Detailed Syllabus

Lecture-wise breakup

Course Code	16B1NCI648	**Semester - Odd** **(specify Odd/Even)**	**Semester** VII **Session** 2023 -2024 **Month from:** July 24- Dec 24
Course Name	Information Retrieval and Semantic Web		
Credits	3	**Contact Hours**	3 – 0 -- 0

Faculty (Names)	**Coordinator(s)**	Prof. Neetu Sardana (Sector-62), Dr. Mukta Goyal (Sector-128)
	Teacher(s) (Alphabetically)	Dr. Mukta Goyal, Prof. Neetu Sardana

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430.11.1	Understand standard Information retrieval models, indexing mechanism, Web technologies used for designing an intelligent web.	Level-2 (Understanding)
C430-11.2	Apply query processing techniques for content extraction in varied Information retrieval systems.	Level-3 (Applying)
C430-11.3	Analyze the searching algorithms for Information Retrieval.	Level-4 (Analysis)
C430-11.4	Evaluate the IR system results using different metrics for knowledge base modeling and parameter estimation.	Level-5 (Evaluating)
C430-11.5	Design intelligent application for solving real world information retrieval problems	Level-6 (Creating)

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.	3
2.	Boolean Retrieval & Index Construction	An example information retrieval problem, Processing Boolean queries, the extended Boolean model versus ranked retrieval, Blocked-Sort based Indexing, Single-pass-in-Memory Indexing, 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 IR, Language Modeling, Distributed word representations (Word Co-occurrence, Word Embedding (GLOVE, Word2Vec)), Evaluation of IR System.	6
5.	Link analysis	Web as graph and Page ranking algorithms	4
6.	Information retrieval tools	Web directory, Search engine, Meta search engines, Web searching and search engine architecture, Searching Algorithms (Fish, Shark etc...).	4
7.	Web Crawling	Web Crawler architecture and Web crawling (parallel, distributed and focused web crawling).	5
8.	Taxonomy and Ontology	Creating domain specific ontology, Ontology life cycle Semantic Web: Resource description Framework (RDF),	10

		Turtle format, Storing RDF in Databases/files, Language Tags and labels in RDF files, RDF schema and web ontology language (OWL), SPARQL Query Language.	
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance = 5, Assignment/ Quiz= 10, Mini Project= 10)
Total	**100**

The students in the group of 3-4 will read research papers in which information retrieval methods such as Index construction, Query Processing, tolerant retrieval, vector space modeling, probabilistic information retrieval, Link Analysis etc are utilized to solve research related problems. The students will implement the research papers using a standard dataset taken from the platforms like Kaggle, Github, UCI, KDD etc. Applying the methods 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 Hinrich Schütze, "An Introduction to Information Retrieval", Cambridge University Press (CUP), 2008.
2.	A Semantic Web Primer, by Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra, Publisher: MIT Press; 3rd edition, 2012.

Reference Books

1.	Salton, G. and McGill, M.J., "Introduction to Modern Information Retrieval", Computer Series. McGraw-Hill, New York, NY, 1983.
2.	Ricardo Baeza-Yates and Berthier Ribeiro-Neto, ―Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011
3.	Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, ―Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
4.	Rijsbergen C. J. 2012," Information Retrieval", 2nd edition**.**
5.	Learning SPARQL: Querying and Updating with SPARQL 1.1, by Bob DuCharme Publisher: O'Reilly Media; 2 edition, July 18, 2013.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B19CI793	**Semester** Odd	**Semester** VII **Session** 2024 -2025 **Month** from July to Dec
Course Name	Summer Training &Viva **NBA Code:** C455		
Credits	Qualifying	**Contact Hours**	6-8 Weeks Industrial Training

Faculty (Names)	**Coordinator(s)**	Kirti Aggarwal, Ashish 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	**Evaluate (Level 5)**
C455.5	Construct written discourse for presentation of work done at industry/institute	**Create Level (Level 6)**

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

Course Description

Course Code	15B19CI791	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2024 -2025 **Month from** July to Dec 2024
Course Name	**Major Project Part – 1 (IT)**		
Credits	4	**Contact Hours**	…

Faculty (Names)	**Coordinator(s)**	Mr. Prashant Kaushik
	Teacher(s) (Alphabetically)	Entire Department

COURSE OUTCOMES		**COGNITIVE LEVELS**
C450.1	**Summarize** the contemporary literature & tools for hands-on in the respective project area	Understand Level (Level 2)
C450 .2	**Develop** a working model for the identified problem	Apply Level (Level 3)
C450 .3	**Analyze** the specific requirements to develop the workable solution for the **identified** computing problem	Analyze Level (Level 4)
C450 .4	**Evaluate** the developed solution using test cases and performances	Evaluate Level (Level 5)
C450 .5	**Create** and **report** the results of the project in written formats	Create Level (Level 6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	…	…	…
2.	…	…	…
...	…	…	…
***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	**16B1NBT531**	**Semester Odd** **(specify Odd/Even)**	**Semester** VII **Session** 2024 -2025 **Month from June -Dec**
Course Name	**Networks of Life**		
Credits	3	**Contact Hours**	**LTP 3 0 0**

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-15.1	Explain types of networks and network analytics.	C2
C401-15.2	Apply networks to solve biological and social problems.	C3
C401-15.3	Analyze networks for understanding the biological interactions	C4
C401-15.4	Evaluate computational approaches for network analysis	C5

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	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester** 2024 **Session** 2024-2025 **Month from** July
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

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

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Introduction to Healthcare markets**	About the various Regulatory bodies for approval of new medical innovations 2 [CO1] Level 2 Understanding	**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 [CO2] Level 3 Applying	**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 [CO2] Level 3 Applying	**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. [CO2] Level 3 Applying	**08**
5.	**Economics of healthcare**	Stakeholders in healthcare- doctors, hospitals and insurers and their roles, technology and human capital [CO1] Level 2 Understanding	**7**
6.	**Medical technology and insurance**	For medical devices, pharmaceuticals, genetic diagnostic tests and their regulations [CO3] Level 4 Analyzing	**4**
7.	**Indian hospital sector**	Various players – government, private, PPP models, strategic perspectives, case studies [CO3] Level 4 Analyzing	**4**
8	**Innovations in the marketplace**	Health to market innovations [CO3] Level 4 Analyzing	**4**
9	**Healthcare informatics**	e-health, collection of health data, data processing, evaluation, health information systems, case studies [CO3] Level 4 Analyzing	**2**

Total number of Lectures	**42**

Project Based Learning: Students analyze the site https://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** 2024 -2025 **Month from** July-December
Course Name	Stress: Biology, Behaviour and Management		
Credits	3 (3-0-0)	**Contact Hours**	3

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

COURSE OUTCOMES: After the completion of the course, students will be able to		**COGNITIVE LEVELS**
C401-16.1	Explain the biological and cognitive basis of stress.	**Understand Level (C2)**
C401-16.2	Identify social and environmental stressors	**Apply level (C3)**
C401-16.3	Develop coping skills through stress management strategies	**Apply level (C3)**
C401-16.4	Analyze stress situations and solutions for improving quality of life	**Analyze level (C4)**

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 techniques and therapeutic strategies	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 Psychological interventions; Developing Cognitive Coping Skills; Creative Problem Solving (case studies);	HICs to be delivered in the modules 1-6 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 Syllabus
Lecture-wise
Breakup

Course Code	**17B1NCI731**	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2024 -2025 Month from July 2024 to Dec 2024
Course Name	Machine Learning and Natural Language Processing		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Parul Agarwal (J-62), Dr. Arti Jain (J-128)
	Teacher(s) (Alphabetically)	Dr. Arti Jain, Dr. Parul Agarwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-2.1	Understand different syntax, semantics, mathematical concepts, and language models in NLP.	Understand Level [Level 2]
C430-2.2	Apply different models for POS tagging and probabilistic parsing techniques in NLP..	Apply Level [Level 3]
C430-2.3	Apply different approaches for Topic modeling.	Apply Level [Level 3]
C430-2.4	Analyze different supervised and unsupervised techniques for text classification.	Analyze Level [Level 4]
C430-2.5	Choose appropriate NLP concepts and machine learning techniques for NLP to solve the real world problems.	Evaluate Level [Level 5]

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction and Basic of Text Processing	Introduction to Machine Learning & NLP, Challenges, Tokenization, Lemmatization, Data Representation	4
2.	Basics of Mathematics for language Model	Linear Algebra, Probability Theory, N Gram Model	4
3.	Parts of Speech Tagging	Various Models: Hidden Markov Model, SVM, CRF, RNN, LSTM	10
4.	Parsing	Linguistic Essentials, Markov Models, Applications of Tagging, Probabilistic Parsing - CFG, CSG, PCFG	8
5.	Text Classification	Supervised: Bayesian, Naive Bayes, Sentiment Analysis, Text Classification, Unsupervised: K-means, Expectation-Maximization (EM) Algorithm, MaxEnt Classifier	6
6.	Topic Modelling	Topic Modelling: Latent Dirichlet Allocation (LDA) and its Variants	3

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), Generative AI, Large Language Models	7
		Total number of Lectures	**42**

Evaluation Criteria

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

Project based learning: Each student in a group of 2-3 would apply Machine Learning and Natural Language Processing models to solve day-to-day problems. To make subject application based, students would apply 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.	Hapke, Hannes, et al. Natural Language Processing in Action: Understanding, Analyzing, and Generating Text with Python. United States, Manning, 2019.

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.	Rao, Delip, and McMahan, Brian. Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning. China, O'Reilly Media, 2019.
3.	Géron, Aurélien. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. United States, O'Reilly Media, 2019.
4.	Eisenstein, Jacob. Introduction to Natural Language Processing. United States, MIT Press, 2019.
5.	Vajjala, Sowmya, et al. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems. Taiwan, O'Reilly Media, 2020.
6.	Raschka, Sebastian, and Mirjalili, Vahid. Python Machine Learning. United Kingdom, Packt Publishing, 2017.
7.	Kochmar, Ekaterina. Getting Started with Natural Language Processing. United States, Manning, 2022.
8.	Zhang, Yue, and Teng, Zhiyang. Natural Language Processing: A Machine Learning Perspective. India, Cambridge University Press, 2021.

Course Description
Detailed Syllabus

Course Code	18B12CS428	**Semester: ODD**	**Semester: VII Session 2024-2025** ***Month:* from July- Dec, 2024**
Course Name	**Introduction to Deep Learning**		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr. Ashish Mishra
	Teacher(s) (Alphabetically)	Dr. Ashish Mishra

Sr. No.	Description	Cognitive Level (Bloom's Taxonomy)
C430-3.1	Understand the basic concepts of machine learning and deep learning.	Understanding (Level-2)
C430-3.2	Understand the basic theory of ANN, probability theory, error minimization, and regularization techniques	Understanding (Level-2)
C430-3.3	Apply with the 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 various deep learning techniques on real-time problems.	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 = 10, Quiz-10 Marks and PBL = 5 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)

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 Press , 2017
2.	FRANÇOIS CHOLLET, Deep Learning with Python, Manning Publications, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester Odd**	**Semester VII Session 2024-2025** **Month from July 2024 - December 2024**
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**.**	Understanding 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.	Analyzing Level (C 4)
C401-20.4	Critically assess and evaluate the outputs obtained from analytical tools and recommend HR related decisions.	Evaluating Level (C 5)
C401-20.5	Create hypotheses, propose solutions and validate using appropriate analytical techniques	Creating 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.	8
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 Analytics, Analytical Performance Management, Retention Analytics. Data Visualization and Storytelling using Tableau.	10
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	**42**

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

Course Code	19B12CS423	**Semester ODD (specify Odd/Even)**	**Semester:** VII **Session** 2024 -2025 **Month from July 2024-Dec 2024**
Course Name	Computing for Data Science		
Credits	3-0-0	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Ankita Verma , Ms. Anuradha Surolia
	Teacher(s) (Alphabetically)	Dr. Ankita Verma, Ms. Anuradha Surolia

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-7.1	Understand the basic concepts, methods, and mathematics relevant to computational techniques for data science.	Understand (Level 3)
C431-7.2	Apply descriptive and inferential statistics for data analysis.	Apply (Level 3)
C431-7.3	Develop and apply advanced and associated computing techniques and technologies for data analysis.	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 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 & Assignments)	25 (Assignments & Attendance) (**Attendance= 10 Internal assessment=5 & Assignment in PBL mode = 10**)
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.
4.	Jiawei, Han, and Kamber Micheline. *Data mining: concepts and techniques*. Morgan kaufmann, 2006. (3rd edition)
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.

Course Description

Subject Code	19B12CS427	**Semester ODD 2024**	**Semester VII Session** 2024–25 **Month from** July '24 **to** Dec '24
Subject Name	Introduction to DevOps		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Amarjeet Prajapati(J62), Dr.Pulkit Mehndiratta(J128)
	Teacher(s)	1. Dr. Amarjeet Prajapati 2. Dr. Pulkit Mehndiratta 3. Dr.Sulabh Tyagi
Sections	1	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-8.1	To understand the needs of Continuous integration, continuous delivery, continuous deployment and continuous monitoring	Understand Level (Level 2)
C431-8.2	To apply pull and push requests using GIT and GIT Hub and also able to review the changes on GitHub	Apply Level (Level 3)
C431-8.3	To analyse scripts for the creating pipeline and deploying the micro services for the Developed Application for the calculated load and response times	Analyse Level (Level 4)
C431-8.4	To evaluate the effectiveness of Docker and containerization concepts by analyzing and executing Docker and Kubernetes commands	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 management in Jenkins using maven, 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	Docker desktop and docker containerization concepts, Docker commands, 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 DevOpsby Joakim Verona , 2017, Packt publishing
2.	Ansible: Up and Running, Automating Configuration Management and Deployment the Easy WaybyLorin Hochstein, Rene Moser, 2017
3.	DevOps: A Software Architect's Perspectiveby Len Bass, Ingo Weber, Liming Zhu, 2018
4.	Accelerate, The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizationsby Nicole Forsgren, Jez Humble, Gene Kim, 2019
Text Books	
5.	Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scaleby Jennifer Davis, Ryn Daniels by Orielly, 2017
6.	Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automationby Jez Humble and David Farley, 2018

Detailed Syllabus

Subject Code	21B12CS411	**Semester ODD**	**Semester: 7th Semester Session ODD 2024** **Month from July to December 2024**
Subject Name	Big Data with Hadoop and Spark		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	**Prof. Shikha Mehta, Dr. Parmeet Kaur**
	Teacher(s) (Alphabetically)	**Dr. Parmeet Kaur, Prof. Shikha Mehta**

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 Map Reduce and Spark to solve big data problems.	Apply Level (Level 2)
C430-13.3	Analyze big data using Pig, Hive, HBase, Spark tools for solving real world problems.	Analyze Level (Level 4)
C430-13.4	Assess Hadoop and Spark for big data analytics	Evaluate Level (Level 5)
C430-13.5	Implement big data applications using Hadoop and Spark	Create Level (Level 6)

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	4
6	Apache Spark	Introduction of Spark, Components, Hadoop Ecosystem Vs Spark,	4

		Running Scala In Spark Shell. Spark Web Ui	
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, Mini-Project = 15)
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., Spark: The definitive guide: Big data processing made simple. " O'Reilly Media, Inc.", 2018.
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** 2024 -2025 **Month: July 2024**
Course Name	Cryptography and its Applications		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Prof. Sangeeta Mittal
	Teacher(s) (Alphabetically)	Prof. Sangeeta Mittal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-8.1	Define the principles of cryptography along with the categorization of cryptographic algorithms and its applicability into various allied areas.	Remember Level (Level 1)
C430-8.2	Verify the feasibility and applicability of different symmetric cryptography, hash and MAC algorithms in distributed applications.	Understand Level (Level 2)
C430-8.3	Apply number theory for construction of asymmetric cryptography, Diffie Hellman Exchange and digital signatures applications.	Apply Level (Level 3)
C430-8.4	Analyse suitability of public key encryption RSA, El Gamal and ECC for securing distributed applications.	Analyze Level (Level 4)
C430-8.5	Apply multiparty secret sharing and zero knowledge techniques for data sharing among partially trusted parties	Analyze Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to cryptography	Historical ciphers along with their cryptanalysis, rigorous versus heuristic approaches; Cryptography in modern era, principles of defining security and its adversarial models, Perfect Secrecy and Its Limitations. Computational securities, Definition of secure encryption	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	How to construct secure encryption? Substitution-permutation and Feistel networks, Substitution-permutation and Feistel networks, Birthday attacks, The Random oracle model. Stream and Block Symmetric encryption algorithms - DES, AES, RC4, Construction of CPA-secure encryption, illustration of CCA attacks, Modes of implementation of symmetric ciphers	7
4.	Message authentication	Differentiate between secrecy and integrity, Security requirements of hash functions, Birthday attacks and the Random oracle model, Secure Hash Algorithm (SHA), MAC functions, CBC-MAC, HMAC, Password hashing.	4
5.	Number theory and Asymmetric key cryptography	Fundamentals of group theory, Factorization, discrete log and Primality testing , Introduction to public key encryption, Diffie-Hellman key exchange	6
6.	Public key encryption	Key management in public key encryption systems, Hybrid model of encryption and KEM/DEM, El Gamal encryption,	4

		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)	4
8.	Analysis of various cryptographic signature	Digital signature definition and its applications, RSA signatures: textbook RSA, hashed RSA , Digital certificates, Certificates and public-key infrastructures, Proxy signature, Kerberos.	6
9.	Multiparty Secret Sharing and Zero Knowledge Techniques	Secret Splitting, Threshold Schemes, Feige-Fiat-Shamir Identification Techniques	4
		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 been identified, the group will analyze the problem and synthesize system based solutions to the identified problem. Each group will apply different cryptographic approaches such as symmetric key, hash function, asymmetric key, and etc. This approach will enhance skills of each student and increase the understanding of security issue in distributed applications. Moreover, candidate will gain the enough knowledge to provide the cryptographic solution to enhance the security of any organization/company. After this course, a student will able to undertake any work in this area in the industry or research.

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

Text Books:

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

References:

1	Alfred J. Menezes,Paul C. Van Oorschot and Scott A. Vanstone, A Handbook of Applied Cryptography, CRC Press Series on Discrete Mathematics and Its Applications, 1997
2.	Michael Luby, Pseudorandomness and Cryptographic Application, Princeton University 1996.
3.	Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, Second Edition (2nd. ed.). Chapman & Hall/CRC, 2014.
4.	ACM Transactions on Privacy and Security (TOPS)
5	IEEE Transactions on Information Forensics and Security

Detailed Syllabus
Lecture-wise Breakup

Subject Code	21B12CS413	**Semester** **Odd**	**Semester:** 7th **Session:** 2024-25 **Month: July to December 2024**
Subject Name	Fog and Edge Computing		
Credits	**3 -0-0**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr K. Rajalakshmi (J62), Ms. Akanksha Mehndiratta (J128)
	Teacher(s) (Alphabetically)	1. Ms. Akanksha Mehndiratta (J128) 2. Dr K. Rajalakshmi (J62)

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	Model and simulate a fog or edge scenario	**Apply level 3**
C431-11.5	Examine the challenges and techniques of data analytics in fog and edge computing	**Analyze Level 4**
C431-11.6	Assess the application of fog and edge computing methods and protocols in IoT smart systems	**Evaluate Level 5**

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Distributed Systems	Review of principles and concepts of Distributed Systems. Evolution of distributed systems: from mainframes to cloud to edge, Multi-tier distributed system architectures, Logical Time vs Physical Time	3
2.	Internet of Things	IoT Architecture & Technologies which include WSN (Wireless Sensor Networks) and IoT cloud computing, characteristics of IoT device platforms and products.	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=8, Mini-Project=7)
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.
2	Chang, Wei, and Jie Wu. "Fog/Edge Computing For Security, Privacy, and Applications." Springer International Publishing, 2021
3.	Mahmud, R., Kotagiri, R., & Buyya, R. , “Fog computing: A taxonomy, survey and future directions”. In Internet of Everything (pp. 103-130). Springer, Singapore, 2020

4.	Ivan Stojmenovic, Sheng Wen ," The Fog Computing Paradigm: Scenarios and Security Issues" Proceedings of the 2014 Federated Conference on Computer Science and Information Systems pp. 1–8 , 2020
5.	Cao, Jie, Quan Zhang, and Weisong Shi. *Edge computing: a primer*. Springer International Publishing, 2018.
Reference Books	
6.	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, 2019
7.	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.
8.	Dastjerdi, Amir Vahid, and Rajkumar Buyya. "Fog computing: Helping the Internet of Things realize its potential." *Computer* 49, no. 8 (2016): 112-116.
9.	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
10.	Buyya, Rajkumar et al. "Cloud Computing Principles and Paradigms." Wiley, 2011.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NCI732	**Semester:** Odd	**Semester:** VII **Session:** 2024- 2025 **Month from** July to December
Course Name	Social Network Analysis		
Credits	3-0-0	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Bhawna Saxena (J62), Dr. Lalita Mishra (J128)
	Teacher(s) (Alphabetically)	Bhawna Saxena, Deepti Singh, Lalita Mishra

COURSE OUTCOMES		**COGNITIVE LEVEL**
C431-9.1	Explain the fundamental principles and models related to social networks	Understand (Level 2)
C431-9.2	Interpret social network structure, characteristics, and metrics	Understand (Level 2)
C431-9.3	Apply social network analysis metrics to real-world datasets using software tools	Apply (Level 3)
C431-9.4	Apply techniques for link prediction, community detection and graph embedding in social networks	Apply (Level 3)
C431-9.5	Analyze and model the flow of information in social network for maximizing the cascade	Analyze (Level 4)

Module No.	**Subtitle of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Fundamental concepts of SNA, Importance of SNA, Real-world use cases of Social Network Analysis.	2
2.	Network Concept	Graphs, Paths and Components, Adjacency Matrices, Ways and Modes, Matrix Product, Node Degree, Types of Nodes and Types of Ties, Actor Attributes	3
3.	Random Network Models	Erdos-Renyi , Barabasi-Albert , Watts-Strogatz Small-World Model, Shortest Path, Six Degrees of Separation	5
4.	Characterizing Whole Network	Cohesion, Reciprocity, Transitivity, Clustering Coefficient, Triad Census, Assortativity Index, Rich Club Coefficient, Neighbourhood Overlap	3
5.	Network Centrality	Non-Valued Networks: Degree, Eigenvector, Betweeness, Closeness, PageRank. Valued Networks, Negative Tie Networks, Subgroup: Cliques and Groups	5
6.	Network Building and Visualization	Tools for SNA: Gephi, NetworkX, SNAP, Pajek	3
7.	Community Detection	Clustering, Community Structure, Modularity, Overlapping Communities, Homophily	6
8.	Link Prediction	The Katz Score, Hitting & Commute Time, Rooted	6

		PageRank, SimRank, Predictors Summary, Meta-measures	
9.	Information Diffusion	Cascading Behavior: Herd Behaviour, Information Cascade Model, Threshold Model, Cascade Maximization, Epidemic Modeling	5
10.	Graph Embedding	Techniques: Node2Vec, DeepWalk, Graph Neural Networks	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance (10), Quiz (5), Mini-Project (10))
Total	**100**

Project based learning: Each student in a group of 3-4 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)

	Text Books
1.	Tanmoy Chakraborty, Social Network Analysis, Wiley, 2021.
2.	Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining: An Introduction, Cambridge University Press, 2017.
3.	Albert-László Barabási, Network Science, Cambridge University Press, 2017
4.	Alessandro Chessa and Guido Caldarelli, Data Science and Complex Networks: Real Case Studies with Python, Oxford University Press, 2016
5.	William L. Hamilton, Graph Representation Learning, Morgan & Claypool Publishers, 2020
	Reference Books
1	Song Yang, Franziska B. Keller, Lu Zheng, Social Network Analysis: Methods and Examples, SAGE Publications, Inc, 2016.
2.	Narsingh Deo, Graph Theory with Applications to Engineering & Computer Science, Dover Publications Inc. 2016
3.	Stephen P. Borgatti, Martin G. Everett, Jeffrey C. Johnson, Filip Agneessens, Analyzing Social Networks Using R, SAGE Publications, 2022
4.	David Knickerbocker, Network Science with Python: Explore the networks around us using network science, social network analysis and machine learning, Packt Publishing, 2023
5.	Niyati Aggrawal, Adarsh Anand, Social Networks: Modelling and Analysis, CRC Press, 2022

Detail Course Description

Course Code	**21B12CS414**	**Semester ODD 2024**	**Semester:** VII **Session** 2024 -2025 **Month from** July to Dec, 2024
Course Name	**Smart System and IoT**		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Vikash
	Teacher(s) (Alphabetically)	Dr. Vikash

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-6.1	Understand IoT and smart sensors systems and its various applications.	Understand (level 2)
C431-6.2	Classify and Illustrate different sensors and its working principle for various applications.	Understand (level 2)
C431-6.3	Model smart systems using IoT standards, protocols, technologies, smart factory processes, recent industry 4.0+ standards, components and devices.	Apply (level 3)
C431-6.4	Evaluate and Assess smart system prototype designs for real-life Smart Applications.	Evaluate (level 5)
C431-6.5	Design and Develop various smart system applications namely, Smart Cities, Smart Home, Smart Health care systems, Smart transportations Systems, Smart Wearable Systems, Smart Agricultural Systems and Smart Factories.	Create (level 6)

Module No.	**Title of the Module**	**Details of the Modules**	**CO**	**Hours**
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.	CO1	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.	CO2	5
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.	CO2	3
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.	CO4	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 Smart Phones, Health Monitoring Equipment and Sensors,	CO4	3

		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.	CO4	5
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.	CO4	5
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.	C04	3
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.	CO3	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.	CO5	4
			Total	42

Evaluation Criteria

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

Project Based Learning: Groups of 3-4 students will choose a project topic related to Sensor Networks based on Internet of Things Applications. They will use a suitable sensor and sensing environment machine learning technique to solve a real-time problem. In a team, they will learn how to apply the concepts of

sensor technology to build Internet of Things applications. Apart from it, most of the project aimed to develop Smart Applications (like, Smart Cities, Smart Home, Smart Health care systems, Smart transportations Systems, Smart Wearable Systems, Smart Agricultural Systems and Smart Factories).	

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.	Learning Techniques for the Internet of Things by Donta, Praveen Kumar, Abhishek Hazra, and Lauri Lovén, Imprint: Springer, 2024.
2.	IoT System Design by James, Alice, Avishkar Seth, and Subhas Chandra Mukhopadhyay, 2021.
3.	Advances in Modern Sensors; Physics, design, simulation and applications by Sinha, G, R, IOP (Institute of Physics Publishing), 2020
4.	Internet of Things: Architecture and Design Principles, Raj Kamal, McGrawHill. 2017
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.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
7.	Jan Ho"ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.

Detailed Syllabus

Subject Code	21B12CS415	**Semester:** ODD	**Semester:** 7th **Session:** 2024-25 **Month:** July 2024 to December 2024
Subject Name	Secure Design of Software Systems		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Shruti Jaiswal , Dr. Tanvi Gautam
	Teacher(s) (Alphabetically)	Dr. Shruti Jaiswal , Dr. Tanvi Gautam

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-13.1	Contrast various methods of securing data and invading (or breaching) security and privacy.	Understand (level 2)
C431-13.2	Apply different secure coding practices for improving the security and robustness of software system.	Apply (level 3)
C431-13.3	Use various open source security testing tools to discover security problems in the software system.	Apply (level 3)
C431-13.4	Analyze and model the security requirements during the secure development of the software system.	Analyze (level 4)
C431-13.5	Evaluate risks and associated impact of the various threats and attacks on different vulnerable points present in the software system.	Evaluate (level 5)

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.	4	C431-13.5
2.	Requirement engineering for secure software	Secure Development Lifecycle, The SQUARE process Model, Requirements elicitation and prioritization	4	C431-13.4
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	C431-13.4 C431-13.5
4.	Secure Coding	Integer Overflows/underflows, Buffer Overflow, format string vulnerability, Beware of (escape characters, reserved words, delimiters and commands) attacks and defense,	7	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
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	8	C431-13.1
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.	6	C431-13.1
		Total number of Lectures	**42**	

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 Attendance (5), Assignment (5), Quiz (5), Mini Project (10)
Total	**100**

Project based learning: Students will work in a group of 3-4 students on a selected project. 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 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	**Semester: VII Session:** 2024-25 **Month from:** JULY-DEC 2024
Course Name	Machine Learning and Big Data (C431-12)		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Deepika Varshney
	Teacher(s) (Alphabetically)	Dr. Deepika Varshney

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

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

Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance (10), Assignments/Mini-project/Tutorials (5+5+5))
Total	**100**

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

Text Books:

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

Reference Books:

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

Detailed Syllabus
Lecture-wise Breakup

Course Code **NBA Code**	**21B12CS418**	**Semester ODD**	**Semester** VII **Session** 2024 -2025 **Month from** July-December
Course Name	Ethical Hacking and Prevention		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	P. Raghu Vamsi (J62), Shariq Murtuza (J128)
	Teacher(s) (Alphabetically)	P. Raghu Vamsi (J62), Shariq Murtuza (J128)

COURSE OUTCOMES		**Cognitive Levels**
C432-9.1	Summarize the concepts of hacking, Malwares, Network attacks, Denial of Service and counter measures	Understand Level (Level 2)
C432-9.2	Demonstrate foot printing and port scanning techniques using simple tools	Apply Level (Level 3)
C432-9.3	Carryout vulnerabilities scanning, exploitation, and countermeasures in operating system, network and web application.	Apply Level (Level 3)
C432-9.4	Examine wireless network and mobile system exploitation tools with prevention	Apply Level (Level 3)
C432-9.5	Explain legal aspects of ethical hacking and writing pen testing report	Analyze Level (Level 4)

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	4
2	Reconnaissance and Prevention	Active and Passive Footprinting,Web tools for Footprinting, Information Gathering by Social engineering, Social Engineer Toolkit(SET), Prevention of Information gathering	4
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	4
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	4
6	Prevention of Exploitation	Protecting against Malware, Best practices for Hardening Operating Systems, Web Filtering, Secure routers, Firewalls, Honeypots, Intrusion Detection Systems	4
7	Post Exploitation and Defense	Maintaining access with Backdoors, rootkits and meterpreter, privilege escalation, Penetrating the Internal Network Further, Defense - Recovery and Counter attack	4

8	Mobile Hacking and Security	Mobile platform attack vector, android vulnerabilities, jailbreaking iOS, windows phone vulnerabilities, mobile security guidelines, and tools	4
9	Pentesting Report	Various types of penetration testing, security audit, vulnerability assessment, and penetration testing roadmap	3
10	Legal Aspects of Ethical Hacking	Code of Ethics, Legal frameworks, Security Research Exemption, Whistle Blowing, Security Activism, IT Act 2000 and IT AA 2008	5
		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.	Wylie, P. L., & Crawley, K. (2020). The Pentester Blueprint: Starting a career as an ethical hacker. John Wiley & Sons.
2.	Wilson, R. (2022). Hands-on ethical hacking and network defense. Cengage Learning.
3.	Singh, G. D. (2022). The Ultimate Kali Linux Book: Perform Advanced Penetration Testing Using Nmap, Metasploit, Aircrack-ng, and Empire. Packt Publishing Ltd.
4.	Gregg, M. (2022). CEH Certified Ethical Hacker Cert Guide. Pearson IT Certification.
5.	Christen, M., Gordijn, B., & Loi, M. (2020). The ethics of cybersecurity (p. 384). Springer Nature.
6.	Chander, H., & KAUR, G. (2022). Cyber laws and IT protection. PHI Learning Pvt. Ltd.

Applied Numerical Methods (17B1NMA732)

Couse Description

Course Code	17B1NMA732	**Semester** - Odd	**Semester** VII **Session** 2024-25 **Month from** Aug 2024 - Dec 2024		
Course Name	Applied Numerical Methods				
Credits	3		**Contact Hours**	3-0-0	
Faculty (Names)	**Coordinator(s)**	Dr. Ram Surat Chauhan			
	Teacher(s) (Alphabetically)	Dr. Ram Surat Chauhan			

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
C401-8.1	explain the methods for roots of non-linear equations, interpolation and numerical linear algebra.	Understanding (C2)
C401-8.2	apply numerical methods for system of linear and non-linear equations, interpolation, differentiation, integration and differential equations.	Applying (C3)
C401-8.3	analyse numerical methods for finding approximate solutions of related problems.	Analyzing (C4)
C401-8.4	evaluate computational techniques for approximation, initial and boundary value problems.	Evaluating (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 for one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equi-spaced points, Divided differences, Spline Interpolation, Least square approximation	7
3.	Numerical Differentiation and Integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods, Iterative methods: Jacobi and Gauss Seidel Methods and their convergence, Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of parabolic and elliptic partial differential equations by Finite Difference Methods	12
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, 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 deBoor, 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:** 2024 -2025 **Month from July to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3

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

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

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

	Nanomaterials	nanoparticles, Quantum dot devices, Quantum well devices, High T_c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS	
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [PBL (10 M), 2 Quiz (6 M), Attendance (5 M) and Internal Assessment (4 M)]
Total	**100**

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

1.	*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.
3.	*The Handbook of Nanotechnology: Nanometer Structures, Theory, Modeling, and Simulation*, A. Lakhtakia, Spie Press USA.
4.	*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.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	17B1NPH731	**Semester:** **Odd** VII Sem	**Session :2024-25** **Month: July-December**
Subject Name	Introduction to Quantum Information Processing (IQIP)		
Credits	**03**	**Contact Hours**	**03**

Faculty (Names)	**Coordinator(s)**	Dr Sandeep Mishra
	Teacher(s) (Alphabetically)	Dr Sandeep Mishra

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401.1	Correlate Quantum Information Processing and their applications in quantum communication and computation.	Remember Level (Level 1)
C401.2	Explain quantum information, Qubit, quantum gates, and quantum circuits. Their applications in quantum computing, quantum cryptography and communications.	Understand Level (Level 2)
C401.3	Demonstrate the use of basic principles in solving various problems related to quantum circuits with the use of linear algebra and many algorithms and protocols.	Apply Level (Level 3)
C401.4	Prove and estimate solution of numerical problems using physical and mathematical concepts involved with various quantum circuits.	Evaluate Level (Level 5)
C401.5	Design of quantum circuits of desired output for quantum cryptography applications.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction and Overview**	What is information? Why do we need to know how to manage the information? Is information independent of physical laws used to store and process it? What is the present status of the subject and how far can we go? A brief history of Quantum information theory and quantum computation. Definitions of classical information, quantum information and their differences.	**4**
2.	**Elements of quantum theory**	Vector space, Hilbert space, Inner, outer product, Linear operators, Pauli matrices, eigenvectors, eigenvalues, Tensor products and Trace. Probability interpretation; Measurement problem; Hilbert space. Basic ideas of classical information theory; Measures of information (information content and entropy); Bell measurement and entanglement, Schmidt decomposition, Holevo bound, Bloch sphere and no cloning Theorem. Classical theory of computation; Universal computer; Turing machine; Computational complexity; Uncomputable functions; Shortcomings of classical information theory and necessity of quantum information theory.	**10**
3.	**Quantum**	Quantum bit (Qubit); Quantum gates (theoretical ideas and	**10**

	computing	experimental gates); Quantum circuits and practical implementation of qubit operations. Quantum algorithms**;** Simulation of physical systems; Quantum complexity, Deusch's algorithm, Deusch-Josza algorithm, Simon's Algorithm, Shor's factorization algorithm and Grover's search algorithm.	
4.	**Quantum teleportation and superdense coding;**	Quantum data compression; Entangled states, concepts and generation. Quantum cryptography; Classical cryptography; RSA and its limitations, Quantum key distributions; different protocol BB84, B92, GV protocol etc. Experimental quantum information processors (ideas related to ion trap, MRI, quantum dot, geometric phase, linear optics-based quantum computers); Quantum error correction.	**10**
4	**Recent ideas on experimental quantum information**	Recent ideas on experimental quantum information processors (quantum computers): their utility and problems (scalability, stability of output states)	**4**
5	Summary	Summary of entire course and a short of introduction to the present goals of quantum information technology.	**2**
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (5-attendance, 10-PBL, 6-Quiz/class test, 4-teacher assessment)
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.	Neil Gershenfeld, The Physics of information technology, Cambridge University Press.
2.	H Hirvensalo, Quantum computing, Springer Verlag.
3.	Lecture notes for Physics 229: Quantum Information and Computation, John Preskil http://www.theory.caltech.edu/people/preskill/ph229/#describe
4	Andewsteane, Quantum computing, Rep. Prog. Phys. 61, 117-173 (1998) or quant-ph/9708022 http://xxx.lanl.gov
5	P A M Dirac, The principles of Quantum mechnaics, Oxford University Press.
6	David J.C. MacKay, Information Theory, Inference and Learning Algorithm.
7	A. Barenco, Quantum Physics and Computers, Contemporary Physics, **37**, 375-89 (1996).
8	C.H. Bennett, Quantum Information and Computattion, Physics Today, Oct., 1995, **24-30** (1995).
9	A. Ekert, P. Hayden, H Inamori, Basic concepts in quantum computation, quant-ph/ 0011013.
10	D. Gottesman and H K Lo, From quantum cheating to quantum security, Physics Today, Nov., 2000.
11	J Preskill, battling decoherence: the fault – tolerent quantum computer. Physics Today, 24-30, June 1999.
12	A. M. Steane and W. Van Dam, Physicists triumph at guess my number, Physics Today, 35-39, Feb. 2000.
13	V. Vedral and M. B. Plenio, Basics of quantum computation, Prog. Quant. Electron, 22 1-39 (1998)
14	A. Zeilinger, Fundamentals of quantum information, Physcs World, 11, March, 1998.