Course Description

Course Code	15B19CI791	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2023 -2024 **Month from** July to Dec 2023
Course Name	**Major Project Part – 1 (INTG)**		
Credits	4	**Contact Hours**	…

Faculty (Names)	**Coordinator(s)**	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 writtenformats	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.

Course Code	15B19CI793	Semester Odd		Semester VII Session 2023 -2024**Month**from Julyto Dec
Course Name	Summer Training &Viva **NBA Code:** C455			
Credits	Qualifying		**Contact Hours**	6-8 Weeks Industrial Training

Faculty (Names)	Coordinator(s)	Dr. Mukta Goyal,Kirti Aggarwal
	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.

INT CSE

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C455.1	1	2	2	2	2	1	1	1	2	2	2	3	3	3
C455.2	2	3	2	3	3	1	1	1	2	2	2	2	2	2
C455.3	1	3	2	3	2	2	1	2	2	2	2	2	3	3
C455.4	2	1	2	3	2	2	2	1	2	2	2	2	3	3
C455.5	1	1	1	1	1	2	3	1	2	2	2	2	3	3

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C450.1	1 Summarization will give engineering knowledge of selected domain	2 Problems of surveyed paper will help in self	2 Design of literature will be seen and understood	2 Survey paper will help in understanding the problem analysis	2 Survey of literature will help in understanding steps of investigations	1 Paper publishers will let know the engineering societies	1 Some of the paper will focus on this	1 Practices followed by researchers will be seen	2 As all members will do the survey	2 Understanding the communication styles of the paper	2 Survey is part of project understanding	3 This process helps in all kinds of engineering discipline	3 Survey helps in acquiring practical scenarios	3 Understanding the existing system make them asses details of hardwires
C450.2	2 Analyzing requirement leads the way to its engineering solution	3 Analyzingrequirement leads to problem analysis and its risks	2 Analyzing requirementleads the way for divide and conquer approach for design	3 Analyzing requirementleads the way for divide and conquer approach for investigations	3 Analyzing requirementleads the way for identifying the tools identification and its usage	1 Analyzing requirementlets know of engineering societies	1 May reruirements and solutions now a days are sustainable	1 Ethics practice for identified problem will be seen while analyzing requirements	2 Various parts of the problem will be attempted by all team members	2 Parts of the problem requires effective communications among team members	2 Analyzing requirementpaves the way for project management	2 This project learning goes to actual working live like environments	2 Analyzing requirementhelp in acquiring the practical competency	2 Analyzingrequirement will lead to assessing and selecting the required peace of software and hardware
C450.3	1 Survey helps in analysing all the current work	3 Problem analysis is the main here	2 Analysis paves the way for design	3 Analysis itself selected solutions	2 Analysis of the problem and tools go hand in hand	2 The analysis of tools helps in getting exposure to open source tools	1 The analysis may focus on sustainable solutions	2 Solutions available and its usage explores the ethics	2 Analysis of various parts helps in team work	2 Analysis by parts requires in communication of teams and available solutions	2 Workable solutions understand management and finances	2 Project work does help in life long understansing	3 Full project is aims to acquire practical comptency	3 Developing the solution requires assessing various software and hardware
C450.4	2 Various test cases give domain knowled	1 Test helps in differentiating the expected and actual outcomes	2 Better design points are found out on test cases	3 Evaluative of test results helps in seeing complex	2 Automated test cases tools help in modern tool usage	2 Use of open source tools by various society	2 Many tools run while application	1 Test cases and its application helps	2 Test cases now days are also	2 Communication of test results in important for	2 Workable solutions understand management and	2 Project management activities are life	3 Full project is aims to acquire practical comptenc	3 Developing the solution requires assessing various software and

	ge		failing	scenarios			usage saving the time and energy for sustainable aims	in know privacy related ethids	development scripts to be written by teams	redevelopments	finances	long learning	y	hardware
C45 0.5	1 Reporting the results in engineering knowledge	1 Reports also identifies new problem in development	1 Test cases are always helping in redesign of the modules	1 Complex problem always needs better reporting	1 Importance of modern tools requires proper reporting	2 Reporting and creating helps engineering society	3 The reports shows proper demonstration of work	1 Creating and reporterg norms should follow the ethics part as well for plagrism avoidance	2 Reporting of various component require team work	2 Reporting itself is mainly a communication	2 Reporting contains mainly the results and finance part for various components	2 reporting of any thing in written is very essential for any kind of life long learning.	3 Full project is aims to acquire practical comptency	3 Developing the solution requires assessing various software and hardware

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NCI648	Semester -Odd (specify Odd/Even)	Semester VII Session 2023-2024
			Month from: July23- Dec 23
Course Name	Information Retrieval and Semantic Web		
Credits	3	Contact Hours	3 – 0 -- 0

Faculty (Names)	Coordinator(s)	Dr. Neetu Sardana, Astha Singh
	Teacher(s) (Alphabetically)	Astha Singh, Dr. 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.	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, Language Modeling, Evaluation of IR System	4
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...).	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 = 5, Assignment &Quiz= 10, 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 Hinrich Schütze, "An introduction toInformation 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.

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

Course Code	17B1NBT732	Semester Odd (specify Odd/Even)	Semester 2023 Session 2023-2024 Month from July
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain healthcare market, drugs and devices, role of various stakeholders	Understand Level (C2)
CO2	Apply related intellectual property laws and regulatory approvals for healthcare sector	Apply Level (C3)
CO3	Analyze the various business models/ innovations in the healthcare industry	Analyze Level (C4)
CO4	Compare economic aspects pertaining to the sector	Analyze Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	**Introduction to Healthcare markets**	About the various Regulatory bodies for approval of new medical innovations 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

Course Code	17B1NBT733	Semester Odd (specify Odd/Even)	Semester VII Session 2023 -2024 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		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 techniques and	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	HICs to be delivered in the modules 1-6

	therapeutic strategies	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

Course Code	**17B1NCI731**	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2023 -2024 Month from July 2023 to Dec 2023
Course Name	Machine Learning and Natural Language Processing		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Archana Purwar(J-62), Dr.Laxmi Chaudhary(J-128)
	Teacher(s) (Alphabetically)	Dr. Ankit Vidyarthi, Dr.ArchanaPurwar,Dr.Laxmi Chaudhary

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.	Basic of Mathematics for language Model	Linear algebra, Probability , 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 Modeling	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 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 modeling 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, Second Edition, Pearson Hall Series, 2013.
2	Eisenstein, Jacob. Introduction to Natural Language Processing. United States, MIT Press, 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	Hapke, Hannes, et al. Natural Language Processing in Action: Understanding, Analyzing, and Generating Text with Python. United States, Manning, 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 (17B1NMA731)

Course Code	17B1NMA731	Semester Odd (specify Odd/Even)	Semester VII Session 2023 -2024 Month from July 2023-Dec. 2023
Course Name	Applied Linear Algebra		
Credits	3	**Contact Hours** 3-0-0	
Faculty (Names)	**Coordinator(s)**	Dr. Ram Surat Chauhan	
	Teacher(s) (Alphabetically)	Dr. Ram Surat Chauhan	

COURSE OUTCOMES : After pursuing the above mentioned course, the students will be able to:	COGNITIVE LEVELS
C401-7.1 Explain basic concepts of vector spaces, metric spaces, normed spaces, and inner product spaces.	Understanding level (C2)
C401-7.2 <mark>Solve the problems related to linear transformations, eigenvalue and eigenvectors and its applications.</mark>	Applying Level (C3)
C401-7.3 Make use of the concepts of norms, orthogonalization, bilinear, and quadratic forms in solving related problems.	Applying Level (C3)
C401-7.4 Analyze the existence and uniqueness of solution of a system of linear equations, diagonalizability of matrices and linear transformations.	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.	<mark>Eigen Values and Eigen Vectors</mark>	Eigen values and Eigenvectors, Modal matrix and diagonalization, Similarity Transformation, Eigen systems of real symmetric, orthogonal, Hermitian and unitary matrices	9

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

CO-PO and CO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1 (ECE)	PSO1 (CSE)	PSO1 (IT)	PSO2
C401-7.1	2	2	2	1								2				
C401-7.2	3	3	2	2					1			2	1	1	1	
C401-7.3	3	3	2	2								2	1	1	1	
C401-7.4	3	3	3	2					1			2	1	1	1	
Avg	2.75	2.75	2.25	1.75					1			2	1	1	1	

Applied Numerical Methods (17B1NMA732)

Couse Description

Course Code	17B1NMA732	**Semester** - Odd	**Semester** VII **Session** 2023-24
			Month from July 2023 - Dec 2023

Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Pankaj Kumar Srivastava and Dr. Yogesh Gupta	
	Teacher(s) (Alphabetically)	Dr. Pankaj Kumar Srivastava and Dr. Yogesh Gupta	

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.

CO-PO and CO-PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
C401 -8.1	2	2	2	1								2		
C401 -8.2	3	3	2	2								2		
C401 -8.3	3	3	2	2								2		
C401 -8.4	3	3	3	3					1			2		
Avg.	**2.8**	**2.8**	**2.3**	**2**					**1**			**2**		

Department of Physics and Materials Science & Engineering
AY: 2023-24 (Odd Semester)
Course Opening Report

Programme Name: INT B.Tech. CSE
Semester: VII
Course Name & Code: **Introduction to Quantum Information Processing (17B1NPH731)**
NBA Code: **C401-5**
Name of Course Coordinator: Prof Anirban Pathak &
                            Dr Sudip Kumar Haldar

1. **Course Outcomes:**
    At the completion of the course, students will be able to,

COs (NBA Code)	Description	Cognitive Level
C401-5.1	Correlate Quantum Information Processing and their applications in quantum communication and computation.	Remembering (C1)
C401-5.2	Explain quantum information, Qubit, quantum gates, and quantum circuits. Their applications in quantum computing, quantum cryptography and communications.	Understanding (C2)
C401-5.3	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.	Applying (C3)
C401-5.4	Prove and estimate solution of numerical problems using physical and mathematical concepts involved with various quantum circuits.	Evaluating (C5)
C401-5.5	Design of quantum circuits of desired output for quantum cryptography applications.	Creating (C6)

2. CO-PO-PSO Mapping:

COs (NBA Code)	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
C401-5.1	3	3	2	2	1							1		
C401-5.2	3	2	1	3	1							1	1	1
C401-5.3	3	2	3	2	2								2	1
C401-5.4	3	3	3	2	1									
C401-5.5	3	2	2	3	1								1	1
Avg.	3.00	2.40	2.20	2.40	1.20							**1.00**	1.33	1.00

3. Identified gaps in Syllabus/ Course Description (If Any): NA

Topics to be introduced	Strengthens CO	Strengthens PO, PSO	Method of Identification

4. Modifications in Syllabus/ Course Description (If Any): NA

Details of Modification (Addition/ Removal)	Justification	Strengthens POs/PSOs

5. Actions for Improving CO Attainments: NA

COs	Attainments in 2020-21	Action to be taken in 2023-24 to improve CO attainment	Strengthens POs/PSOs
C401-5.1			
C401-5.2			
C401-5.3			
C401-5.4			
C401-5.5			

** Since the COs are revised in AY 23-24, the actions to be taken mentioned here are for achieving better attainments in each CO. These actions are derived from the suggestions provided in previous year's closing report after discussion with faculty members teaching the course.

6. Innovative Teaching and Learning Method to be used:

Assignments will be given on topic of advance development in the renewable energy and climate modeling and open discussion sessions will be held for further understanding of these topics.

7. Strategies for

- **Weak Learners:**

S No.	Strategy	Expected Outcomes	Documents to be produced
1	Extra study material and questions will be given for weak learners to practice.	Weak learners will be able to develop a better understanding and perform better.	Tutorials

- **Bright Students:**

S No.	Strategy	Expected Outcomes	Documents to be produced
1.	Students will be given related research papers and will be asked to go through and present the important points of research articles.	Bright students will develop presentation skills about research articles and project development skills.	Project/assignment report

8. Innovative Evaluation Strategy to be used:

Regular assessment of students throughout the semester in the form me quiz, tutorial solution, assignments and open discussion

Signature: **Signature:**

Module Coordinator: Dr. Alok P. S. Chauhan   **Course Coordinator:**

Prof. Anirban Pathak &
Dr. Sudip Kumar Haldar

Department of PMSE

AY: 2023-24, Odd Semester

Course Opening Report

Programme Name: B. Tech. (CSE) Integrated

Semester: 7th

Course Name & Code: Nanoscience and Technology (17B1NPH732)

NBA Code: C401-4
Name of Course Coordinator: Prof. Navendu Goswami

1. Course Outcomes:

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

COs (NBA Code)	Description	Cognitive Level
C401-4.1	Define the Nanoscience and Technology and to know about various other terminologies and developments involved with Nanoscience and Technology	C1
C401-4.2	Classify the nanomaterials depending on the nature of dimensionalities, type of materials classes and explain the basic concepts of nanomaterials	C2
C401-4.3	Apply the concepts of Nanoscience for solving the theoretical and numerical problems	C3
C401-4.4	Determine the properties of nanomaterials through suitable characterization tools	C5

2. CO-PO-PSO Mapping:

COs (NBA Code)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C401-4.1	3	3										1		
C401-4.2	3	3										1		
C401-4.3	3	3										1		
C401-	3	3			3									

4.4													
Avg.	3.00	3.00			3.00							1.00	

3. Identified gaps in Syllabus/ Course Description (If Any): NIL

Topics to be introduced	Strengthens CO	Strengthens PO, PSO	Method of Identification

4. Modifications in Syllabus/ Course Description (If Any): NIL

Details of Modification (Addition/ Removal)	Justification	Strengthens POs/PSOs

5. Actions for Improving CO Attainments:

COs	Attainments in 2022-23	Action to be taken in 2023-24 to improve CO attainment	Strengthens POs/PSOs
C401-4.1	3.0	NIL	NA
C401-4.2	2.0	NIL	NA
C401-4.3	3.0	NIL	NA
C401-4.4	1.4	Development of critical thinking through some PBL exercises is required.	PO1, PO2, PO3, PO5

6. Innovative Teaching and Learning Method to be used: More questions in the form of question bank would be developed and provided to students as there are not much questions/quizzes available in existing text books on this subject.

7. Strategies for

- **Weak Learners:** Personalized mentoring for struggling students so as to discuss their doubts and exact points of difficulties will be implemented.

- **Bright Students:** Students will be encouraged to take up some project-based learning work pertaining to their topic of interest in this course but relevant to their core program like CSE/IT/ECE/BT.

8. Innovative Evaluation Strategy to be used: Nil

Signature: **Signature:**

Module Coordinator: Dr. Manoj Tripathi   **Course Coordinator: Prof. Navendu Goswami**

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17M11CS111	Semester (specify Odd/Even)		Semester Odd Session 2023-2024 Month from July 23 to December 23
Subject Name	Data Structure & Algorithms for Big Data			
Credits	3	Contact Hours		3(L)

Faculty (Names)	Coordinator(s)	Shikha Jain
	Teacher(s) (Alphabetically)	Shikha Jain

COURSE OUTCOMES		COGNITIVE LEVELS
C110.1	Understand the importance of data structure and algorithm for Big Data	Understand Level (Level 2)
C110.2	Apply appropriate data structure for the big data problems.	Apply Level (Level 3)
C110.3	Analyze various algorithms required to solve problems from the domain of big data.	Analyze Level (Level 4)
C110.4	Design and evaluate an efficient solution to a given real world problem using Big data based data structures and algorithms	Create Level (Level 6)

S.N.	Subtitle of the Module	Topics in the module	No. of Lectures for the module	Remarks
1.	Introduction to Big Data	Big Data and its characteristics, Type of data, Motivation, Applications of Big Data, Domains for Big Data, Various tools and services	2	
2.	Basic Data Structures Concepts	Array: searching, sorting; Trees: Binary Tree, AVL, B-tree; Graph: BFS, Spanning Tree	3	
3.	Parallel Basic Algorithms	Brent's Theorem, Sum of n numbers, Prefix scan, Pointer Jumping, Rank of list, Pointer to root, Suffix sum, Preorder traversal of binary tree.	4	
4.	Parallel advance Algorithms	Parallel Sorting (Merge Sort, Quick Sort, Odd even transposition sort), Parallel shortest Path Algorithm, Parallel Matrix Algorithms	5	

5.	Indexing strategies Trees	R and R+ Trees, Prefix Trees, LSM trees	5	
6.	Big Data Databases	MongoDB, Accumulo, BigTable	5	
7.	Map Reduce	MapReduce, Mapreduce Job scheduling	4	
8.	Hash and membership	Hashing, Approximate Membership, Bloom Filter, Counting Bloom Filter	5	
9.	Cardinality and Frequency	LogLog, HyperLogLog, Count Sketch, Count–2 min sketch	5	
10.	Big Data Framework	Hadoop HDFS, Read and write operation, Fault Tolerance-Failures and Recovery	4	
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: Students in group of 3 to 4 students are required to develop mini-project based on the concepts taught in this course. In mini-project, students need to create the distributed environment either using Hadoop framework/Multithreading using OpenMP/ Matlab. Problem statements need to be formulated in various applications domains of big data, proposing the solution approach and implemented over the created distributed environment.

Text Books	
1.	Algorithms and Data Structures for Massive Datasets by Dzejla Medjedovic, Emin Tahirovic, and Ines Dedovic, MEAP began July 2020
2.	Data Algorithms: Recipes for Scaling Up with Hadoop and Spark by Mahmoud Parsian, O'Reilly Media, 2015
Reference Books	
1.	Probabilistic Data Structures and Algorithms in Big Data Applications by Andrii Gakhov, 2022
2.	Sequential and Parallel Algorithms and Data Structures by Roman Dementiev, Martin Dietzfelbinger, Peter Sanders, Kurt Mehlhorn, 2019
3.	Big Data with Hadoop MapReduce A Classroom Approach By Rathinaraja Jeyaraj, Ganeshkumar Pugalendhi, Anand Paul, 2021

COs	PO1	PO2	PO3	PSO 1	PSO2
C110.1	1 Students will understand the existing algorithms to solve various open problems in the domain.		2 Towards the end of the semester, students will submit a mini-project taken from the domain of Big Data		
C110.2	2 Students will design algorithms to solve various open problems in the domain.	1 Students will submit a mini project report	2 Towards the end of the semester, students will submit a mini-project taken from the domain of Big Data	2 Various real-world problems in the domain will be discussed and given in assignments/exam	
C110.3	2 Students will design algorithms to solve various open problems in the domain.	1 Students will submit a mini project report	2 Towards the end of the semester, students will submit a mini-project taken from the domain of Big Data	2 Various real-world problems in the domain will be discussed and given in assignments/exam	
C110.4	2 Students will design algorithms to solve various open problems in the domain.	1 Students will submit a mini project report	2 Towards the end of the semester, students will submit a mini-project taken from the domain of Big Data	2 Various real-world problems in the domain will be discussed and given in assignments/exam	1 Students will work on mini project to provide ethical solution to the real world problem
Avg.	2	1	2	2	1

Subject Code	17M11CS112	**Semester (specify Odd/ Even):** Odd	**Semester:** Odd **Session** 2023-2024 **Month from** July to December
Subject Name	Machine Learning and Data Mining		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Anita Sahoo
	Teacher(s)	Anita Sahoo

COURSE OUTCOMES		COGNITIVE LEVELS
C112.1	Explain different techniques used in machine learning and data mining.	Level-2- (Understanding)
C112.2	Identify and apply a suitable technique to solve the given problem in the domain of data mining and machine learning.	Level-3 (Apply)
C112.3	Derive implications by applying pre-processing techniques on datasets for machine learning problems.	Level-4 (Analyze)
C112.4	Solve to provide the complete solution to a given knowledge discovery/ prediction problem and evaluate its performance using suitable metric(s).	Level-5 (Evaluate)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1	Introduction	Introduction to Machine Learning, Data Mining and Knowledge Discovery in Databases, Data Types, EDA	4
2	Classification	Introduction to classification, k-Nearest Neighbours, Naïve Bayes, Decision Trees, Support Vector Machine, Back-propagation Neural Network	8
3	Regression	Linear Regression with One Variable, Linear Regression with Multiple Variables, Logistic Regression	4
4.	Clustering	Introduction, Different type of Clustering Methods, Partitioning Clustering Methods, Hierarchical Clustering Methods, k-means, k-medoids, density based clustering, Self-Organizing Map, cluster validation	6
5.	Association Rules	Support, Confidence, Lift, Conviction; Apriori algorithm, Eclat algorithm, FP-growth algorithm	5
6.	Dimensionality Reduction	Introduction, Subset Selection, PCA, SVD, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis	4
7.	Ensemble Methods	Ensemble methods of classification-Bagging, Boosting, and Random Forest	4
8.	Quantum Machine Learning	Fundamentals of quantum computing, quantum states, quantum gates, interference, superposition, entanglement, measurements, variational quantum circuit using Qiskit	7
		Total number of Lectures	42

Evaluation Criteria	
Components	Maximum
Marks T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance (10), Mini-project/Assignment (15))
Total	100

Project based learning: Each student in a group of 3-4 will have to develop a mini project based on association mining, classification and clustering approaches. The students can choose any real-world application that requires some decision-making. The students have to implement the mini-project using any open-source programming language. Project development will enhance the knowledge and employability of the students in IT sector.

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

1	Han, Jiawei, Jian Pei, and Micheline Kamber. Data mining: concepts and techniques. Elsevier, 3rd edition ,2012
2	Kimball R. and Ross M ,The Data Warehouse Toolkit", Wiley, 3rd edition,2013
3	Pujari, Arun K, Data mining techniques , Universities press, 3rd edition , 2013
4	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, second edition, 2019
5	Soumen Chakrabarti, Mining the Web: Discovering knowledge from hypertext data", Morgan Kaufmann, Elsevier
6	Mitchell, Tom, and Machine Learning McGraw-Hill. "Edition." (1997).
7	Wittek, Peter. Quantum machine learning: what quantum computing means to data mining. Academic Press, 2014.
8	Anahory S. and Murray D, Data Warehousing in the Real World, Addison- Wesley
9	Dunham, Margaret H. Data mining: Introductory and advanced topics. Pearson Education India, 2006.
10	Mattison R. ,Web Warehousing and Knowledge Management", Tata McGraw- Hill.
11	David Hand, Heikki Mannila and Padhraic Smyth ,Principles of Data Mining,PHI
12	Transactions on Database Systems (ACM)
13	IEEE Transactions on Knowledge & Data Engineering
14	The VLDB Journal The International Journal on Very Large Data Bases

Course Code	18B12HS412	Semester Odd	Semester VII Session 2023-2024
			Month from July 2023 - December 2023

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 Analytics, Analytical Performance Management, Retention Analytics. Data Visualization and Storytelling using	12

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

Course Code	19B12CS423	Semester ODD (specify Odd/Even)	Semester: VII Session 2023 -2024 Month from July 2023-Dec 2023
Course Name	Computing for Data Science		
Credits	3-0-0	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Ankita Verma
	Teacher(s) (Alphabetically)	Dr. Ankita Verma

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 & Assignment in PBL mode = 15)
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	21B12CS412	Semester Odd (Specify Odd/Even)	Semester VII Session 2023 -2024 Month: July 2023
Course Name	Cryptography and its Applications		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	Coordinator(s)	Dr. Sangeeta Mittal, Dr. Kedar Nath Singh
	Teacher(s) (Alphabetically)	Dr. Kedar Nath Singh, Dr. 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	Applymultiparty 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,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 logand 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, RSA: textbook encryption, attacks on textbook RSA, padded RSA;CCA secure RSA KEM.	4

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 Substitution-permutation and Feistel networks, Birthday attacks, The Random oracle model.	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 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

Course Description

This course explores concepts, frameworks, and applications in fog and edge computing. The course begins with a review of Distributed and Cloud Computing and then covers foundation of IoT systems. The course covers concepts and need of fog and edge computing. It explores frameworks for computing over edge devices and cloud. The course provides information on the different types of fog and edge architectures; compute deployments as well as different types of fog edge compute services. The course also includes methods and challenges of data analytics over fog and edge devices. Relevant case studies will also be discussed.

Subject Code	21B12CS413	Semester Odd	Semester 7 Session 2023-24 Month from Aug to Dec 23
Subject Name	Fog and Edge Computing		
Credits	3	Contact Hours	3 Lectures

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: <mark>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.</mark>

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

References

1. Buyya, Rajkumar, and Satish Narayana Srirama, eds. "Fog and edge computing: principles and paradigms". John Wiley & Sons, 2019.

2. Chang, Wei, and Jie Wu. "Fog/Edge Computing For Security, Privacy, and Applications." 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.

CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C431-11.1	2	2	2	2	2	1	1		1					
C431-11.2	2	2	2	2	2	1	1		2		1			
C431-11.3	3	3	2	3	3	2	2		3		2		2	
C431-11.4	2	2	2	2	3	1	1		2				2	
C431-11.5	3	3	2	3	3	2	2		2				2	
C431-11.6	1	1	2	1	1	1	1				1			1
AVG.	2	2	2	2	2	1	1		2		1		1	

1. CO-PO-PSO mapping B.Tech [CSE]:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C431-11.1	Define the technologies, architectures, entities and protocols, used for cloud and IoT systems (Remember Level 1)													
	2	2	2	2	2	1	1		1					
Justification	Basic definition of IoT & Cloud computing, basic architecture of Cloud and IoT systems	Problem analysis on need for IoT and Cloud Computing for simple real world problems	Discuss possible solutions for simple real world problems using IoT and Cloud Computing	Comparis on of different solution approaches using IoT and Cloud computing	Explore modern Tools and programmin g platform for implementin g simpler solution approach	Explore methods of Data gathering, reasoning and assess from societal context for applying IoT and Cloud computing	Discuss Sustainable solution approaches using IoT and Cloud computing		Solve assignments , quiz on multidiscipl inary approach in solving real world using IoT and Cloud computing					
C431-11.2	Illustrate need, advantages, disadvantages, and application opportunities of fog and edge computing (Understand Level 2)													
	2	2	2	2	2	1	1		2		1			

Justification	Basic requirements for applying fog and edge computing and perform comparison of advantages, disadvantages over fog and edge computing	Analyze simpler real world problem for need and application opportunity of fog and edge Computing	Discuss possible solutions for simpler real world problems using fog and edge Computing	Discuss existing complex solutions using fog and edge Computing	Explore modern Tools and programming platform for implementing solution approach	Basic methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computing in simpler problem	Discuss Sustainable solution approaches using of fog and edge Computing		Solve assignments, quiz on multidisciplinary approach in solving simpler real world using of fog and edge Computing		Assignment & mini project on multidisciplinary approach in solving simpler real world using of fog and edge Computing		
C431-11.3	Outline the architecture, components and performance of fog and edge computing systems (Understand Level 2)												
	3	3	2	3	3	2	2		3		2		2
Justification	In complex problems, understand underlying requirements for using Fog computing and edge computing systems	Identify complex problems, breaking into smaller problems and analyse suitable sys architecture and components and performance metrics for fog and edge computing	Discussion on apt solutions for complex real world problems using fog and edge Computing	Analyze existing solution approach in larger problems using fog and edge Computing	Explore modern Tools and programming platform for implementing solution approach	Discuss methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computing	Discuss sustainable solution approaches in complex systems using fog and edge Computing		Solve assignments, quiz on multidisciplinary approach in solving complex real world using of fog and edge Computing		Assignment & mini project on multidisciplinary approach in solving complex real world using of fog and edge Computing		Design algorithms and implement at moderate level of IoT systems and Cloud computing
C431-11.4	Model and simulate a fog or edge scenario (Apply Level 3)												
	2	2	2	2	3	1	1		2				2

Justification	Basic concept of Model and simulating complex Fog and Edge Computing	Model and simulate Complex Problem domains for fog and edge	Solutions using Fog and Edge will be analyzed	Usage of Fog and Edge in wide domains will be evaluated	Programming language implementation of solutions for large size problem	Application of appropriate fog and edge based complex scenario to solve real world problems will be analyzed	Usage of fog and edge based solutions in complex environmental context and their sustainability		Assignments and Project on real-time problems using fog and edge will be given				Usage of fog or edge in various domains will be evaluated	
C431-11.5	**Examine the challenges and techniques of data analytics in fog and edge computing (Analyze Level 4)**												
	3	3	2	3	3	2	2		2				2
Justification	Basic concept big data and data analytics in Fog and Edge Computing	Problem domains on big data handling and data analytics for fog and edge	Big data analysis and solutions integrate with Fog and Edge will be analyzed	Usage of data analytics using Fog and Edge in various domains will be evaluate d	Programming language implementation of data analytics models on huge data for fog and edge computing	Application of data analytics appropriate fog and edge based scenario to solve real world problems will be analyzed	Usage of data analytics for fog and edge based solutions in environmental context and their sustainability		Assignments and Project on real-time data analytics problems using fog and edge will be given				Usage of data analytics models and huge databases fog or edge in various domains will be evaluated
C431-11.6	**Assess the application of fog and edge computing methods and protocols in IoT smart systems (Evaluate Level 5)**												
	1	1	2	1	1	1	1			1			1
Justification	Essential concept of IoT smart systems , protocols, integrated approach other emerging technologies	Various Problem domains for IoT smart systems	Solutions using IoT smart systems will be analyzed	Usage of IoT smart systems in various domains will be evaluate d	Programming language implementation of solutions	Application of appropriate IoT smart systems based scenario to solve real world problems will be analyzed	Usage of IoT smart systems based solutions in environmental context and their sustainability			Assignments and Project on real-time problems using integrated fog & Edge computing in IoT smart systems will be given			Assess the application of fog and edge computing methods and protocols in IoT smart systems
Avg.	2	2	2	2	2	1	1		2		1		1

2. CO-PO-PSO mapping B.Tech [IT]:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C431-11.1	**Define the technologies, architectures, entities and protocols, used for cloud and IoT systems (Remember Level 1)**													
	2	2	2	2	2	1	1		1					
Justification	Basic definition of IoT & Cloud computing, basic architecture of Cloud and IoT systems	Problem analysis on need for IoT and Cloud Computing for simple real world problems	Discuss possible solutions for simple real world problems using IoT and Cloud Computing	Comparison of different solution approaches using IoT and Cloud computing	Explore modern Tools and programming platform for implementing simpler solution approach	Explore methods of Data gathering, reasoning and assess from societal context for applying IoT and Cloud computing	Discuss Sustainable solution approaches using IoT and Cloud computing		Solve assignments, quiz on multidisciplinary approach in solving real world using IoT and Cloud computing					
C431-11.2	**Illustrate need, advantages, disadvantages, and application opportunities of fog and edge computing (Understand Level 2)**													
	2	2	2	2	2	1	1		2		1			
Justification	Basic requirements for applying fog and edge computing and perform comparison of advantages, disadvantages over fog and edge computing	Analyze simpler real world problem for need and application opportunity of fog and edge Computing	Discuss possible solutions for simpler real world problems using fog and edge Computing	Discuss existing complex solutions using fog and edge Computing	Explore modern Tools and programming platform for implementing solution approach	Basic methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computing in simpler problem	Discuss Sustainable solution approaches using of fog and edge Computing		Solve assignments, quiz on multidisciplinary approach in solving simpler real world using of fog and edge Computing		Assignment & mini project on multidisciplinary approach in solving simpler real world using of fog and edge Computing			
C431-11.3	**Outline the architecture, components and performance of fog and edge computing systems (Understand Level 2)**													
	3	3	2	3	3	2	2		3		2		2	

JIIT University, Noida

Justific ation	In complex problems, understand underlying requirement s for using Fog computing and edge computing systems	Identify complex problems , breaking into smaller problems and analyse suitable sys architecture and component s and performanc e metrics for fog and edge computing	Discussio n on apt solutions for complex real world problems using fog and edge Computi ng	Analyze existing solution approach in larger problems using fog and edge Computin g	Explore modern Tools and programmin g platform for implementin g solution approach	Discuss methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computin g	Discuss sustainable solution approaches in complex systems using fog and edge Computing		Solve assignments , quiz on multidiscipl inary approach in solving complex real world using of fog and edge Computing		Assignmen t & mini project on multidiscip linary approach in solving complex real world using of fog and edge Computing		Design algorithms and implement at moderate level of IoT systems and Cloud computing
C431-11.4	**Model and simulate a fog or edge scenario (Apply Level 3)**												
	2	2	2	2	3	1	1		2				2	
Justific ation	Basic concept of Model and simulating complex Fog and Edge Computing	Model and simulate Complex Problem domains for fog and edge	Solutions using Fog and Edge will be analyzed	Usage of Fog and Edge in wide domains will be evaluated	Programmin g language impleme ntation of solutions for large size problem	Applicatio n of appropriat e fog and edge based complex scenario to solve real world problems will be analyzed	Usage of fog and edge based solutions in complex environment al context and their sustainability		Assignment s and Project on real-time problems using fog and edge will be given				Usage of fog or edge in various domains will be evaluated	
C431-11.5	**Examine the challenges and techniques of data analytics in fog and edge computing (Analyze Level 4)**												
	3	3	2	3	3	2	2		2				2	
Justific ation	Basic concept big data and data analytics in Fog and Edge Computing	Problem domains on big data handling and data analytics for fog and edge	Big data analysis and solutions integrate with Fog and Edge will be analyzed	Usage of data analytics using Fog and Edge in various domains will be evaluate d	Program ming language impleme ntation of data analytics models on huge data for fog and edge computing	Applicatio n of data analytics appropriat e fog and edge based scenario to solve real world problems will be analyzed	Usage of data analytics for fog and edge based solutions in environment al context and their sustainability		Assignment s and Project on real-time data analytics problems using fog and edge will be given				Usage of data analytics models and huge databases fog or edge in various domains will be evaluated	
C431-11.6	**Assess the application of fog and edge computing methods and protocols in IoT smart systems (Evaluate Level 5)**												

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
	1	1	2	1	1	1	1				1			1
Justification	Essential concept of IoT smart systems , protocols, integrated approach other emerging technologies	Various Problem domains for IoT smart systems	Solutions using IoT smart systems will be analyzed	Usage of IoT smart systems in various domains will be evaluate d	Programming language implementation of solutions	Application of appropriate IoT smart systems based scenario to solve real world problems will be analyzed	Usage of IoT smart systems based solutions in environmental context and their sustainability				Assignments and Project on real-time problems using integrated fog & Edge computing in IoT smart systems will be given			Assess the application of fog and edge computing methods and protocols in IoT smart systems
Avg.	2	2	2	2	2	1	1		2		1		1	

2. CO-PO-PSO mapping B.Tech [INTG]:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
C431-11.1	Define the technologies, architectures, entities and protocols, used for cloud and IoT systems (Remember Level 1)													
	2	2	2	2	2	1	1		1					
Justification	Basic definition of IoT & Cloud computing, basic architecture of Cloud and IoT systems	Problem analysis on need for IoT and Cloud Computing for simple real world problems	Discuss possible solutions for simple real world problems using IoT and Cloud Computing	Comparison of different solution approaches using IoT and Cloud computing	Explore modern Tools and programming platform for implementing simpler solution approach	Explore methods of Data gathering, reasoning and assess from societal context for applying IoT and Cloud computing	Discuss Sustainable solution approaches using IoT and Cloud computing		Solve assignments , quiz on multidisciplinary approach in solving real world using IoT and Cloud computing					
C431-11.2	Illustrate need, advantages, disadvantages, and application opportunities of fog and edge computing (Understand Level 2)													
	2	2	2	2	2	1	1		2		1			

Justification	Basic requirements for applying fog and edge computing and perform comparison of advantages, disadvantages over fog and edge computing	Analyze simpler real world problem for need and application opportunity of fog and edge Computing	Discuss possible solutions for simpler real world problems using fog and edge Computing	Discuss existing complex solutions using fog and edge Computing	Explore modern Tools and programming platform for implementing solution approach	Basic methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computing in simpler problem	Discuss Sustainable solution approaches using of fog and edge Computing		Solve assignments, quiz on multidisciplinary approach in solving simpler real world using of fog and edge Computing		Assignment & mini project on multidisciplinary approach in solving simpler real world using of fog and edge Computing		
C431-11.3	**Outline the architecture, components and performance of fog and edge computing systems (Understand Level 2)**												
	3	3	2	3	3	2	2		3		2		2
Justification	In complex problems, understand underlying requirements for using Fog computing and edge computing systems	Identify complex problems, breaking into smaller problems and analyse suitable sys architecture and components and performance metrics for fog and edge computing	Discussion on apt solutions for complex real world problems using fog and edge Computing	Analyze existing solution approach in larger problems using fog and edge Computing	Explore modern Tools and programming platform for implementing solution approach	Discuss methods of Data gathering, reasoning and assess from societal context for applying of fog and edge Computing	Discuss sustainable solution approaches in complex systems using fog and edge Computing		Solve assignments, quiz on multidisciplinary approach in solving complex real world using of fog and edge Computing		Assignment & mini project on multidisciplinary approach in solving complex real world using of fog and edge Computing		Design algorithms and implement at moderate level of IoT systems and Cloud computing
C431-11.4	**Model and simulate a fog or edge scenario (Apply Level 3)**												
	2	2	2	2	3	1	1		2				2

Justification	Basic concept of Model and simulating complex Fog and Edge Computing	Model and simulate Complex Problem domains for fog and edge	Solutions using Fog and Edge will be analyzed	Usage of Fog and Edge in wide domains will be evaluated	Programming language implementation of solutions for large size problem	Application of appropriate fog and edge based complex scenario to solve real world problems will be analyzed	Usage of fog and edge based solutions in complex environmental context and their sustainability		Assignments and Project on real-time problems using fog and edge will be given				Usage of fog or edge in various domains will be evaluated	
C431-11.5	**Examine the challenges and techniques of data analytics in fog and edge computing (Analyze Level 4)**													
	3	3	2	3	3	2	2		2				2	
Justification	Basic concept big data and data analytics in Fog and Edge Computing	Problem domains on big data handling and data analytics for fog and edge	Big data analysis and solutions integrate with Fog and Edge will be analyzed	Usage of data analytics using Fog and Edge in various domains will be evaluate d	Programming language implementation of data analytics models on huge data for fog and edge computing	Application of data analytics appropriate fog and edge based scenario to solve real world problems will be analyzed	Usage of data analytics for fog and edge based solutions in environmental context and their sustainability		Assignments and Project on real-time data analytics problems using fog and edge will be given				Usage of data analytics models and huge databases fog or edge in various domains will be evaluated	
C431-11.6	**Assess the application of fog and edge computing methods and protocols in IoT smart systems (Evaluate Level 5)**													
	1	1	2	1	1	1	1				1			1
Justification	Essential concept of IoT smart systems , protocols, integrated approach other emerging technologies	Various Problem domains for IoT smart systems	Solutions using IoT smart systems will be analyzed	Usage of IoT smart systems in various domains will be evaluate d	Programming language implementation of solutions	Application of appropriate IoT smart systems based scenario to solve real world problems will be analyzed	Usage of IoT smart systems based solutions in environmental context and their sustainability		Assignments and Project on real-time problems using integrated fog & Edge computing in IoT smart systems will be given					Assess the application of fog and edge computing methods and protocols in IoT smart systems
Avg.	2	2	2	2	2	1	1		2		1		1	

Detail Course Description

Course Code	21B12CS414	Semester ODD SEM 7th Sem	Session 2023 -2024
			Month from Aug to Dec, 2023

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	Understand IoT and smart sensors systems and its various applications.	Understand (level 2)
C431-6.2	Classifyand 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	Lecture 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.	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.	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.	5
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 Smart Phones, Health Monitoring Equipment and Sensors, Security and Privacy issues in IoT Protocol, Big Data for Health Management System.	4

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.	4
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.	4
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.	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.	4
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.	5
		Total	42

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
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.	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, McGrawHill. 2017
3.	ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
	References:
1.	Jan Ho"ller, VlasiosTsiatsis, 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.
2.	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.
3.	https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
4.	https://www.emerald.com/insight/content/doi/10.1108/PRR-08-2019-0027/full/html
5.	https://www.digi.com/blog/post/introduction-to-smart-transportation-benefits
6.	https://nodered.org/docs/getting-started
7.	https://www.arduino.cc/en/Tutorial/HomePage
8.	https://www.raspberrypi.org/documentation/

Subject Code	21B12CS415	Semester: ODD	Semester: 7ᵗʰ Session: 2023-24
			Month: July to December 2023

Subject Name	Secure Design of Software Systems

Credits	3	Contact Hours	3-0-0

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

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.	SecureDesign	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), Assignments in PBL mode/ Mini-Project/ Quiz (20))
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, etcand 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.

Course Code NBA Code	21B12CS418	Semester ODD		Semester VII **Session** 2023 -2024
				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	Pings and Ping Sweeps, Port Scanning, NMap, Vulnerability Scanning, Enumerating OS,OS	4

		Vulnerabilities scanning – NETBIOS, Tools for identifying Windows and Linux vulnerabilities, Web applications vulnerability scanning, Preventing Scanning	
	Prevention		
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.

Text Books

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.
Reference Books	
1.	Gregg, M. (2022). CEH Certified Ethical Hacker Cert Guide. Pearson IT Certification.
2.	Christen, M., Gordijn, B., & Loi, M. (2020). The ethics of cybersecurity (p. 384). Springer Nature.
3.	Chander, H., & KAUR, G. (2022). Cyber laws and IT protection. PHI Learning Pvt. Ltd.

Advanced Statistical Methods (22B12MA411)

Course Description

Course Code	22B12MA411		Semester Odd		Semester I Session 2023-24
					Month from Aug - Dec 2023
Course Name	Advanced Statistical Methods				
Credits	3			Contact Hours	3-0-0
Faculty (Names)	Coordinator(s)	Dr. Ayushi Singh Sengar			
	Teacher(s) (Alphabetically)	Dr. Ayushi Singh Sengar			

COURSE OUTCOMES		COGNITIVE LEVELS
After pursuing the above mentioned course, the students will be able to:		
C401-22.1	Recall the concepts of univariate descriptive statistics and distributions.	Remembering Level (C1)
C401-22.2	Explain the concepts of time series, control charts, Hypothesis testing and multivariate statistics.	Understanding Level (C2)
C401-22.3	Make use of Correlation, Regression and Hypothesis testing in multivariate data.	Applying Level (C3)
C401-22.4	Analyze data using Regression and ANOVA techniques.	Analyzing Level (C4)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
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 with Known and unknown (Hotelling T2 statistic) of a multivariate normal population, one way and two-way analysis of variance	12

		(ANOVA) (populations with equal variance), Wilk's test statistic.	
		Total number of Lectures	42

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorial, PBL)
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**.**
8.	**Seldom M. Ross,** Introduction to Probability and Statistics for Engineers and Scientists, Third Edition, Elsevier.

CO-PO and CO-PSO mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1 (ECE)	PSO1 (CSE)	PSO1 (IT)	PSO2
C401-22.1	2	2	1									2				
C401-22.2	2	2	2									2	1			
C401-22.3	3	3	3									2				
C401-22.4	3	3	3						1			2		1	1	
Avg.	2.5	2.5	2.25						1			2	1	1	1	

Subject Code	19B12CS427	Semester ODD 2023	Semester VII Session 2023–24 Month from July '23 to Dec '23
Subject Name	Introduction to DevOps		
Credits	3	**Contact Hours**	3L

Faculty (Names)	**Coordinator(s)**	Dr. Amarjeet Prajapati(J62), Dr.Pulkit Mehndiratta(J128)
	Teacher(s)	1. Dr. Amarjeet Prajapati 2. Dr. Pulkit Mehndiratta 3. Ms. Aupama Pada
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 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