Detailed Syllabus
Lecture-wise Breakup

Course Code	**17B1NCI731**	**Semester** ODD **(specify Odd/Even)**	**Semester**VII **Session** 2022 -2023 **Month**: July 2022 to Dec 2022
Course Name	Machine Learning and Natural Language Processing		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. HimansuSekarPattanayak(J-62), Dr.Laxmi Chaudhary(J-128)
	Teacher(s) (Alphabetically)	Dr. HimansuSekarPattanayak,Dr.Laxmi Chaudhary

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 ofNLP	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 Learningtechniques 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
		Total number of Lectures	**42**

Evaluation Criteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	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.

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 HinrichSchtze: Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Course Description

Course Code	15B19CI791	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** July 2022 to Dec 2022
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**
1.	…	…	…
2.	…	…	…
3.	…	…	…
...	…	…	…
n.	…	…	…

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** 2022 -2023 **Month from** July 2022 to Dec 2022
Course Name	Summer Training &Viva		
Credits	2	**Contact Hours**	6-8 Weeks Industrial Training

Faculty (Names)	**Coordinator(s)**	Dr. Mukta Goyal , Dr. 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 ofwork 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.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	15B1NCI738	**Semester : odd**	**Semester Seventh Session 2022- 2023** **Month from July 2022 to Dec 2022**
Subject Name	Social Network Analysis		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	1. Dr. Somya Jain(JIIT 62) 2. Bansidhar Joshi (JIIT 128)
	Teacher(s) (Alphabetically)	Akanksha Mehndiratta, Bansidhar Joshi (JIIT 128) , Dr. Somya Jain(JIIT 62)

Course objective:

Objective of the course Social Network Analysis is to provide students with essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks. In this course We will start with basic statistical descriptions of networks; analyze network structure, roles and positions of nodes in networks, connectivity patterns and methods for community detection.
We will discuss processes on networks and practical methods of network visualization. We conclude the course with examples from social media mining and Facebook, LinkedIn and Twitter analysis And Information Diffusion on these real networks.

COURSE OUTCOMES		**COGNITIVE LEVEL (BLOOMS TAXONOMY)**
C430-7.1	Define social network growth models and their characteristics.	Remember level (Level 1)
C430-7.2	Compare and interpret social network structure, size and its connectivity pattern using degree distribution, clustering coefficient, centrality, motifs, density, etc.	Understand Level (Level 2)
C430-7.3	Apply link prediction techniques like Jaccard Coefficient, Adamic Adar, Preferential attachment, Katz score, etc. to discover new links in the social network	Apply Level (Level 3)
C430.7.4	Discover community structure in complex network using statistical techniques like Newman Girvan, Clique Percolation Method, Ford Fulkerman etc.	Analyse Level (Level 4)
C430-7.5	Model the cascading/flow of information in social network for maximizing the cascade, locating the seed nodes and influential nodes.	Apply Level (Level 3)
C430-7.6	Develop secured social networks by applying mechanisms like K-anonymity, L-diversity, T-closeness, etc. to ensure privacy and security.	Apply Level (Level 3)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction a.	Concepts: how services such as Facebook, LinkedIn, Twitter, etc. are using SNA to understand their users and improve their functionality.	2
2.	Network Concept	Introduction: Graphs, Paths and components, Adjacency Matrices, Ways and Modes, Matrix Product, node degree, types of nodes and types of ties, actor attributes	4
3.	Random network models	Erdos-Renyi , Barabasi-Albert , Watts-Strogatz small-world model, shortest path, six degree of separation	5
4.	Social Network Visualization	Tools: Gephi, NetLogo, Pajek, EgoNet	2
5.	Characterizing whole network	Cohesion, reciprocity, Transitivity and clustering Coefficient, Triad census, Assortativity Index, Rich Club Coefficient, Neighbourhood overlap	3
6.	Network centrality	Undirected Non-valued networks: Degree, Eigenvector, betweeness. Directed Non-valued Networks: Degree, Eigenvector, closeness. Valued Networks, Negative tie Networks, subgroup: Cliques and groups	5
7.	Community Detection	clustering, community structure, modularity, overlapping communities	5
8.	Link Prediction	The Katz Score, Hitting & Commute Time, Rooted PageRank, SimRank, Predictors Summary, Meta-measures	5
9.	Information Diffusion	Cascading Behavior: Herd Behaviour, Information Cascade Model, Threshold Model, Cascade Maximization, Epidemic Modeling	5
10.	Security and Privacy in Social Network	Introduction, K-Anonymity, L-Diversity, Q-Anon, T- Closeness	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/ Mini-Project: 15)
Total	**100**

Project based learning: Each student in a group of 2 will study a practical problem in social network analysis 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 using social network tools and techniques 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)	
1.	Liu, Bing. Web data mining. Springer-Verlag Berlin Heidelberg, 2007.
2.	Chakrabarti, Soumen. Mining the Web: Discovering knowledge from hypertext data. Morgan Kaufmann, 2003.
3.	Scime, Anthony, ed. Web mining: applications and techniques. IGI Global, 2005.
4.	Hitzler, Pascal, Markus Krotzsch, and Sebastian Rudolph. Foundations of semantic web technologies. CRC Press, 2011.
5.	King, Andrew B. Website optimization. " O'Reilly Media, Inc.", 2008.
6.	Segaran, Toby. Programming collective intelligence: building smart web 2.0 applications. " O'Reilly Media, Inc.", 2007.
7.	Charu.C. Aggarwal, Social Network Data Analytics, Springer Science+Business Media, LLC 2011
8.	Easley, David, Jon Kleinberg. *Networks, Crowds, and Markets: Reasoning about a Highly Connected* World. New York, NY: Cambridge University Press, 2010.
9.	Jackson, Matthew O. *Social and Economic Networks*. Princeton, NJ: Princeton University Press, 2008

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NBT531**	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from July 2022 – Dec 2022**
Course Name	**Networks of Life**		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	1. Dr. Shazia Haider
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Jain 2. Dr. Shazia Haider

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-15.1	Explain different type of networks	C2
C401-15.2	Explain models, motifs and network analytics	C2
C401-15.3	Apply networks to solve biological and social problems.	C3
C401-15.4	Case studies on pathogen informatics, metabolic pathways	C4

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Network Sciences**	Introduction to network sciences, Graph Theory, Random network, Scale Free Property, Various Models- Erdos Renyi, Barabasi-Albert etc. Centrality and Weighted Networks, Degree, Communities Identification, Robustness, Motifs and Evolving Networks.	18
2.	**Computational Resources**	Hands-on Cytoscape tool, Gephi, etc.	4
3.	**Applications & advanced topics**	Multi-Layered Networks, Spreading phenomenon, Temporal Networks, Networks in epidemics, networks in business, social networks, controlling networks, percolation, rewiring, machine learning in networks	10
4.	**Miscellaneous**	Case studies, projects, hands on	10

		workshop on advanced modules on python.	
		Total number of lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, MCQ, PBL)
Total	**100**

PBL: Students will choose any topic on Biological Network, Python language, Analysis tools and it's application to solve the biological problem linked to a particular disease in a group of 4-5 students.

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.	R. Cohen and S. Havlin, Complex Networks - Structure, Robustness and Function, Cambridge Univ Press, 2010.
2.	M.O. Jackson, Social and Economic Networks, Princeton Univ Press, 2008.
3.	A. Barrat, M. Barthelemy and A. Vespignani, Dynamical Processes on Complex Networks, Cambridge Univ Press, 2008.
4.	E. Kolaczyk, Statistical analysis of network data, Springer, 2009.
5.	S. Wasserman, K. Faust, Social Network Analysis: Methods and Applications, Cambridge Univ Press, 1994.
6.	P. Van Mieghem, Graph Spectra for Complex Networks, Cambridge Univ Press, 2011.
7.	R. Diestel, Graph Theory (4th edition), Springer, 2010.
8.	R.K.Ahuja and T.L.Magnanti, Network Flows: Theory, Algorithms, and Application , Pearson, 1993.
9.	Mark Newman, Albert-László Barabási, and Duncan J. Watts, The Structure and Dynamics of Networks, ISBN: 9780691113579, Princeton University press, 2006
10.	Albert-László Barabási, Network Science, Cambridge University Press in 2015.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NBT531**	**Semester Odd** **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from June -Dec**
Course Name	**Networks of Life**		
Credits	3	**Contact Hours**	**3- 0 -0**

Faculty (Names)	**Coordinator(s)**	1. Dr. Shazia Haider
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Jain 2. Dr. Shazia Haider

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-15.1	Explain different type of networks	C2
C401-15.2	Explain models, motifs and network analytics	C2
C401-15.3	Apply networks to solve biological and social problems.	C3
C401-15.4	Case studies on pathogen informatics, metabolic pathways	C4

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Network Sciences**	Introduction to network sciences, Graph Theory, Random network, Scale Free Property, Various Models- Erdos Renyi, Barabasi-Albert etc. Centrality and Weighted Networks, Degree, Communities Identification, Robustness, Motifs and Evolving Networks.	18
2.	**Computational Resources**	Hands-on Cytoscape tool, Gephi, etc.	4
3.	**Applications & advanced topics**	Multi-Layered Networks, Spreading phenomenon, Temporal Networks, Networks in epidemics, networks in business, social networks, controlling networks, percolation, rewiring, machine learning in networks	10

4.	**Miscellaneous**	Case studies, projects, hands on workshop on advanced modules on python.	10
		Total number of lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, MCQ, PBL)
Total	**100**

PBL: Students will choose any topic on Biological Network, Python language, Analysis tools and it's application to solve the biological problem linked to a particular disease in a group of 4-5 students.

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.	R. Cohen and S. Havlin, Complex Networks - Structure, Robustness and Function, Cambridge Univ Press, 2010.
2.	M.O. Jackson, Social and Economic Networks, Princeton Univ Press, 2008.
3.	A. Barrat, M. Barthelemy and A. Vespignani, Dynamical Processes on Complex Networks, Cambridge Univ Press, 2008.
4.	E. Kolaczyk, Statistical analysis of network data, Springer, 2009.
5.	S. Wasserman, K. Faust, Social Network Analysis: Methods and Applications, Cambridge Univ Press, 1994.
6.	P. Van Mieghem, Graph Spectra for Complex Networks, Cambridge Univ Press, 2011.
7.	R. Diestel, Graph Theory (4th edition), Springer, 2010.
8.	R.K.Ahuja and T.L.Magnanti, Network Flows: Theory, Algorithms, and Application , Pearson, 1993.
9.	Mark Newman, Albert-László Barabási, and Duncan J. Watts, The Structure and Dynamics of Networks, ISBN: 9780691113579, Princeton University press, 2006
10.	Albert-László Barabási, Network Science, Cambridge University Press in 2015.

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NCI648	**Semester -Odd** **(specify Odd/Even)**	**Semester**VII **Session** 2022-2023 **Month from:** Aug 22- Dec 22
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**
C430.5.1	Design and implement information retrieval systemsfor unstructured data.	Apply Level (Level 3)
C430-5.2	Apply query processing techniques for tolerant retrieval.	Apply Level (Level 3)
C430-5.3	Analyze Information retrieval models and their metrics.	Analyze Level (Level 4)
C430-5.4	Analyze the searching algorithms for Information Retrieval.	Analyze Level (Level 4)
C430-5.5	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, PageRank	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	WebCrawler 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 = 10, Assignment &Quiz= 05, Mini Project= 10)
Total	**100**

The students in the group of 3-4 will choose one of the information retrieval algorithms such as Index construction, Query Processing, spelling correction, vector space modeling, Link Analysis etc. The chosen algorithm will be applied in context to some application area preferably on some standard dataset taken from the platforms like Kaggle, Github, UCI, KDD etc. Applying these algorithms on standard dataset will enable the students in enhancing their understanding and skills towards Information retrieval.

Recommended Reading material:

Text Books

1.	Christopher D. Manning, Prabhakar Raghavan and HinrichSchütze, "An introduction to Information Retrieval", 2013 Cambridge University Press UP.
2.	Rijsbergen C. J. 2012,"Information Retrieval", 2nd edition**.**

Reference Books

1.	Salton, G. and McGill, M.J., "*Introduction to Modern Information Retrieval*", Computer Series. McGraw-Hill, New York, NY**.**
2.	ACM Transaction on Internet Technology.

SYLLABUS AND EVALUATION SCHEME

Lecture-wise Breakup

Course Code	16B1NPH732	**Semester : ODD**	**Semester** VII **Session** 2022 -2023 **Month : July-December**
Course Name	Green Energy and Climate Modelling		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Prashant Chauhan – JIIT 128
	Teacher(s)	Dr. Prashant Chauhan

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-6.1	Recall the basic information about different energy resources, reserves and define the problem with fossil fuel	Remember Level (Level 1)
C401-6.2	Explain green house effect, modelling of temperature measurement and physics behind the global warming	Understand Level (Level 2)
C401-6.3	Demonstrate the basic principles and designs of different solar collectors and concentrators, and identify the best design/material/location to absorb maximum solar energy	Apply Level (Level 3)
C401-6.4	Analyze the potential of different renewable energy sources like wind, ocean and bio mass energy	Analyzing Level (Level 4)
C401-6.5	Compare the output of renewable energy source using different design under different conditions/location	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Man and energy, world and Indian production /reserve of conventional energy sources, alternative energy sources.	02
2.	The greenhouse effect	Physics behind greenhouse effect, Blackbody radiation, layer model depending on energy flux and temperature at earth surface, radiation effect on Greenhouse gases, temperature structure of the atmosphere, Heat, pressure, wind, feedback	10

		mechanism. Carbon Cycle and Climate, Fossil Fuels, Effect of Conventional energy sources.	
3.	Solar energy	Nature and availability of radiation, estimation of solar energy radiation. Effect of receiving surface, location and orientation, heat transfer consideration relevant to solar energy, Characteristics of materials and surface used in solar energy absorption. Device for thermal collection and storage	06
4.	Ocean Energy	Tidal energy, and its characteristics, tidal energy estimation, important component of tidal energy plant, single basin plant, double basin plant, turbine, tidal power plant development in India, wave energy, design parameters of wave energy plant, introduction and working of ocean thermal energy conversion,	06
5.	Wind Energy and Bio Mass energy	Introduction to wind energy, Nature, power, forces, conversion and estimation. Components of wind energy system types, safety and environment, Introduction to bio mass energy, conversion and utilization of biogas plants and gas fiers	10
6.	Fusion Energy	Basics of DT fusion, Magnetic confinement fusion, laser inertial fusion, present status of fusion reactors and future scope at international and national level	6
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz/Assignments: 6 marks, PBL: 10 marks, Attendance: 5 marks, internal assessment: 4 marks)
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.	Global Warming : Understanding the forecast by David Archer, Wiley.

2.	Kothari D.P. renewable energy resources and emerging technologies, Prentice of India.
3.	Rai G D, Non-conventional energy sources, Khanna Publishers .
4.	C S Duffie J A & Beckmann W A, Solar engineering of thermal process, Wiley-International Publication.

Project based Learning: Students will be given small projects in groups to enhance their understanding on the topics of energy issues including production, reserve, limitation and issues of conventional energy sources, alternative energy sources like solar energy, wind energy, ocean energy and fusion energy. Students will be asked to submit the report of given project and give presentations of the same.

Detail Course Description

Course Code	21B12CS414	**Semester:ODD 2022** **VII Sem**	**Semester: VII Session** 2022 -2023 **Month from** Aug to Dec, 2022
Course Name	**Smart System and IoT**		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. \PRAKASH KUMAR
	Teacher(s) (Alphabetically)	Dr. PRAKASH KUMAR

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-6.1	Understanding IoT and smart sensors systems and their various applications.	Understand (level 2)
C431-6.2	Study of different sensors, its working principle for different applications.	Understand (level 2)
C431-6.3	Examine Architectural design of smart systems and its different components.	Analyze (level 4)
C431-6.4	Assess Design challenges of different smart system applications	Evaluate (level 5)
C431-6.5	Application of smart manufacturing processes and Industry 4.0 in smart factories.	Apply (level 3)
C431-6.6	Design and development of a smart system prototype for real-life problem.	Create (level 6)

Module No.	**Title of the Module**	**Topics in the Modules**	**No of Lectures**
1.	**Introduction to Smart Sensor and IoT**	Introduction:IoT, Smart Sensors, Measuring and Monitoring Environmental Condition, Different types of Smart Systems and its various application field using IoT.	4
2.	**Different Sensors and its characteristics**	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications; Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc. Important Characteristics of Sensors: Static and Dynamic.	4
3.	**Design of smart sensors**	Importance and need to embrace the Smart Sensors, Architecture of Smart Sensors: Important components, their features. Interfacing Circuit for Smart Sensors and its Challenges.	4
4.	**Smart Home and Cities**	Benefit from the IoT to improve energy efficiency, security and convenience, Introduction of intelligent and connected devices. Smart Metering of Gas, Water, Electricity, Kitchen appliances, Smart Grid, Smart Traffic Management systems.	4
5.	**Smart Health care system**	Aging population,Challenges in digital health-care adoption, Health-care environment,Electronic Health Record (EHR) systems, Connected Healthcare system, Smart Health using	4

		Smart Phones, Health Monitoring Equipment and Sensors, Security and Privacy issues in IoT Protocol, Big Data for Health Management System.	
6.	**Smart Transportation system**	Introduction to Intelligent Transportation Systems (ITS), Broad categories: Public infrastructure and the Automotive industry. Smart Transportation: Car Navigation, Traffic signal control systems, Automatic number plate recognition, Speed cameras, Management, Efficiency, and Safety.Challenges: Security, Environmental Considerations, Supply Chain Resiliency, Power Consumption and Responsible Data Management. SMART Dispatch System case study.	3
7.	**Smart Wearable System**	Smart Wearable: health, activity, mobility, and mental status for both indoors and outdoors environment. Physiological sensor systems, Mobility Measurement System Designs: IoT based Wireless protocols. Real-Time decision support processing for disease prevention, symptom detection, and diagnosis. Challenges in design of wearable devices: flexible, lightweight, self-powered, miniaturized and self-healing materials.	3
8.	**Smart Agricultural System**	Precise Farming and Smart Farming, IoT components for Smart Farming: sensors, drones and robots. Suitable crops and water requirements for optimization using Smart Farming, Satellite imagery detects for pest and decease, Field Data analysis for profits, yields and patterns.	4
9.	**Smart Factory**	Smart Manufacturing Processes and Industry 4.0- Three Dimensions: (1) Demand Driven and Integrated Supply Chains; (2) Dynamically Optimized Manufacturing Enterprises; (3) Real Time, Sustainable Resource Management. Smart Design/Fabrication - Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices.	6
10.	**Designing and prototyping a Smart System**	Design and development of a prototype for the above discussed smart system application using IoT, Characteristics of the design: low cost, user-friendly interface, scalable and reliable. Hardware and software co-design, basic requirements of prototype demonstration.	6

Evaluation Criteria

Components	**Maximum Marks**
Tes-1	20
Test-2	20
End Term Exam	35
Attendance	10
Assignment	7.5
Project Based Assessment	7.5 (Project Based Learning)
Total	**100**

Project Based Learning: A group of 4-5 students are to be formed. Each group shall design and develop IoT based Smart system device. These projects may involve software and hardware components and tools. They may also use certain simulation tools related to IoT

and smart systems. 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.	Advances in Modern Sensors; Physics, design, simulation and applications by Sinha, G, R, IOP (Institute of Physics Publishing), 2020
2.	Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill. 2017
3.	Jan Ho"ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Aves and, David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
4.	ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
5.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", CISCO Press, 2017.
6.	https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
7.	https://www.emerald.com/insight/content/doi/10.1108/PRR-08-2019-0027/full/html
8.	https://www.digi.com/blog/post/introduction-to-smart-transportation-benefits
9.	https://nodered.org/docs/getting-started
10.	https://www.arduino.cc/en/Tutorial/HomePage
11.	**https://www.raspberrypi.org/documentation/**

Detailed Syllabus

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester** 2021 **Session** 2021-2022 **Month from** July
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Shweta Dang
	Teacher(s) (Alphabetically)	Dr. 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)
C401-14.1.3	Analyze the various business models/ innovations in the healthcare industry	AnalyzeLevel (C4)
C401-14.1.4	Compare economic aspects pertaining to the sector	AnalyzeLevel (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 innovations2	**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 theirroles, 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,	**4**

		strategic perspectives, case studies	
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**

Project Based Learning: Students analyze the sitehttps://pmjay.gov.in/about/pmjay, understand the following sections:

- Coverage under PM-JAY
- Implementation Model
- Financing of the Scheme

And represent them in one comprehensive diagram, integrating all the above components. This helps them in understanding recent innovations in healthcare market and integration of healthcare informatics.

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (PBL, 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.	https://www.who.int/nationalpolicies/processes/stakeholders/en/
2.	Conflict of interests. I. Lo, Bernard. II. Field, Marilyn J. (Marilyn Jane) III. Institute of Medicine (U.S.). Committee on Conflict of Interest in Medical Research, Education, and Practice. IV. National Academies Press (U.S.), 2009
3.	Research papers and online resources

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT733	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** Sept-December
Course Name	Stress: Biology, Behaviour and Management		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Vibha Gupta
	Teacher(s) (Alphabetically)	Vibha Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-16.1	Explain the biological basis of stress.	**Understand Level (C2)**
C401-16.2	Relate cognitive processes and stress management.	**Understand level (C2)**
C401-16.3	Apply acquired knowledge in understanding and adjusting to different people and situations.	**Apply level (C3)**
C401-16.4	Improve quality of life by reducing stress.	**Create level (C6)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	The concept of Stress - Major stressors vs. routine hassles ; Major types of Stressors - Occupational Stressors; Organization Stress; Environmental Stressors; Happy Interactive Class (HIC)	3
2.	Scientific Foundations of Stress	HIC 1, The Nature of Stress; Human Physiology; Stress and Relaxation Responses; Stress and Disease	5
3.	Body Systems activated by stressors	HIC2, Nervous System, Endocrine System, immune system, Cardiovascular system, Gastrointestinal System, Muscles	9
4.	Cognitive Psychology	HIC3, Theoretical models: psychodynamic, behavioral, and cognitive; Thoughts, Beliefs and Emotions: Behavioral Patterns; Self-concept and Self-esteem; Stress emotions - Anger and Fear; Personality Traits – Stress prone and Stress resistant	11
5.	Social Psychology	HIC4, Family and Culture; Demands and Responsibilities; Relationships; Verbal and Non-verbal Communication; Human Spirituality	3
6.	Stress and the Human Environmental Interactions	HIC4, Time; Body Rhythms; Weather and Climate; Nutrition; Exercise; Drugs and Addictions; Violence and Post Traumatic Stress	3
7.	Happy Interactive Class (HIC) related to Stress management	HIC1 - DIY Strategies- Exercise and Health; HIC2 - Journal Writing/Music and Art Therapy; HIC3- Humor and Comic Relief; HIC4- Meditation/Mindfulness/Belly Breathing/Visual Imagery/Progressive Muscle Relaxation	HICs to be delivered in the modules 1-6

	techniques and therapeutic strategies	Psychological interventions; Developing Cognitive Coping Skills; Creative Problem Solving (case studies);	4
8.	The adaptive brain	Neuroplasticity – positive adaptation to stress	2
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Quiz and class discussions)
Total	**100**

Project based learning:

To identify factors responsible for stress and steer 2 people on a joyful path by becoming their “Happiness Coach”

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.	George Fink “Stress: Concepts, Cognition, Emotion, and Behavior: Handbook in Stress Series; Volume 1; Academic Press; 2016
2.	Jeanne Ricks “The Biology of Beating Stress”Kindle Edition; 2014
3.	Jerrold S. Greenberg “Comprehensive Stress Management” Tata McGraw-Hill Edition; Tenth Ed., 2009
4.	Brian Luke Seaward “Managing Stress: Principles and Strategies for Health and Well-Being” Sixth Ed., Jones and Bartlett Publishers, 2009
5.	Saundra E. Ciccarelli, and Glenn E. Meyer “Psychology” South Asian Edition; Published by Pearson Education (2008); ISBN 10:8131713873 / ISBN 13: 9788131713877

Detailed SyllabusLecture-wise Breakup

Subject Code	**17B1NHS733**	**Semester: ODD**	**Semester: VII Session 2022-23 Month: July 2022- Dec 2022**
Subject Name	**Human Rights and Social Justice**		
Credits	**3**	**Contact Hours**	**3-0-0**

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

COCode	**COURSE OUTCOMES**	**COGNITIVE LEVELS**
C401-18.1	Demonstrate an understanding of the concept and idea of human rights and social justice	Understand (C2)
C401-18.2	Evaluate and interpret information about human rights issues fromvarious sources like print and electronic media, film, documentary and other information technologies	Evaluate(C5)
C401-18.3	Demonstrate an understanding of the International norms and standards of human rights	Understand (C2)
C401-18.4	Analyze the emerging dimensions of human rights and the challenges posed by them	Analyze (C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Hours for the module
1.	Conceptual Background of Human Rights and Social Justice	● Meaning and Concept of Human Rights & Social Justice ● Notion and Classification of Rights: Natural, Moral and Legal Rights, ● Concept of Civil Rights ● Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights; Collective/Solidarity Rights), Distinction between CPR & ESCR	6
2.	Evolution of Human Rights	Human Rights in Middle Ages: ● Magna Carta Modern Movement for Human Rights: ● The United States Declaration of Independence ● The French Declaration of the Rights of Man and the Citizen ● United States Bill of Rights ● Geneva Convention of 1864	9
3.	International Human Rights Standards	● Universal Declaration of Human Rights, 1948. ● International Covenant on Civil and Political Rights, 1966 ● International Covenant on Economic, Social and Cultural Rights, 1966	8
4.	Human Rights of the specially disadvantaged sections of the society	● Scheduled Castes/Scheduled Tribes and Other Backward Classes: Caste Prejudice and Discrimination ● Minorities: Human Rights Issues of Ethnic minorities ● Women and Children: Gender Discrimination, Domestic Violence and Offences against Women; Gender Sensitive Laws, Children: Child Abuse, Child Labour, Street Children	8

		● Aged and Disabled Persons: Vulnerability and social taboos	
5.	Human Rights of the Working Class	● Migrant Workers ● Bonded Labourers ● Agricultural Labourers ● Casual Workers	5
6.	Emerging Dimensions Of Human Rights	● National Sovereignty versus 'international enforcement' of human rights ● International politics of human rights and selective application of international sanctions ● Unilateral use of coercion and implementation of human rights ● Human rights, and science and technology	6
Total number of Hours			**42**

Evaluation Criteria

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

Project Based Learning: The students will be required to form groups of 4-5 and review documentaries/movies which are based on the violation/issues of human rights and social justice

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.	Banton, M. (1996). *International Action against Racial Discrimination*. Oxford: Clarendon Press
2.	Cassese, J. (1990). *Human Rights in Changing World.* Philadelphia: Temple University Press
3.	Cruft, R., Liao, S.M.& Renzo. M. (2015). *Philosophical Foundations of Human Rights*. Oxford: Oxford University Press
4.	Dhiman, O.P. (2011). *Understanding Human Rights An Overview*. New Delhi: Kalpaz Publication
5.	Donnelly, J. (2013).*Universal Human Rights and Practices*. Ithaca: Cornell University Press
6.	Easterly, W. (2014). *The tyranny of experts: Economists, dictators, and the forgotten rights of the poor*. New York: Basic Books

7.	Joshi. K.C. (2019). *International Law and Human Rights*. Lucknow: Eastern Book Company
8.	Saksena, K.P. (ed.) (1984). *Human Rights in Asia: Problems and Perspectives*. New Delhi: HURITER
9.	Sen, A. (1999). *Development as Freedom*. Oxford: Oxford University Press
10.	Sinha, M.K, (2000). *Basic Documents on International Human Rights and Refugee Laws*. New Delhi: Manak Publications
11.	Verma, R.S., (2000). *Human Rights: Burning Issues of the World*. Volumes I, II and III. Delhi: Radiant Publishers
12.	U.N. Department of Public Information. (2018). *Universal Declaration of Human Rights*. U.SA.: United Nations

Applied Linear Algebra (17B1NMA731)

Course Description

Course Code	17B1NMA731	**Semester Odd (specify Odd/Even)**		**Semester** VII **Session** 2022 -2023 **Month from** July 2022-Dec. 2022	
Course Name	Applied Linear Algebra				
Credits	**3**		**Contact Hours**	**3-0-0**	
Faculty (Names)	**Coordinator(s)**	Prof. R.C. Mittal			
	Teacher(s) (Alphabetically)	Prof. R.C. Mittal			

COURSE OUTCOMES : After pursuing the above mentioned course, the students will be able to:		**COGNITIVE LEVELS**
C401-7.1	explain field, vectors, vector spaces and their dimensions.	Understanding level (C2)
C401-7.2	apply linear transformations in solving practical engineering problems.	Applying Level (C3)
C401-7.3	develop the concept of rank, determinant, existence and uniqueness of solution of a system of linear equations.	Applying Level (C3)
C401-7.4	explain the concept of length, distance and inner-product.	Understanding level (C2)
C401-7.5	apply the concept of orthogonality and orthogonal matrices to orthogonalize a set of linearly independent vectors.	Applying Level (C3)
C401-7.5	analyze eigenvalues, eigenvectors and their properties to solve a system of ordinary differential equations.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Vector Space and Dimension	Field, Vector Space, Vector subspace, linear dependence and independence, Span of a set, Dimension of a vector space, Direct Sum and Complement	7
2.	Linear Transformation I	Linear Transformation and its algebra, and its matrix representation, homomorphism, isomorphism, rank and null subspace, rank-nullity theorem, Solution of a system of Linear Equations, Determinant	7
3.	Linear Transformation II	Change of basis, Inverse of a linear transformation, Linear functional, transpose	5
4.	Inner Product and Metric	Inner product space, Metric and normed spaces. Orthonormal basis, Orthogonal Subspaces, Gram-Schmidt orthogonalization.	8
5.	Eigen Values and Eigen Vectors	Eigen values and Eigenvectors, Modal matrix and diagonalization, Similarity Transformation, Eigen systems of real symmetric, orthogonal, Hermitian and unitary	9

		matrices	
6.	Applications of Linear Algebra	Bilinear and Quadratic forms, Positive definite matrices, Norm of a matrix, Condition number, Application to find solutions of ordinary differential equations	6
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Quizzes)
Total	**100**

Project Based Learning: Each student in a group of 4-5 students will apply the concepts of eigenvalues and eigenvectors to solve the ordinary differential equations arising in various real-life problems.

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.	**Hoffman, K and Kunze, R.** , Linear Algebra, Fourth Edition, Prentice Hall of India, 2005
2.	**Strang, G**., Linear Algebra and its Applications, 3rd Ed., 1998
3.	**Noble, B. and Daniel, J.** , Applied Linear Algebra, Prentice Hall of India, 2000
4.	**Lipshutz, S. and Lipsom, M. ,** Linear Algebra, 3rd Edition, Schaum Series, 2001
5.	**Krishnamurthy, V., Mainra, V. P., and Arora, J. L.** , An Introduction to Linear Algebra, Affilated East-West, 1976

Applied Numerical Methods (17B1NMA732)

Course Description

Course Code	17B1NMA732	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** July 2022 – Dec 2022
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Yogesh Gupta and Dr. Neha Ahlawat
	Teacher(s) (Alphabetically)	Dr. Mohd. Sarfaraz, Dr. Neha Ahlawat, Dr. Pinkey Chauhan 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,	12

		Numerical solutions of parabolic and elliptic partial differential equations by finite difference methods	
		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**

Project Based Learning: Each student in a group of 4-6 will apply the concepts of numerical methods for the solution of ODE and PDE.

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, 6th Ed., Pearson Education, 1999.
2.	**Conte, S.D. and De Boor, C.**, Elementary Numerical Analysis, 3rd Ed., McGraw-Hill, 1980.
3.	**Gupta, R.S.**, Elements of Numerical Analysis, 1st Ed., Macmillan 2009.
4.	**Jain, M.K., Iyengar, S.R.K. and Jain, R.K.**, Numerical Methods for Scientific and Engineering Computation 5th Ed., New Age International, New Delhi, 2007.
5.	**Smith, G.D.**, Numerical Solution of Partial Differential Equations, 2nd Ed., Oxford, 1978.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	**Semester: ODD**	**Semester: 7th Session:**2022 -2023 **Month from July2022 to Dec 2022**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Prof. Navendu Goswami Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Prof. Navendu Goswami Dr. Sandeep Chhoker

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 Nanomaterials	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	10
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA and Internal Assessment (5 M)]	25 [PBL (6 M), 2 Quiz (7 M), Attendance (7 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)

Text Books:

1.	*Nanostructures and nanomaterials: synthesis properties and application*, Guozhong Cao, Imperial college press, London.
2.	*Introduction to nanotechnology*, Charles Poole *et al* J John Wiley & Sons, Singapore.

Reference Books:

1.	*The Handbook of Nanotechnology: Nanometer Structures, Theory, Modeling, and Simulation*, A.Lakhtakia, Spie Press USA.
2.	*Springer Handbook of Nanotechnology*, 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 Tc 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.

Course Description

Detailed Syllabus

Course Code	18B12CS428	**Semester: ODD**	**Semester : VII Session** 2022-2023 ***Month:*** **from July 2022- Dec 2022**
Course Name	Introduction to Deep Learning		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Satish Chandra, Mukesh Saraswat
	Teacher(s) (Alphabetically)	Satish Chandra, Mukesh Saraswat

Sr. No.	**Description**	**Cognitive Level (Bloom's Taxonomy)**
C430-3.1	Identify and express the motivation behind and need of Deep Learning.	Understanding (Level-2)
C430-3.2	Comprehend the basic theory of learning, probability in learning, error minimization and regularization techniques.	Understanding (Level-2)
C430-3.3	Design and Model Convolution Neural Networks for Image recognition and Computer Vision.	Apply (Level-3)
C430-3.4	Apply Recurrent Neural Networks and LSTM for temporal data	Apply (Level-3)
C430-3.5	Assess the Deep Learning techniques on the basis of performance measures such as training speed, classification error, kappa coefficient, precision, recall and F-Measure.	Evaluate (Level-5)

Lecture Plan:

Sr. No.	**Module**	**Topic**	**No. of Lectures**
1.	Introduction	Course overview: Deep Learning Overview; Deep Learning successes; Deep Networks versus Shallow Networks;	**02**
2.	Mathematics for Machine Learning	Gradient descent, Linear Regression, Logistic Regression; Continuous and discrete distributions; Maximum likelihood estimation, Expectation Maximization; Principle Component Analysis;	**06**
3.	Neural Network Fundamentals	Neural networks: Feed-Forward Networks, MLP, Back propagation Networks; Activation Functions;	**04**
4.	Deep Neural Network-1	Deep learning strategies: GPU training, Regularization Techniques; Loss and Cost functions.	**04**
5.	Deep Neural Network-2	Convolutional neural networks: Image analysis with ANN, CNN;	**05**
6.	Deep Neural Network-3	CNN Architectures LeNet, AlexNet, GooleNet, VGG Net, ResNet: Comparative analysis	**05**
7.	RNN-1	Recurrent Neural Networks: Architecture and Application; Variants of RNN Architectures: LSTM, GRU, Bi- LSTM.	**06**
8.	RNN-2	Attention in DL, Self Attention, Soft vs Hard Attention, Global vs Local Attention, Sequence to sequence model: Encoder-Decoder, Transformer, Transformer XL	**06**
9.	Unsupervised Deep learning	Unsupervised deep learning (Autoencoders)	**04**
		Total Lectures	**42**

Project based learning: Each student in a group of 3-4 will have to develop a mini project based on Deep Learning Models. The datasets ranging from object detection problem to natural language processing will be provided for implementing the models. Project development and its presentation will enhance the knowledge and employability of the students in IT sector.

Evaluation Criteria	
Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
(Attendance = 05, Class Test, Quizzes, etc = 10, Assignments in PBL mode = 10)	
Total	100

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
Text Books	
1.	Nikhil Buduma, Fundamentals of Deep Learning, Shroff Publishers , 2018
Reference Books	
1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Pess , 2017
2.	FRANÇOIS CHOLLET, Deep Learning with Python, Manning Publications, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester Odd**	**Semester VII Session 2022 -2023** **Month from July 2022 - December 2022**
Course Name	**HUMAN RESOURCE ANALYTICS**		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr Kanupriya Misra Bakhru
	Teacher(s) (Alphabetically)	Dr Kanupriya Misra Bakhru Email id: kanupriya.misra@jiit.ac.in

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-20.1	Understand different analytical techniques used for solving HR related problems**.**	Understand Level (C 2)
C401-20.2	Apply descriptive and predictive analysis techniques to understand trends and indicators in human resource data.	Applying Level (C 3)
C401-20.3	Analyze key issues related to human resource management using analytical techniques.	Analyze Level (C 4)
C401-20.4	Critically asses and evaluate the outputs obtained from analytical tools and recommend HR related decisions.	Evaluate Level (C 5)
C401-20.5	Create hypotheses, propose solutions and validate using appropriate analytical techniques	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Human Resource (HR) Analytics	Understanding the need for mastering and utilizing HR analytic techniques, Human capital data storage and 'big (HR) data' manipulation, Predictors, prediction and predictive modeling, Current state of HR analytic professional and academic training, HR's Contribution to Business Value, the Changing Nature of HR.	8
2.	Human Resource information systems and data	Understanding HR metrics and data, Data collection, tracking, entry, Data availability in the entire Employment Lifecycle, Approaches and costs of collecting HR related data, Analysis software options, Using SPSS, Preparing the data, Using Tableau.	10
3.	Analysis Strategies	From descriptive reports to predictive analytics, Statistical significance, Data integrity, Types of data, Categorical variable types, Continuous variable types, Using group/team-level or individual-level data, Dependent variables and independent variables, Introduction of tools for HR data analysis: Correlation, Regression, Factor Analysis, Cluster Analysis, Structural equation modeling.	10
4.	Application of Human Resource Analytics	Workforce Planning Analytics, Diversity Analytics, Talent Sourcing Analytics, Talent Acquisition Analytics, Talent Engagement Analytics, Training and Intervention	12

		Analytics, Analytical Performance Management, Retention Analytics. Data Visualization and Storytelling using Tableau.	
5.	Future of Human Resource Analytics	Rise of Employee Behavioral Data, Automated Big Data Analytics, Big Data Empowering Employee Development, Quantification of HR, Artificial Intelligence in HR.	6
		Total number of Lectures	**44**

Evaluation Criteria

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

Project Based Learning:

Students, in groups of 5-6, are required to select a contemporary topic of HR. Further students are required to select a sector from where they will collect the data. Data should be collected from at least 50 respondents from the chosen sector. The information can be collected with the help of an interview or some kind of questionnaire pertaining to the HR topic chosen. Analysis of the collected data should be done using SPSS software. Findings should be discussed and recommendations should be suggested.

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.	Edwards and Edwards, Predictive HR Analytics. Mastering the HR Metric, Kogan Page, Limited, 2019
2.	Banerjee, Pandey and Gupta, Practical Applications of HR Analytics, Sage, 2019
3.	Bhattacharyya, HR Analytics: Understanding Theories and Applications, Sage, 2017
4.	Isson, Harriott and Jac Fitz-enz, People Analytics in the Era of Big Data: Changing the Way You Attract, Acquire, Develop, and Retain Talent, Wiley, 2016
5.	Guenole, Ferrar and Feinzig, The Power of People: How Successful Organizations Use Workforce Analytics To Improve Business Performance, First Edition, Pearson, 2017
6.	Sesil, Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing, Incentive and Improving Collaboration, Pearson, 2014

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12CS423	**Semester ODD (specify Odd/Even)**	**Semester:** VII **Session** 2022 -2023 **Month from July 2022-Dec 2022**
Course Name	Computing for Data Science		
Credits	4	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Megha Rathi(J62), Ms. Anuradha Gupta(J128)
	Teacher(s) (Alphabetically)	Ms. Anuradha Gupta, Dr. Megha Rathi, Dr. Shikha Mehta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-7.1	Make use of basic concepts, methods, and mathematics relevant to computational techniques for data science	Apply (Level 3)
C431-7.2	Develop own statistical analyses and implement them with advanced statistical programming tools	Apply (Level 3)
C431-7.3	Develop and apply advanced and associated computing techniques and technologies.	Apply (Level 3)
C431-7.4	Compare the performance of multiple methods and models, recognize the connections between how the data were collected and the scope of conclusions from the resulting analysis, and articulate the limitations and abuses of formal inference and modeling.	Analyze (Level 4)
C431-7.5	Evaluate strategies for constructing models and can use different measures of model fit and performance to assess models.	Evaluate (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Data Science	Characteristics & Evolution of data, Data Science Process, Types & Levels of data, Datafication, Steps of Data Science, Central Tendency, Measure of Dispersion, Data Munging, Feature Engineering	7
2.	Statistical Methods in Data Science Sampling of data, Correlation Analysis	Data Distribution (Bernoulli, Uniform, Binomial, Normal, Poisson, Exponential), Mathematical Statistics, Inferential Statistics, Descriptive Statistics, Random Variable, Probabilistic Statistics,	7
3.	Computing techniques for Data Science	Regression, Mapping Problem to Machine Learning Task, Memorization Method, Generalized Additive Models, Time-Series Model, Predictive Modeling, Fuzzy C Means Clustering, Ensemble Techniques, Outlier Detection.	10
4.	Technologies & Tools in Database Analytics	SQL Essentials for data science, String Pattern, Ranges, Sorting & Grouping Result Set, working with multiple tables, accessing database using R/Python, Database Text Analysis, User defined Functions & Aggregates, MADlib, Tools & Techniques for unstructured data.	5

5.	Statistical Methods for Evaluation	Hypothesis Testing, Difference of Means, Significance Level and P-Value, Test Statistics (Z-test, ANOVA, T-Test, Redundancy Test), Bias Variance Trade off, Cross Validation	6
6.	Exploratory Data Analysis & Data Science Process	Visualization before analysis, Dirty Data, Visualizing single and multiple variables, summary statistics of EDA, Data Exploration versus Presentation, Real time case study, Tools & Techniques	5
7.	Data Science & Ethical Issues	Privacy, Security & Ethics, Next generation Data Scientist	2
		Total number of Lectures	**42**

Project based learning: Each student in a group of 4-5 will choose an industrial application for development. The objective of the course is to gain the knowledge about the data science. To fulfill the objective of this course student needs to learn and apply the data science concept by using Python programming languages on computer science problem. Students need to consider trending research problems and should apply statistical analysis and machine learning solutions on them. Understanding the core concept and statistical knowledge helps the students in enhancing their expertise.

Evaluation Criteria

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

Recommended Reading material:

Text Books

1.	Haider, M. (2015). Getting Started with Data Science: Making Sense of Data with Analytics. IBM Press.
2.	Dietrich, D. (Ed.). (2015). Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley.
3.	Trevor, H., Robert, T., & JH, F. (2009). The Elements of Statistical Learning: Data Mining, Inference, And Prediction.

Reference Books

4.	Grus, J. (2015). Data Science from Scratch: First Principles with Python. O'Reilly Media, Inc.
5.	Taylor, J. K., & Cihon, C. (2004). Statistical Techniques for Data Analysis. Chapman and Hall/CRC.
6.	Shalev-Shwartz, S., & Ben-David, S. (2014). Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press.
7.	Zumel, N., & Mount, J. (2014). Practical Data Science with R. Manning Publications Co..
8.	Saltz, J. S., & Stanton, J. M. (2017). An Introduction to Data Science. SAGE Publications.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12CS425	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2022-2023 **Month: July 2022 to December 2022**
Course Name	Advanced Blockchain: A game theoretic view		
Credits	3	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-4.1	Define all the basic terminologies related to blockchain, game theory, nash equilibrium, pareto optimal solutions and decentralized applications.	Remember Level (Level 1)
C430-4.2	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)
C430-4.3	Identify the feasibility of applying different game theories in world distributed application scenarios.	Apply Level (Level 3)
C430-4.4	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)
C430-4.5	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.	4
2.	GameTheory basics	Mixed-Strategy Nash Equilibrium, Pareto optimal solutions, Prisoner's dilemma, Computing Mixed Nash Equilibrium, Hardness Beyond 2x2 Games	4
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	4
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.	8
6.	Further Use cases with practical implementation	Use case 2: VANET (Vehicular ad hoc network) Use Case 3: MANET(mobile ad hoc network) offloading problem solved	8

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-10, Assignment / Quiz / PBL- 15)
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 2-4.

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-lifeproblem-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** 2022-2023 **Month from** July 2022- December 2022
Course Name	IoT Analytics		
Credits	3	**Contact Hours**	3-0-0

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(Tutorials regularity) 25 (Assignments and Attendance)	Attendance = 10 Internal assessment &Assignments in PBL mode = 15
Total	**100**

Recommended Reading material:

Text Books

1.	**K David Hanes, Gonzalo Salguerio,"IoT Fundamentals" Pearson, 2018.**
2.	**Andrew Minteer, "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 ODD 2022**	**Semester VII Session** 2022–23 **Month from** July 2022 **to** Dec 2022
Subject Name	Introduction to DevOps		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Sulabh Tyagi(J62), Dr. Nitin Shukla(J128)
	Teacher(s)	1. Dr. Sulabh Tyagi 2. Dr. Amarjeet Prajapati 3. Dr. Anubhuti Roda Mohindra 4. Dr. Nitin Shukla
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 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: Student shall be a part of a group of 5-6 students and will be require to create software projects using DevOps principles. The students are supposed to use advance tools like Chef, Ansible and Jenkins to implement automatic building and pipelining. Understanding how these building works them will enable their employability in software engineering sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, **Reference Books**	
1.	**Practical DevOps**by Joakim Verona **, 2017, Packt publishing**
2.	**Ansible: Up and Running, Automating Configuration Management and Deployment the**

	Easy Wayby Lorin Hochstein, Rene Moser, 2017
3.	**DevOps: A Software Architect's Perspective**by 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
Text Books	
5.	**Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale**by Jennifer Davis, Ryn Daniels by Orielly, 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	20B12PH411	**Semester** ODD	**Semester** 7th **Session** 2022 -2023 **Month from July to December**
Course Name	SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Dinesh Tripathi
	Teacher(s) (Alphabetically)	Dr. Dinesh Tripathi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-13.1	Define unusual properties exhibited by superconducting materials and how these properties are important in the development of superconducting Devices.	Remember Level (Level 1)
C401-13.2	Explain the theories of superconductivity, the basic and operating parameters of superconductors, their classifications and design limitations for superconductor's applications-devices.	Understand Level (Level 2)
C401-13.3	Solve the various issues related to fabrication of superconducting wires, tapes, design of superconducting magnets and devices.	Apply Level (Level 3)
C401-13.4	Examine the potential use of low Tc and high Tc superconductors for designing both small and large scale applications.	Analyze Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic properties of Superconducting materials	Historical review, the state of zero resistance, Perfect Diamagnetism, Meissner effect, London's theory, Penetration depth, Concept of coherence length and origin of surface energy, Intermediate and mixed states, Critical currents and critical fields, Outlines of B-C-S theory, concept of energy gap, Levitation force of superconductors, Tunneling in superconductors: Gaiever tunneling and Josephson tunneling	10
2.	Classifications & synthesis of Superconducting materials	Type I and Type II superconductors, Classification of superconducting materials, Conventional superconductor: metals (Pb, Nb, Ti etc.), metal alloys (NbTi, Nb3Sn etc.) and Inter-metallic superconductors (MgB2); Non-conventional Superconductors: Oxide based superconductors (BSCCO, YBCO), iron pnictides superconductors, Fabrication of superconducting wires & tapes.	10
3.	Design of Superconducting magnet	Flux flow, Flux pinning, Pinning force, Magneto-thermal Instabilities in Type II superconductors, Flux Jumps, Stabilization Criterion: Cryostatic and dynamic stabilization, Manufacture of long length superconducting multifilamentary wires, Design and fabrication of superconducting magnets, Magnetic field calculations, current leads,	12

		Persistent switches, and superconducting magnet energization.	
4.	Superconducting devices	Josephson junction in magnetic field, Superconducting Quantum Interference Devices (SQUIDS) and its applications, Superconductive Switches, Infrared detectors Superconducting energy storage system (SMES), Fault current limiters (SFCL), Maglev trains	8
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25: Quizzes (6 marks), Attend. (5 marks), PBL (10 marks) and class performance (4 marks)
Total	**100**

Project based learning: To make a better understanding about the subject, groups of 4-5 students will be formed and a project on materials and applied superconductivity viz. synthesis technique of superconducting materials, fabrication of superconducting wires and tapes, design of superconducting magnet, SQUID, SFCL, SMES, IR detector, Superconducting switches, Maglev etc. will be allotted to each of the groups. The students will collect all the information's and understand about the basic principle, fabrication process and current research activities going on in the particular field. The students will also be encouraged to explore the field and create interactive simulations based on these devices.

Recommended Reading material:

1.	Roseins & Rhodrih, Introduction to Superconductivity, 2nd Edition, Pergamon Press plc
2.	Vladimir Z. Kresin & Stuart A. Wolf, Fundamentals of Superconductivity, Springer Science & Business Media
3.	Williams, Applied Superconductivity, Academic press New York.
4.	M. N. Wilson, Superconducting Magnet Design (Monographs on Cryogenics), Clarendon Press, Oxford Science Publications

Detailed Syllabus

Subject Code	21B12CS411	**Semester : ODD**	**Semester VII Session** 2022 -2023 **Month July 2022 to December 2022**
Subject Name	Big Data with Hadoop and Spark		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	**Dr Shikha Mehta, Mr. Prashant Kaushik**
	Teacher(s) (Alphabetically)	**Dr Shikha Mehta, Mr. Prashant Kaushik**

COs	Description	Cognitive Level (Bloom Taxonomy)
C430-13.1	Understand Big data challenges and need of Big data storage and computation tools	Understand Level (Level 2)
C430-13.2	Apply Hadoop, HBase , MapReduce, Spark to solve big data problems.	Apply Level (Level 2)
C430-13.3	Analyze big data using Pig, Hive, Spark tools for solving real world problems.	Analyze Level (Level 4)
C430-13.4	Assess and apply Hadoop and Spark tools for big data analytics	Evaluate Level (Level 5)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction To Big Data And Hadoop	Digital Data Type, Introduction To Big Data, History Of Hadoop, Apache Hadoop And The Hadoop Ecosystem,	4
2.	Map Reduce	About Map Reduce, Analysing Data With Hadoop, Data Flow, Combiner Functions, Hadoop Streaming Using Python.	4
3	Hadoop Eco System – Pig	Introduction To Pig, Execution Modes Of Pig, Comparison Of Pig With Databases, Pig Latin, User Defined Functions, Data Processing Operators.	4
4	Hadoop Eco System – Hive	Apache Hive, Hive Sql Over Hadoop Mapreduce, Hive Shell, Hive Services, Hive Metastore, Comparison With Traditional Databases, Hiveql, Tables, Querying Data And User Defined Functions.	5
5	Hadoop Eco System- Hbase And Big Sql	Nosql DB Hbase, Hbase Architecture, Hbase Shell, Data Model, Hbase Versus RDBMS Big SQL Introduction	4
6	Apache Spark	Introduction Of Spark, Components, Hadoop Ecosystem Vs Spark, Running Scala In Spark Shell. Spark Web Ui	4

7	Scala	Scala Installation, Functional Programming, Programming With Scala, Logical Operator, Type Inference Classes, Functions In Scala,	4
8	Spark Rdd	Resilient Distributed Datasets (RDD), RDD In Spark, RDD Operations	4
9	Spark Sql	Spark SQL Introduction, Dataframes, Spark SQL Architecture, Data Formats, Dataframe Using SQL Query, RDD Vs Dataframes VS Datasets	4
10	Sparkmllib	Spark Mllib Modeling Big Data, Analytics In Spark, ML: Supervised, Unsupervised, Spark Mllib Use For ML Modeling , Spark Graphx	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks	
T1	20	
T2	20	
End Semester Examination	35	
TA	25	
		Attendance = 10
		Class Test/Quiz = 10
		Mini-Project = 5
Total	100	

Project Based Learning: Students will form a group of 3-4 students. Students will analyze a complex Big data computing problem and apply Hadoop Ecosystem design and programming using spark concept to provide effective solution to a Big Data Specific Problem Statement. Students will read 4-5 research papers/ Industrial Projects in which these concepts have been used to handle real scenario problems. Theme/topic of project is chosen based on studied literature. Understanding usage of appropriate Hadoop and Spark technique, then implementation of the project using selected technologies and evaluating its effectiveness will help students to know the concept of applying the big data technologies in real life case scenario.

Text Books Books

1.	Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012
2.	Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). Learning spark: lightning-fast big data analysis. " O'Reilly Media, Inc.".

Reference Books

1.	Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2.	Chambers, B., & Zaharia, M. (2018). Spark: The definitive guide: Big data processing made simple. " O'Reilly Media, Inc.".
3.	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.`
5.	Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
6.	Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013
7.	Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012

Detailed Syllabus
Lecture-wise Breakup

Course Code	21B12CS412	**Semester Odd (Specify Odd/Even)**	**Semester VII Session** 2022 -2023 **Month: July 2022 to Dec 2022**
Course Name	Cryptography and its Applications		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Sangeeta Mittal, Dr. Rashmi Kushwah
	Teacher(s) (Alphabetically)	Dr. Sangeeta Mittal, Dr. Rashmi Kushwah, Dr. Himanshu Agrawal

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 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,	5

		RSA: textbook encryption, attacks on textbook RSA, padded RSA;CCA secure RSA KEM.	
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, 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(5), PBL(10))
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 beenidentified, 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	21B12CS415	**Semester: (specify Odd/Even): Even**	**Semester: Odd Session:** 2022-23 **Month:** August to Dec
Subject Name	Secure Design of Software Systems		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr. Sulabh Tyagi(J62) & Ashish Kumar (J128)
	Teacher(s) (Alphabetically)	Ashish Kumar , Dr. Sulabh Tyagi,

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

Detailed Syllabus

Course Code	21B12CS417	**Semester:** Odd **(specify Odd/Even)**	**Semester: VII Session:** 2022-23 **Month from:** July-Dec
Course Name	Machine Learning and Big Data (C431-12)		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Ambalika Sarkar, Dr. Dharamveer Rajput
	Teacher(s) (Alphabetically)	Ambalika Sarkar, Dr. Dharamveer Rajput

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, 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	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** 2022 -2023 **Month from** August–January
Course Name	Ethical Hacking and Prevention		
Credits	3	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-9.1	Defined the need and basics of Ethical Hacking	Remember Level (Level 1)
C432-9.2	Enumerate the footprinting and information gathering techniquesand their prevention	Understand Level (Level 2)
C432-9.3	Apply scanning tools for Operating System and Service Enumeration and prevention	Apply Level (Level 3)
C432-9.4	Implement and Analyze Network, System and Web Based exploitation Tools and Prevention	Analyze Level (Level 4)
C432-9.5	Evaluate Post Exploitation Effectiveness , Mobile hacking and Security	Evaluate Level (Level 5)
C432-9.6	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	Reconnaissanceand 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	5

		Network Further, Defense - Recovery and Counter attack / 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	LegalAspects 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 (10 Marks), Assignment/Quiz/Mini-project (15 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)

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
4.	Corey P. Schultz, Bob Percianccante, "Kali Linux Cook Book", Second edition, Packet Publishing, 2017.
5.	Lee Allen, Tedi Heriyanto, Shakeel Ali, "Kali Linux – Assuring Security by Penetration Testing, Packet Publishing, 2014.
6.	Dejey, Murugan, "Cyber Forensics", Oxoford University Press, 2018.
7.	Engebretson, Patrick. The basics of hacking and penetration testing: ethical hacking and penetration testing made easy. Elsevier, 2013.

Advanced Statistical Methods (22B12MA411)

Course Description

Course Code	22B12MA411	**Semester:** Odd	**Semester VII Session- 2022-23** **Month from** JULY 2022 – Dec 2022
Course Name	Advanced Statistical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Shikha Pandey	
	Teacher(s) (Alphabetically)	Dr. Shikha Pandey	
COURSE OUTCOMES			**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:			
C401-22.1	apply univariate statistics in Time series, control charts.		Applying Level (C3)
C401-22.2	apply linear and normal regression to fit data.		Applying Level (C3)
C401-22.3	understand multivariate statistics related statistical measures.		Understanding Level (C2)
C401-22.4	apply hypothesis testing for mean and variance in multivariate data.		Applying Level (C3)
Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures**
1.	Univariate Statistics	Univariate descriptive statistics, central limit theorem, Sampling Distribution associated with normal population, Sampling distributions, (chi square, t, F and Z) and hypothesis tests, Time Series: Components, Measurement of trends by graphical method and method of semi averages, Techniques of statistical quality control, control charts for variables and attributes.	12

2.	Regression analysis	Linear Regression, Least Squares Estimation, Normal Regression, Tests of hypothesis for regression coefficients and mean.	8
3.	Introduction to Multivariate Statistics	Introduction of random vectors, Descriptive Statistics, Covariances, Correlations matrices, Multivariate normal distribution.	10
4.	Multivariate Hypothesis Testing	Tests of hypothesis: Tests on μ with Σ Known and Σ unknown (Hotelling T^2 statistic) of a multivariate normal population, one way and two- way analysis of variance (ANOVA) (populations with equal variance), Wilk's test statistic.	12
Total number of lectures			**42**

Evaluation Criteria

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

Project based learning: Students in groups will collect multivariate data and use it for hypothesis testing.

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.	**T. W. Anderson**, *Introduction to multivariate analysis*, John Wiley, 1984.
2.	**Biswas and Srivastava**, *A Textbook, Mathematical Statistics* 1st Edition, Narosa Publishing House, New Delhi, 2011.
3.	**A. M. Kshirsagar**, *Multivariate analysis*, Marcel Dekker, 1983.
4.	**R. A. Johnson and D. W. Wichern**, *Applied multivariate statistical analysis*, Prentice hall Inc., 1988.
5.	**D. F. Morrison**, *Multivariate Statistical Methods*, McGraw Hill Co.,3rd ed., 1990.
6.	**W. K. Hardle and L. Simar**, *Applied Multivariate Statistical analysis*, Springer, New York, 2019.
7.	**Alvin C. Rencher**, *Methods of Multivariate Analysis*, A JOHN WILEY & SONS, INC. PUBLICATION, Newyork, 2001.

Course Description

Course Code	19B12MA412	**Semester** Odd	**Semester** VII **Session** 2022-23 **Month from** Aug 2022-Jan 2023
Course Name	Generalized Fuzzy Set Theory with Applications		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Mohd. Sarfaraz	
	Teacher(s) (Alphabetically)	Dr. Mohd. Sarfaraz & Dr. Amit Srivastava	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-21.1	Apply the concept of Intuitionistic fuzzy sets in defining new information measures and in medical diagnosis and pattern recognition problems.	C5
C401-21.2	Explain various hesitant fuzzy and generalized fuzzy operations.	C2
C401-21.3	Describe various aggregation and generalized aggregation operators.	C2
C401-21.4	Apply the concept of Pythagorean fuzzy sets in defining new information measures and in multiple attribute decision making (MADM) problems.	C5
C401-21.5	Illustrate Fuzzy and possibility measures with evidence theory.	C3

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Intuitionistic fuzzy sets	Intuitionistic fuzzy sets (*IFS*s) – Basic definitions and operations. Measures of entropy, similarity and discrimination between Intuitionistic fuzzy sets (*IFS*s). Applications of *IFS*s in medical diagnosis and pattern recognition.	10
2.	Hesitant fuzzy sets	Hesitant fuzzy sets – concepts, basic operations and basic properties. Extensions of hesitant fuzzy sets – Dual Hesitant fuzzy sets, Interval valued Hesitant fuzzy sets, Triangular Fuzzy Hesitant Fuzzy Sets, Hesitant Fuzzy Linguistic Term Sets.	10
3.	Aggregation Operators	Aggregation Operators – concepts, basic operations and basic properties, weighted aggregation operators, Ordered weighted averaging operator,Induced ordered weighted averaging operator.	8
4.	Pythagorean fuzzy sets	Pythagorean fuzzy sets - concepts, basic operations and basic properties, Hesitant Pythagorean fuzzy sets and their aggregation operators in multiple attribute decision making.	8
5.	Dempster-Shafer Theory	Dempster-Shafer Theory as an alternative to Bayesian networks. Frame of discernment, Belief function, Plausibility and basic probability assignments.	6

		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Quiz, Assignments, PBL)
Total	**100**

Project based learning: Students are divided in a group of 4-5 to do a survey on the application based study of highlighted topics. The student can recognize the real life problems and try to understand by themselves that the structure of the problem similar to the application of the topics coloured above in the course.

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

1.	**Atanassov, Krassimir T.,** Intuitionistic Fuzzy Sets -Theory & Applications, Springer, 1999.
2.	**Xu, Zeshui,** Hesitant Fuzzy Sets Theory, Springer Verlag, 2014.
3.	**Bhargava, A. K.,** Fuzzy Set Theory, Fuzzy Logic and Their Applications, S. Chand & Company Pvt. Ltd., 2013.
4.	**CengizKahraman, UzayKaymak, Adnan Yazici, (**Editors), Fuzzy Logic in Its 50th Yea New Developments, Directions and Challenges, Studies in Fuzziness and Soft Computing, Springer Verlag, Vol. 341, 2016.
5.	**Huchang Liao, ZeshuiXu,** Hesitant Fuzzy Decision Making Methodologies and Applications, Uncertainty and Operations Research, Springer Verlag, 2017.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	21B12CS413	**Semester** **Odd**	**Semester** 7 **Session** 2022-23 **Month from Aug to Dec 22**
Subject Name	Fog and Edge Computing		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr Neeraj Jain , Dr Parmeet Kaur
	Teacher(s) (Alphabetically)	1. Dr Neeraj Jain 2. Dr Parmeet Kaur

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	Illustrate need, advantages, disadvantages, and application opportunities of fog and edge computing	**Understand Level 2**
C431-11.3	Outline 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	Model and simulate a fog or edge scenario	**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	3

		system architectures, Logical Time vs Physical Time	
2.	Internet of Things	IoT Architecture & Technologies which include WSN (Wireless Sensor Networks) and IoT cloud computing, characteristics of IoT device platforms and products.	4
3.	Cloud computing	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, Virtual Machines, Containers	3
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-Methodology and Benefits	6
5.	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, Hierarchy of Fog and Edge Computing	5
6.	Fog and Edge Computing Architecture	Performance Evaluation Components, Metrics, Architecture-Modeling, Proximity Detection Protocols, FaaS, Middleware for Fog and Edge Computing	7
7.	Data Management in Fog Computing	Fog Data Management, Big Data Analytics in the Fog, Machine Learning in Fog Computing, Security and Privacy Issues	6
8.	Case Studies	Related Paradigms of Mobile Edge Computing, Mist Computing, Mobile Ad hoc computing etc. Fog Enhanced Smart Homes and buildings, Modeling and Simulation of Fog and Edge Computing Environments Using iFogSim Toolkit	8
			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	
Text Books	
1.	Buyya, Rajkumar, and Satish Narayana Srirama, eds. “Fog and edge computing: principles and paradigms”. John Wiley & Sons, 2019.
Reference Books	
1.	Chang, Wei, and Jie Wu. "Fog/Edge Computing For Security, Privacy, and Applications."
2.	Mahmud, R., Kotagiri, R., & Buyya, R. (2018). Fog computing: A taxonomy, survey and future directions. In Internet of Everything (pp. 103-130). Springer, Singapore
3.	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
4.	Cao, Jie, Quan Zhang, and Weisong Shi. *Edge computing: a primer*. Springer International Publishing, 2018.
5.	Mahmud, Redowan, and Rajkumar Buyya. "Modelling and simulation of fog and edge computing environments using iFogSim toolkit." *Fog and edge computing: Principles and paradigms* (2019): 1-35.
6.	Dastjerdi, Amir Vahid, Harshit Gupta, Rodrigo N. Calheiros, Soumya K. Ghosh, and Rajkumar Buyya. "Fog computing: Principles, architectures, and applications." In *Internet of things*, pp. 61-75. Morgan Kaufmann, 2016.
7.	Dastjerdi, Amir Vahid, and Rajkumar Buyya. "Fog computing: Helping the Internet of Things realize its potential." *Computer* 49, no. 8 (2016): 112-116.
8.	Serpanos, Dimitrios, and Marilyn Wolf (2017). Internet of things (IoT) Systems: Architectures, Algorithms, Methodologies. Springer. DOI:https://doi.org/10.1007/978-3-319-69715-4