategic Imperatives	Introduction, CRM in Marketing and IT, CRM for Business Leadership, Criticality of customer relationships, Why businesses should adopt CRM, Implementing CRM.	3
2.	Conceptual Foundations of CRM, Building Customer Relationships	Evolution of CRM, Benefits, Schools of thought on CRM, Defining CRM. Customer Retention and Customer Acquisition, Customer Profitability is Skewed, Service Benefits of CRM, Transaction Marketing vs. Relationship Marketing, Relationship Building as a process, Bonding for Customer Relationships-Financial, Social, customization and Structural bonds, Ladder of Loyalty Zero Customer Defection, CRM Framework.	7
3.	Relationship Marketing and Economics of CRM	Internal and external relationships, Electronic Relationships, Operational, Analytical and Collaborative CRM, Market Share vs. Share of Customer, Customer Lifetime Value, and Activity based costing for CRM	6
4.	CRM in B2C ,B2B Markets , Customer Experience Management	CRM in Product and Service Markets, Case Studies, Characteristics of Business Markets, Participants in the business buying process, Key Account Management, Using KAM for Customer Segmentation, Customer Retention Strategy, KAM as a growth and Development Strategy , Customer Value Management in Business Markets,	7

		Importance of CRM in B2B Markets, Customer Emotion, Customer Knowledge, Reciprocity, Voice of the Customer, Participation. ***Dominos using different types of content to practice engagement	
5.	Components of e CRM solutions (Overview) and Role of Digital Technologies	Data warehousing, Datamining and CRM, Market Basket Analysis and Retail sector, Campaign Management, Sales Force Automation, Customer Service and Support, Corporate Blogs, Online communities, Twitter, Wikis. The Experience ecosystem. CEM, Consumer engagement, segmentation and differentiation. ** Exercise on online campaign management solutions	7
6.	Product offerings in the CRM Marketplace (Overview) and CRM Roadmap	Evaluating Technological solutions for CRM, Comparison of Siebel, Oracle, MySAP.com and People Soft Enterprise solutions, Comparison of Talisma, Sales logix, Microsoft and Sales notes for small and medium enterprises, Defining a CRM strategy, CRM Implementation Roadmap, Developing a relationship orientation, Customer centric marketing and processes, Building organizational capabilities through internal marketing, Issues in implementing a technology solution for CRM.	7
7.	Operational issues in implementing CRM, Social CRM	Process view of CRM, Budgeting for attraction vs. retention, Learning from customer defections, Customer Retention Plans, Evaluating Retention programs, Social Customer Relationship Management, Social Customer Insights, Social CRM Strategy, and Social Customer Analytics. * Exercise on Mckinsey's social media model	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Project: Report, Viva, Class Participation)	
Total		100	

Project Based Learning: The project is to be done in group size of 4-5 members each. Student groups can choose an organization from one of the industry vertical like banking, IT, hospitality, telecom, airlines, logistics and consulting. Students need to study the CRM processes (internal CRM processes for improving employee productivity and external processes improving the organization-consumer interface) in the vertical/organization chosen. They need to develop a conceptual model to depict the processes. A questionnaire needs to be developed it can either be an employee-based survey or consumer-based survey. Based on data collection and analysis, CRM strategies have to be formulated, for better consumer segmentation/process improvement/productivity enhancement/ identification of customers with greater Customer Life Time Value/ Customer Retention Program. Strategies can be developed for Key Account Management and Campaign Management. This adds to the employability skills of customer management in an organization.

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.	Berry, Michael, J. A, Linoff, Gordon S., Datamining Techniques for Sales, Marketing and CRM, 3 rd Edition, Wiley Publications, 2011.
2.	Customer Relationship Management, Ed. Peelan Rob Beltman, 2 nd Edition, Pearson, 2014.
3.	Customer Relationship Management-A strategic perspective, G. Shainesh, Jagdish Sheth, Reprinted Macmillan Publishers India Limited, 21 st edition 2017.

4.	Customer Relationship Management Concepts and Technologies-Francis Buttle, 3 rd Edition Taylor and Francis, 2015.
5.	Lin, Y. C., Lee, Y. C., & Lin, S. Y. The influence of the personality traits of webcasters on online games. <i>International Journal of Electronic Customer Relationship Management</i> , 11(1), 94-103, 2017
6.	Menzel, C. M., & Reiners, T. Customer relationship management system a case study on small-medium-sized companies in north Germany. In <i>Information Systems for Small and Medium-sized Enterprises</i> pp. 169-197. Springer, Berlin, Heidelberg, 2014.
7.	Mukerjee, K., Customer Relationship Management-A Strategic approach to Marketing, 3rd Edition Prentice Hall of India, 2007.
8.	Ou, Y. C., Verhoef, P. C., & Wiesel, T. The effects of customer equity drivers on loyalty across services industries and firms. <i>Journal of the Academy of Marketing Science</i> , 45(3), 336-356, 2017.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12CS425	Semester Odd (specify Odd/Even)	Semester VII Session 2021-2022 Month: from Sep 2021
Course Name	Advanced Blockchain: A game theoretic view (Integrated M tech)		
Credits	3	Contact Hours	42

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

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Define all the basic terminologies related to blockchain, game theory, nash equilibrium, pareto optimal solutions and decentralized applications.	Remember Level (Level 1)
CO2	Understand the real fun in decentralized applications by understanding the use of game theories in deciding strategies by different nodes of decentralized applications like prisoner's dilemma, double auctioning, stackelberg algorithms etc.	Understand Level (Level 2)
CO3	Identify the feasibility of applying different game theories in world distributed application scenarios.	Apply Level (Level 3)
CO4	Analyze the change in the optimal solution and overall profit of the participating nodes by changing the theories in same and different applications.	Analyze Level (Level 4)
CO5	Evaluation of performance, scalability, efficiency, throughput and state replication metrics in distributed applications using different game theories.	Evaluate Level (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Context, Requirements, and Application: History of Game theory, blockchain basics, and use cases for using game theory in blockchain based applications.	3
2.	GameTheory basics	Mixed-Strategy Nash Equilibrium, Pareto optimal solutions, Prisoner's dilemma, Computing Mixed Nash Equilibrium , Hardness Beyond 2x2 Games	2
3.	Game theory implementation	Maxmin Strategies, Correlated Equilibrium: Intuition , Dominated Strategies & Iterative Removal: An Application, Strictly Dominated Strategies & Iterative Removal	9
4.	Blockchain Basics	Blockchain use cases, bit coin, crypto currencies, distributed consensus, Directed acyclic graphs, permissioned and permission less networks	3
5.	Combining blockchain and game theory	Practical use cases for implementing game theory in blockchain to get the nash equilibrium in distributed network and to provide optimal solutions. Use case 1: Energy Trading.	10
6.	Further Use cases	Use case 2: VANET (Vehicular ad hoc network)	10

	with practical implementation	Use Case 3: MANET(mobile ad hoc network) offloading problem solved	
7.	Result comparison	Comparing the results of different strategies by modelling them on MATLAB	5
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Attendance , Assignment and Quiz)	
Total		100	

Project based learning: Each student works on different case study in Tutorial and Assignments. They utilize the concepts taught in lecture and develop project in a group of 3-4.

The course emphasized on the skill development for employability in software industry by engaging students on real life projects based on blockchain and game theory. Various activities are carried out to enhance the student's skills and real life problem solving using game theory. Some of them are study and application of distributed computing and game theory in various domains such as transportation, education, energy trading, etc.

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.	The Strategy of Conflict: With a New Preface by the Author (Paperback)
2.	Theory of Games and Economic Behavior (Paperback)
3.	Game Theory: A Very Short Introduction (Paperback)
4.	IEEE Transactions on vehicular technology
5	ACM Transactions on Blockchain and Game theory

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12CS426	Semester ODD (specify Odd/Even)	Semester VII Session 2021-2022 Month from July 2021- December 2022
Course Name	IoT Analytics		
Credits	3-1-0	Contact Hours	4

Faculty (Names)	Coordinator(s)	Dr. Chetna Dabas	
	Teacher(s) (Alphabetically)	Dr. Chetna Dabas	

COURSE OUTCOMES		COGNITIVE LEVELS
C432-3.1	Understand how analytics relates to IoT data	Understand Level (Level 2)
C432-3.2	Apply appropriate machine learning, Deep Learning algorithms to gain business insights from IoT data.	Apply Level (Level 3)
C432-3.3	Analyze various big data platforms and massively parallel processing databases for IoT systems	Analyse Level (level 4)
C432-3.4	Examine how streaming and predictive analytics can be used for IoT Data processing and analysis, in real time.	Apply Level (Level 3)
C432-3.5	Understand the concept of network flow analytics using Flexible NetFlow in IoT systems.	Understand Level (Level 2)
C432-3.6	Evaluate the performance of the overall system and security in IoT network.	Evaluate Level (level 5)
C432-3.7	Design methods and develop web based IoT applications using big data analytics for real world problems	Create Level (Level 6)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	INTRODUCTION TO DATA ANALYTICS FOR IoT	An introduction to Data Analytics for IoT – Structured Versus Unstructured Data – Data in Motion Versus Data at Rest – IoT Data Analytics Overview – IoT data Analytics Challenges	6
2.	MACHINE LEARNING FOR IoT ANALYTICS	Machine Learning for IoT – Machine Learning Overview – Machine learning and getting Intelligence from IoT Big Data – IoT Predictive Analytics - Geographical Concepts and Spatial Technology for IoT – Deep Learning techniques	10
3.	BIG DATA PLATFORM FOR IoT ANALYTICS	Big Data Platform for IoT Analytics - Massively parallel processing databases- Azure Data Lake and IoT Hub, Node RED, Hadoop Ecosystem, Lambda Architecture- NoSQL Databases	8
4.	EDGE COMPUTING & FOG COMPUTING FOR IoT ANALYTICS	Architecture of Edge and Fog Computing - Edge Analytics Core Functions – Distributed Analytics Systems - Fog Computing -Big Data Metadata Management – Data lifecycle - Data analytics at different Fog Layers –Smart-health application	7
5.	IoT NETWORK ANALYTICS	Flexible NetFlow Architecture – FNF components – Flexible NetFlow in Multiservice IoT Networks	5

6.	WEB ENHANCED IoT	Design layers, design complexity- Web Enhanced Building Automation Systems – Smart City Control and Monitoring – Smart Environment Monitoring	6
		Total	42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25	
(Assignments and Attendance)		Attendance = 10 Internal assessment & Assignments (PBL based) = 15	
Total		100	

Project based learning components in the Assignment. An individual report submission by students based on the machine learning for gain business insights from Big Data in IoT will be given as project application.

Recommended Reading material:	
Text Books	
1.	K David Hanes, Gonzalo Salguerio,"IoT Fundamentals" Pearson, 2018.
2.	Andrew Minter, "Analytics for Internet of Things (IoT)", Packt, 2018
3.	Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.
Reference Books	
1.	Dr. John Bates , "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates, 2015
2.	"Fog and Edge Computing : Principles and Paradigms" RajkumarBuyya, Satish Narayana Srirama, Wiley
3.	Internet of Things Journal, IEEE

Course Description

Subject Code	19B12CS427	Semester 2021	ODD Semester VII Session 2021 – 22 Month from Aug '21 to Dec '21
Subject Name	Introduction to DevOps		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Prashant Kaushik, Shariq Murtuza
	Teacher(s)	1. Prashant Kaushik 2. Shariq Murtuza
Sections	1	

COURSE OUTCOMES		COGNITIVE LEVELS
C431-8.1	Students will be able to understand the needs of Continuous integration, continuous delivery, continuous deployment and continuous monitoring.	Understand Level (Level 2)
C431-8.2	Students will be able to create pull and push requests using GIT and GIT Hub and also able to review the changes on GitHub	Create Level (Level 6)
C431-8.3	Students will be able to Write scripts for the creating pipeline and deploying the micro services for the Developed Application for the calculated load and response times.	Create Level (Level 6)
C431-8.4	Students will be able to write scripts for the measuring and loading of the reports in KAFKA and Tableau for management view.	Evaluate Level (Level 5)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction	Why DevOps? What is DevOps? DevOps Market Trends DevOps Engineer Skills DevOps Delivery Pipeline DevOps Ecosystem	8

2.	Git,CI, CD, CDep, CM	Creating and merging different Git Branches Git workflows Git cheat sheet What is Continuous Integration? What is Continuous Delivery? What is Continuous Deployment? What is Continuous Monitoring?	8
3.	Jenkins	Introduction to Jenkins (With Architecture) Jenkins Management Adding a slave node to Jenkins Building Delivery Pipeline Pipeline as a Code Implementation of Jenkins in the Projects	8
4.	Chef and Ansible	Introduction to Chef & Ansible Chef Installation and Uses Ansible Installation Configuring Ansible Roles	8
5.	Containerization	Revisiting Kubernetes Cluster Architecture Spinning up a Kubernetes Cluster on Ubuntu VMs Exploring your Cluster Understanding YAML Creating a Deployment in Kubernetes using YAML	10
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 Attendance (05 Marks), Assignment/Quiz/Mini-project (20 Marks)	
Total		100	

Project based learning: Students shall be a part of a group of 5-6 students and will be required to create software projects using DevOps principles. The students are supposed to use advanced tools like Chef, Ansible and Jenkins to implement automatic building and pipelining. Understanding how these buildings work will enable their employability in the software engineering sector.

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

1.	Practical DevOps by Joakim Verona , 2017, Packt publishing
2.	Ansible: Up and Running, Automating Configuration Management and Deployment the Easy Way by Lorin Hochstein, Rene Moser, 2017
3.	DevOps: A Software Architect's Perspectiveby Len Bass, Ingo Weber, Liming Zhu, 2018
4.	Accelerate, The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations by Nicole Forsgren, Jez Humble, Gene Kim, 2019

Reference Books

5.	Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale by Jennifer Davis, Ryn Daniels by O'reilly , 2017
6.	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	21B12CS412	Semester Odd (Specify Odd/Even)	Semester VII Session 2021 -2022 Month: August 2021
Course Name	Cryptography and its Applications		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. K. Rajalakshmi
	Teacher(s) (Alphabetically)	Dr. K. Rajalakshmi Ms. Pratishtha Verma

COURSE OUTCOMES		COGNITIVE LEVELS
C430-8.1	Define the principle of cryptography along with the categorization cryptography algorithms and its applicability into various allied areas.	Remember Level (Level 1)
C430-8.2	Understand the various cryptographic problems in distributed applications and its solutions such as cryptography, hashing, and digital signatures.	Understand Level (Level 2)
C430-8.3	Verify the feasibility and applicability of different cryptography and security algorithms in distributed applications.	Apply Level (Level 3)
C430-8.4	Perform the various cryptoanalysis algorithms like El Gamal, ECC, etc. for various distributed applications.	Analyze Level (Level 4)
C430-8.5	Evaluate the performance for various applications using various cryptographic algorithms and other related secure technologies.	Evaluate Level (Level 5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to cryptography	Cryptography in modern era, Historical of ciphers along with their cryptanalysis, rigorous versus heuristic approaches; principles of defining security and its adversarial models, Perfect Secrecy and Its Limitations.	4
2.	Categorization of cryptographic algorithms	Categories of cryptographic algorithms, Conceptual security, Introduction to public and private key cryptography and its applications.	3
3.	Symmetric cryptography models	Computational securities, Definition of secure encryption, How to construct secure encryption? Pseudo randomness, Construction of CPA-secure encryption, illustration of CCA attacks.	4
4.	Message authentication	Differentiate between secrecy and integrity, pseudorandom generators, DES, AES, Hash and MAC function, RC4, CBC-MAC, HMAC, Password hashing.	4
5.	Number theory and asymmetric key cryptography	Fundamental of group theory, Factorization, Primes and RSA, Cryptographic assumptions in cyclic groups, hash functions to collision resistance with discrete log, Introduction to public key encryption, Diffie-Hellman key exchange.	6
6.	Public key encryption	Public key encryption systems and its definitions, Hybrid model of encryption and KEM/DEM, El Gamal encryption, RSA: textbook encryption, attacks on textbook RSA, padded RSA; CCA secure RSA KEM.	5

7.	Elliptic Curve Cryptography (ECC) and Cryptoanalysis	Elliptic curve over finite fields, Elliptic curve cryptosystems (Diffie-Helman, El Gamal), Elliptic curve digital signatures (ECDSA, Bitcoin), Elliptic curve factorization, Pairing based systems and Review	4
8.	Analysis of various cryptographic signature	Digital signature definition and its applications, RSA signatures: textbook RSA, hashed RSA, security with ROM, Digital certificates, Certificates and public-key infrastructures, Proxy signature, Kerberos.	6
9.	Cryptographic evaluation techniques	Constructions of Pseudorandom Permutations (Block Ciphers) in Practice, Substitution-permutation and Feistel networks, DES and attacks on reduced-round versions, double-DES and triple-DES, Security of CTR with n - k bit counter for messages to size 2k blocks with proof directly to the LR definition, CCA attacks, Birthday attacks, The Random oracle model.	6
Total number of Lectures			42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance(10) , Assignment/Quiz(8), PBLmode(7))
Total	100

Project based learning:

Students form group of size 2-3 members. Each group will identify several security issues in distributed applications in various thrust areas like healthcare, industrial, education, smart city, logistics, environment, governance and etc. Once problem has been identified, the group will analyze the problem and synthesize system based solutions to the identified problem. Each group will apply different cryptographic approaches such as symmetric key, hash function, asymmetric key, and etc. This approach will enhance skills of each student and increase the understanding of security issue in distributed applications. Moreover, candidate will gain the enough knowledge to provide the cryptographic solution to enhance the security of any organization/company. After this course, a student will able to undertake any work in this area in the industry or research.

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

Text Books:

1.	DR Stinson, Paterson M. Cryptography: theory and practice. CRC press, 2018 Aug 14.
2.	Keith Martin. Everyday Cryptography: Fundamental Principles and Applications. Oxford University Press, 2017.

References:

1	Cryptography: Portable technology offers boost for nuclear security, arms control applications
2.	Journal of Cryptography
3.	ACM Transactions on Information and system security
4.	IEEE Press Computer Security and Privacy
5	IEEE Transactions on Information Forensics and Security

Detailed Syllabus
Lecture-wise Breakup

Subject Code	21B12CS413	Semester (Even)	Semester Odd Session 2021-22 Month from Aug to Dec 21
Subject Name	Fog and Edge Computing		
Credits	3	Contact Hours	3 Lectures

Faculty (Names)	Coordinator(s)	Dr Parmeet Kaur / Nitin Shukla
	Teacher(s) (Alphabetically)	1. Dr Parmeet Kaur 2. Nitin Shukla

COURSE OUTCOMES		COGNITIVE LEVELS
C431-11.1	Define the technologies, architectures, entities and protocols, used for cloud and IoT systems	Remember Level 1
C431-11.2	Identify need, advantages, disadvantages, and application opportunities of fog and edge computing	Understand Level 2
C431-11.3	Describe the architecture, components and performance of fog and edge computing systems	Understand Level 2
C431-11.4	Examine the challenges and techniques of data analytics in fog and edge computing	Analyze Level 4
C431-11.5	Assess the application of fog and edge computing methods and protocols in IoT smart systems	Evaluate Level 5
C431-11.6	Demonstrate fog or edge scenario using simulation	Apply level 3

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Distributed Systems	Review of principles and concepts of Distributed Systems. Evolution of distributed systems: from mainframes to cloud to edge, Multi-tier distributed system architectures, Logical Time vs Physical Time	3
2.	Internet of Things	IoT Architecture & Technologies which include WSN (Wireless Sensor Networks) and IoT cloud computing, characteristics of IoT device platforms and products.	3
3.	Cloud computing	Introduction, Cloud Infrastructure Services, Cloud Computing characteristics of elasticity, multi-tenancy, on-demand access, ubiquitous access, usage metering, self-service capability, SLA-monitoring, Cloud Service Models/Types, Cloud deployment models, Mobile Cloud Computing,	4

		Virtual Machines, Containers	
4.	Fog Computing	Definition, Characteristics, Application Scenarios, Issues, Fog Computing and Internet of Things, Pros and Cons, Need and Reasons for Fog Computing, Integrating IoT , FOG, Cloud-Benefits	6
5.	Fog Computing Architecture	Performance Evaluation Components, Metrics, Architecture-Modeling, Proximity Detection Protocols, FaaS	8
6.	Data Management in Fog Computing	Fog Data Management, Big Data Analytics in the Fog, Security and Privacy Issues	6
7.	Edge Computing	Introduction, Origins of edge, Difference from fog, Edge helping low-end IoT nodes, Edge helping higher-capability mobile devices: mobile offloading, Edge helping the cloud, Data processing on the edge, Compare architectural design options regarding the tradeoff between computations in an IoT system, at edge or at cloud depending on application demands and resource constraints	6
8.	Case Studies	Fog Enhanced Smart Homes and buildings, Modeling and Simulation of Fog and Edge Computing Environments Using iFogSim Toolkit	6
			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 (Attendance = 10, Assignment/Quiz/ Mini-Project: 15)	
Total		100	
Project based learning: Each student in a group of 4-5 will study a practical problem in fog and edge computing in detail along with its real-world applications. They will present it as a Case study or give a practical demonstration of the problem and its solution. This detailed study on distributed environment will help their employability into 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)			
References			
1.	Buyya, Rajkumar, and Satish Narayana Srirama, eds. “Fog and edge computing: principles and paradigms”. John Wiley & Sons, 2019.		
2	Chang, Wei, and Jie Wu. "Fog/Edge Computing For Security, Privacy, and Applications."		
3.	Mahmud, R., Kotagiri, R., & Buyya, R. (2018). Fog computing: A taxonomy, survey and future directions. In Internet of Everything (pp. 103• 130). Springer, Singapore		
4.	Ivan Stojmenovic, Sheng Wen ,” The Fog Computing Paradigm: Scenarios and Security Issues” Proceedings of the 2014 Federated Conference on Computer Science and Information Systems pp. 1–8		

5.	Cao, Jie, Quan Zhang, and Weisong Shi. <i>Edge computing: a primer</i> . Springer International Publishing, 2018.
6.	Mahmud, Redowan, and Rajkumar Buyya. "Modelling and simulation of fog and edge computing environments using iFogSim toolkit." <i>Fog and edge computing: Principles and paradigms</i> (2019): 1-35.
7.	Dastjerdi, Amir Vahid, Harshit Gupta, Rodrigo N. Calheiros, Soumya K. Ghosh, and Rajkumar Buyya. "Fog computing: Principles, architectures, and applications." In <i>Internet of things</i> , pp. 61-75. Morgan Kaufmann, 2016.
8.	Dastjerdi, Amir Vahid, and Rajkumar Buyya. "Fog computing: Helping the Internet of Things realize its potential." <i>Computer</i> 49, no. 8 (2016): 112-116.
9.	Serpanos, Dimitrios, and Marilyn Wolf (2017). <i>Internet of things (IoT) Systems: Architectures, Algorithms, Methodologies</i> . Springer. DOI: https://doi.org/10.1007/978-3-319-69715-4

Detailed Syllabus
Lecture-wise Breakup

Subject Code	21B12CS415	Semester: (specify Odd/Even): Even	Semester: 7th Session: 2021-22 Month: August to Dec. 2021
Subject Name	Secure Design of Software Systems		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Prof. Sandeep Kumar Singh, Dr. Shruti Jaiswal
	Teacher(s) (Alphabetically)	Prof. Sandeep Kumar Singh, Dr. Shruti Jaiswal

COURSE OUTCOMES		COGNITIVE LEVELS
C431-13.1	Understand and articulate the implementation of secure practices in the software development lifecycle (SDLC).	Understand (level 2)
C431-13.2	Apply secure coding practices for improving the security and robustness of programs.	Apply (level 3)
C431-13.3	Apply tools to discover security problems and perform penetration testing of the software.	Apply (level 3)
C431-13.4	Perform security audit of databases to identify vulnerabilities.	Apply (level 3)
C431-13.5	Understand the various methods of invading data privacy.	Understand (level 2)

Module No.	Subtitle of the Module	Topics in the Module	No. of Lectures for the module	CO Mapping
1.	Security of a software	Introduction, the problem, Software Assurance and Software Security, Asset, Vulnerability, Threat, Risk, Threats to software security, Sources of software insecurity, What Makes Software Secure: Properties of Secure Software.	3	C431-13.1
2.	Requirement engineering for secure software	Secure Development Lifecycle, The SQUARE process Model, Requirements elicitation and prioritization	3	C431-13.1
3.	Secure Design	Threat Modeling, Dataflow Diagram (DFD), Threat Tree (Attack Tree), STRIDE, DREAD, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles and guidelines.	7	C431-13.2
4.	Secure Coding	Integer Overflows/underflows, Buffer Overflow, format string vulnerability, Beware of (escape characters, reserved words, delimiters and commands) attacks and defense,	5	C431-13.2
5.	Security Testing	Static Analysis, Penetration Testing, Fuzz Testing, Code Auditing, Developers guidelines and Checklist, Security Review, Attack Surface review.	6	C431-13.3, C431-13.4

6.	Database Security and Auditing	Access control, Privileges, roles, Access Control Models, Design and Implementation of Discretionary Access Control, Role Based Access Control and Mandatory Access Control, Database Application Security models, SQL Injection, Virtual Private Databases, Database Auditing Models, Multilevel secure relational model, Watermarking relational databases, Security in distributed databases	10	C431-13.4
7.	Data Privacy and Metrics	Attacks on Privacy, Sanitization mechanisms, Privacy Definitions: k-anonymity, l-diversity, Protection against Background knowledge, Differential Privacy, Data anonymization, Anonymization operations: Generalization, Suppression, Anatomization, Permutation, Bucketization, Perturbation, Minimal distortion, Discernibility metric, Distinctive attribute.	8	C431-13.5
Total number of Lectures			42	
Evaluation Criteria				
Components		Maximum Marks		
T1		20		
T2		20		
End Semester Examination		35		
TA		25 (Attendance (10), Assignment/ Mini-Project/ Tutorial/ Quiz (15))		
Total		100		

Project based learning: Each student will make an application using any technologies (either single or in combination). Students will be required to develop a secure application while following secure software development practices and having countermeasures implemented against injection attacks, buffer overflows, etc and also maintain database security.

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	Robert C. Seacord: <i>Secure Coding in C and C++</i> , 2 nd Edition, SEI series in software engineering, 2013.
2.	Julia H. Allen , Sean J. Barnum, Robert J. Ellison, Gary McGraw , Nancy R. Mead: <i>Software Security Engineering: A Guide for Project Managers</i> , SEI series, 2008.
3.	Julia H. Allen, <i>Software Security Engineering</i> ., Pearson Education
4.	Adam Shostack: <i>Threat Modeling: Designing for Security</i> , Wiley, 2014.
	Reference Books
1	Gary McGraw, <i>Software security Building security IN</i> , Addison-Wesley software security, 2006.
2	Jason Grembi, <i>Developing Secure Software</i> , Cengage Learning, 2009.

Detailed Syllabus

Course Code	21B12CS417	Semester: Odd (specify Odd/Even)	Semester: VII Session: 2021-22 Month from: July-Dec
Course Name	Machine Learning and Big Data (C431-12)		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Ambalika Sarkar, Dr. Anuja Arora
	Teacher(s) (Alphabetically)	Ambalika Sarkar, Dr. Anuja Arora

COURSE OUTCOMES: At the end of the course, students will be able to		COGNITIVE LEVELS
CO1	Identify the characteristics of datasets and use of machine learning techniques	Understand Level (Level 2)
CO2	Demonstrate online learning methods for big data applications.	Apply Level (Level 3)
CO3	Select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.	Apply Level (Level 3)
CO4	Implement parallel learning algorithms using OpenMP/ CUDA/ OpenCL.	Apply Level (Level 3)
CO5	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, 2 nd 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
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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: 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, 3 rd edition, Cambridge University Press, 2019 (http://infolab.stanford.edu/~ullman/mmds/book0n.pdf)
2	Data-Intensive Text Processingwith MapReduce by Jimmy Lin and Chris Dyer, Morgan publishers, 2010. (http://www.iro.umontreal.ca/~nie/IFT6255/Books/MapReduce.pdf)
Reference Books:	
1	Machine Learning - A Complete Exploration of Highly Advanced Machine Learning Concepts, Best Practices and Techniquesby Peter Bradley, Draft2digital, 25 June 2019
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

Detailed Syllabus
Lecture-wise Breakup

Course Code NBA Code	21B12CS418	Semester Odd	Semester VII Session 2021 -2022 Month from August–Dec 2021
Course Name	Ethical Hacking and Prevention		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Vartika Puri, Dr. Amanpreet Kaur	
	Teacher(s) (Alphabetically)	Dr. Amanpreet Kaur , Dr. Vartika Puri	

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Defined the need and basics of Ethical Hacking	Remember Level (Level 1)
CO2	Enumerate the footprinting and information gathering techniques and their prevention	Understand Level (Level 2)
CO3	Apply scanning tools for Operating System and Service Enumeration and prevention	Apply Level (Level 3)
CO4	Implement and Analyze Network, System and Web Based exploitation Tools and Prevention	Analyze Level (Level 4)
CO5	Evaluate Post Exploitation Effectiveness , Mobile hacking and Security	Evaluate Level (Level 5)
CO6	Understand Legal Aspects of Ethical Hacking and write Penetration Testing Reports	Understand Level (Level 2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1	Overview	Types of Hackers, Introduction to Ethical Hacking, What is legal and what is not, TCP/IP overview	3
2	Reconnaissance and Prevention	Active and Passive Footprinting, Web tools for Footprinting, Information Gathering by Social engineering, Social Engineer Toolkit (SET), Prevention of Information gathering	6
3	Scanning and Prevention	Pings and Ping Sweeps, Port Scanning, NMap, Vulnerability Scanning, Enumerating OS, OS Vulnerabilities scanning – NETBIOS, Tools for identifying Windows and Linux vulnerabilities, Web applications vulnerability scanning, Preventing Scanning	6
4	Exploitation – Network and System	Techniques for Gaining Access, Remote service access, password crackers, Sniffing the Network, Network Attacks – ARP, Session Hijacking and Denial of Service	6
5	Exploitation – Web Based	Basics of Web Hacking, Nikto, Spidering, WebScarab, Code injection, PDF Hacking	5
6	Prevention of Exploitation	Protecting against Malware, Best practices for Hardening Operating Systems, Web Filtering, Secure routers, Firewalls, Honeypots, Intrusion Detection Systems	3
7	Post Exploitation and Defense	Maintaining access with Backdoors, rootkits and meterpreter, privilege escalation , Penetrating the Internal Network Further, Defense - Recovery and Counter attack /	5

		Hackback	
8	Mobile Hacking and Security	Mobile platform attack vector, android vulnerabilities, jailbreaking iOS, windows phone vulnerabilities, mobile security guidelines, and tools	3
9	Pentesting Report	Various types of penetration testing, security audit, vulnerability assessment, and penetration testing roadmap	3
10	Legal Aspects of Ethical Hacking	Code of Ethics, Legal frameworks, Security Research Exemption, Whistle Blowing, Security Activism	2
Total number of Lectures			42
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 Attendance (05 Marks), Assignment/Quiz/Mini-project (20 Marks)	
Total		100	

Project based learning: Student shall be a part of a group of 4-5 students and will be required to model and simulate real life enterprise system and apply ethical hacking tools to launch, detect and mitigate the attack. The highlighted content can be used to choose project topics that help students evaluate and apply the knowledge gained. The goal for each project is to work on case studies similar to those that a professional security tester comes across.

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.	Sean-Philip Oriyano, "Certified Ethical Hacker Version 9 - Study Guide", EXAM 312-50, Sybex Wiely, 2016.
2.	Georgia Weidman, "Penetration testing A Hands-On Introduction to Hacking", No Scratch Press, 2014.
3.	Raphaël Hertzog, Jim O’Gorman, and Mati AharoniKali, "Linux Revealed Mastering the Penetration Testing Distribution", OFFSEC Press, 2017
Reference Books	
1.	Corey P. Schultz, Bob Percianccante, "Kali Linux Cook Book", Second edition, Packet Publishing, 2017.
2.	Lee Allen, Tedi Heriyanto, Shakeel Ali, "Kali Linux – Assuring Security by Penetration Testing, Packet Publishing, 2014.
3.	Dejey, Murugan, “Cyber Forensics”, Oxford University Press, 2018.
4.	Engbretson, Patrick. The basics of hacking and penetration testing: ethical hacking and penetration testing made easy. Elsevier, 2013.

SYLLABUS AND EVALUATION SCHEME

Course Code:	21B12HS411	Semester: ODD	Semester: 7th Session: 2021-2022 Months: August to December
Course Name	Urban Sociology		
Credits	03	Contact Hours	3-0-0

Faculty (Names)	Coordinator(s)	Prof. Alka Sharma
	Teacher(s) (Alphabetically)	Prof. Alka Sharma Dr. Priyanka Chhaparia

COURSE OUTCOMES		COGNITIVE LEVELS
C401-25.1	Understand the concepts and theories of Urban Sociology	C2
C401-25.2	Apply an analytical framework to understand the structural characteristics of cities students are residing in	C3
C401-25.3	Analyze the role of agencies and actor in shaping the process of urbanisation	C4
C401-25.4	Evaluate the importance of good governance and urban planning	C5

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to Urban Sociology	Basic Concepts and terminologies of Urban Sociology, Origin of urban societies, Rural-Urban Continuum	4
2.	Theories in Urban Sociology	The Classical Foundations of Simmel, Max Weber, Tonnies, Louis Wirth, Durkhiem and Friedrich Engels	5
3.	The Ecological View	The Chicago School, Concentric zone theory (Burgess), Sector theory (Hoyt), Multiple Nuclei theory (Harris and Ullman)	3
4.	Contemporary Urban Sociology	Political Economy of Cities, Henry Lefebvre, Class Conflict Theories, Accumulation Theory, Neoliberalism, Neo-Weberian, Neo- Marxism, Colonialism	4
5.	Mapping and Organisation	Social Area Analysis, Urban Social Divisions, Concentration and Centralization, Segregation, Cooperatives, Role of Cooperatives in Urban planning and development	4
6.	Urbanisation in India	Development of Urban Sociology in India, Evolution of and from different structures, Spatial Structures and classification of cities	4

7.	Urban Planning	Historical timeline of urban planning, Principles of Urban Planning, Need for planning, Governance, Agencies Involved, Urban local bodies	5
8.	Urban Issues in India	Level, trends, and pattern, Issues (poverty, slum, and environment) and Implications, Lessons from a pandemic	4
9.	Technology and Urbanisation	Digitisation and expansion of cities, Impact of technology on Urbanisation, role of technology in governance	4
10.	Globalisation and Urban Development	Concept of globalisation and its impact on urbanisation, new perspectives on urbanisation, emergence of Mega cities	4
11.	Sustainable Urban Development	Challenges in current model of urbanisation, Need for sustainable urban development, Tenets of sustainable development, Introduction to SDGs and their relevance to urbanisation, sustainable structures	4
Total number of Lectures			45
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20/ (Project)	
End Semester Examination		35	
TA		25 (Assignment + Quiz)	
Total		100	

Project Based Learning: The students would be divided into a group of 4-5. They would be asked to map and discuss the different parts of their cities. The lectures and readings on the process of urbanization and models of urbanization will form the basis for this exercise. Students would be required to critically analyse the urban spaces using sociological perspectives and theories. The students would be needed to make a presentation and also submit a report.

Recommended Reading material:	
1.	Gottdiener, M., Budd, L., &Lehtovuori, P. <i>Key concepts in urban studies</i> . Sage. (2015)
2.	Lin Jan and Mele Christopher, ed. <i>The Urban Sociology Reader</i> . London: Routledge. (2005)
3.	Rao, M. S. A., ed. <i>Urban Sociology in India: Reader and Source Book</i> . New Delhi: Orient Longman. (1974)
4.	Savage, M., and Warde, A. <i>Urban sociology, capitalism and modernity</i> . Macmillan International Higher Education. (1993)
5.	Sivaramakrishnan, K.C., Kundu, Amitabh & Singh, B.N. <i>Handbook of Urbanization in India</i> . Oxford University Press (2007)
6.	Wirth, Louis. <i>Urbanism as a Way of Life</i> . American Journal of Sociology. (1938)
7.	Sharma, A.K. and Misra, B.D. <i>Urbanization in India: Issues & Challenges</i> . New Delhi: Ane Books Pvt. Ltd.(2018)

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	Semester: ODD	Semester: 7th Session: 2021 -2022 Month from July to December
Course Name	Nanoscience and Technology		
Credits	3	Contact Hours	3+1

Faculty (Names)	Coordinator(s)	Navendu Goswami
	Teacher(s) (Alphabetically)	Navendu Goswami

COURSE OUTCOMES		COGNITIVE LEVELS
C401-4.1	Define the Nanoscience and Technology and to know about various other terminologies and developments involved with Nanoscience and Technology	Remembering (C1)
C401-4.2	Classify the nanomaterials depending on the nature of dimensionalities, type of materials classes and explain the basic concepts of nanomaterials	Understanding (C2)
C401-4.3	Apply the concepts of Nanoscience for solving the theoretical and numerical problems	Applying (C3)
C401-4.4	Determine the properties of nanomaterials through suitable characterization tools	Analyzing (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction	Development of nanoscience and nanotechnology, naturally occurring nanomaterials, Crystallinity of nanomaterials, Metallic nanostructures, Semiconductor nanostructures, Magnetic nanomaterials, Chemically assisted nanostructures, Growth in 2-D nanostructures, Carbon nanomaterials	10
2.	Properties of Nanomaterials	Surface to volume ratio, Surface states and energy, Nanoscale oscillators, Confinement in nanostructures, Density of States and number of states of 0-, 1-, 2-, 3-dimensional systems, Change in Band structure and gap, Energy levels, confinement energy and emission in nano, Fluorescence by QDs, Concept of Single electron transistor	5
3.	Nanomaterials Synthesis	Introduction to synthesis techniques, Top down and bottom up approach, Biological methods, Sol-gel method, Nucleation and growth, Ball Milling technique, Chemical vapor deposition, Physical Vapor deposition: Concept of Epitaxy and sputtering, Basics of Photolithography and its limitations, Soft Lithography and Nanolithography	10
4.	Characterization of Nanomaterials	Resolving power (Rayleigh and other criteria) of microscopes and their limitations for nanostructure measurements, Concept of Far and Near field and modification by NSOM, Basic principle, Design of setup, Theory and working, Characterization procedure, result analysis, Merits/demerits of SEM, TEM, STM, AFM	5
5.	Application of	Nanoelectronics, Nanobiotechnology, Catalysis by	10

	Nanomaterials	nanoparticles, Quantum dot devices, Quantum well devices, High T _c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS	
Total number of Lectures			40
Evaluation Criteria			
Components		Maximum Marks	
T1		20	
T2		20	
End Semester Examination		35	
TA		25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]	
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.	<i>Nanostructures and nanomaterials: synthesis properties and application</i> , Guozhong Cao, Imperial college press, London.
2.	<i>Introduction to nanotechnology</i> , Charles Poole <i>et al</i> J John Wiley & Sons, Singapore.
3.	<i>The Handbook of Nanotechnology: Nanometer Structures, Theory, Modeling, and Simulation</i> , A. Lakhtakia, Spie Press USA.
4.	<i>Springer Handbook of Nanotechnology</i> , Edited by B. Bhushan, Springer Verlag.

Project based learning: Students would work on a project of their choice in the field of Nanoelectronics, Nanobiotechnology, Catalysis by nanoparticles, Quantum dot devices, Quantum well devices, High T_c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS. In such projects students can apply the basic concepts of Nanoscience for solving theoretical and numerical problems. They can also work on analysis of a nanomaterial to determine its properties through suitable characterization tools such as SEM, TEM, AFM etc. The learning gained through this project would consolidate the understanding and provide skills of analysis and application in Nanoscience and Technology and thereby providing the employability prospects in the organizations and industries involved in the research and development of nanomaterials synthesis and characterizations, nanoelectronics, nanobiotechnology/nanomedicine etc.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17BINMA732	Semester - Odd (specify Odd/Even)	Semester VII Session 2021 -2022 Month from August 2021 – Dec 2021
Course Name	Applied Numerical Methods		
Credits	3	Contact Hours	3-1-0

Faculty (Names)	Coordinator(s)	Dr. Yogesh Gupta and Dr. Neha Ahlawat
	Teacher(s) (Alphabetically)	Dr. Neha Ahlawat and Dr. Yogesh Gupta

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C401-8.1	Solve a single and a system of non-linear equations and analyze the convergence of the methods.	Applying Level (C3)
C401-8.2	explain finite and divided difference formulae for numerical interpolation.	Understanding Level (C2)
C401-8.3	apply numerical differentiation and integration in engineering applications.	Applying Level (C3)
C401-8.4	solve a system of linear equations using direct and iterative methods with their applications in various engineering problems.	Applying Level (C3)
C401-8.5	solve eigen-value and corresponding eigen-vector problem for a square matrix.	Analyzing Level (C4)
C401-8.6	evaluate the solutions of initial and boundary value problems using various numerical methods.	Evaluating Level (C5)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Roots of Non-linear Equations	Concept of round-off and truncation errors. Iterative methods to find roots of one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equispaced points, Divided differences, Spline interpolation, Least square approximation	7
3.	Numerical Differentiation and integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods, Iterative methods: Jacobi and Gauss Seidel Methods and their convergence, Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of parabolic and elliptic partial differential equations by finite difference methods	12
Total number of Lectures			42

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials, PBL)
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.	Gerald, C.F. and Wheatley P.O. , Applied Numerical Analysis, 6 th Ed., Pearson Education, 1999.
2.	Conte, S.D. and DeBoor, C. , Elementary Numerical Analysis, 3 rd Ed., McGraw-Hill, 1980.
3.	Gupta, R.S. , Elements of Numerical Analysis, 1 st Ed., Macmillan 2009.
4.	Jain, M.K., Iyengar, S.R.K. and Jain, R.K. , Numerical Methods for Scientific and Engineering Computation 5 th Ed., New Age International, New Delhi, 2007.
5.	Smith, G.D. , Numerical Solution of Partial Differential Equations, 2 nd Ed., Oxford, 1978.

Detailed Syllabus
Lecture-wise Breakup

Course Code	21B12EC413	Semester Odd (specify Odd/Even)	Semester 7th Session 2021-22 Month from August-December
Course Name	Solar Engineering		
Credits	3	Contact Hours	3L

Faculty (Names)	Coordinator(s)	Dr. Ruby Beniwal
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COURSE OUTCOMES		COGNITIVE LEVELS
C402-37.1	Outline the basic concepts of Solar Energy with recent scenario.	Understanding Level (C2)
C402-37.2	Identify various techniques for Solar Engineering	Applying Level (C3)
C402-37.3	Innovative ideas for applications of Solar Energy in Electronics	Applying Level (C3)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Solar Basics	Introduction , Environmental Characteristics, Heat transfer concept, Heat Transfer coefficient, Optimization of Heat Losses, Thermal analysis and effect of environment with economic analysis	8
2.	Solar Engineering-I: Electrical Aspect	Solar Cell materials, Single crystal solar cell or solar grade, Types of Solar Energy Collectors, Performance of Solar Collectors, Photovoltaic Systems, Design and Modeling of Solar Systems, Solar Energy Analysis	12
3.	Solar Engineering-II: Thermal Aspect	Solar Thermal Power Systems, PVT air/water collectors performance, design and modeling	10
4.	Applications	Solar Water-Heating Systems, Solar Space Heating and Cooling, Industrial Process Heat, Solar Dryers, Solar Desalination Systems, and applications of Solar Energy in Electronics and communication engineering	12
Total number of Lectures			42

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Attendance & Quiz)
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.	G.N. Tiwari, Solar Energy : fundamentals, Design, Modelling and applications. Narosa Publishing House, 2016.

2.	Chetan Singh Solanki, Solar Photovoltaics: Fundamental, technologies and applications. Prentice Hall of India, 2015
3.	James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley-IEEE Press, 2012.
4	Juan Bisquert, The Physics of Solar Cell, CRC Press, Taylor & Francis group, 2018