

Code: CA-401		Paper: Research Methodology & IPR	
Contacts Hours/Week: 2		Total Contact Hours: 20	
Credit: 2			
Course Objectives:			
The course aims to:			
1	Introduce students to the fundamentals of research methodology, including problem formulation and research design.		
2	Equip students with knowledge of data collection, analysis, and interpretation for effective research.		
3	Familiarize students with Intellectual Property Rights (IPR) and its importance in research and innovation.		
4	Enable students to apply ethical principles in research and understand patent filing and copyright laws.		
Course Outcomes (COs):			
Upon successful completion of this course, students will be able to:			
1	Identify and define research problems and formulate research objectives.		
2	Conduct literature reviews and choose appropriate research methodologies.		
3	Analyze data using qualitative and quantitative techniques.		
4	Understand the significance of IPR, patents, copyrights, and trademarks in research.		
Module	COURSECONTENT		
1	Introduction to Research Methodology (4 Hours) <ul style="list-style-type: none"> • Meaning, Objectives, and Importance of Research • Types of Research (Fundamental, Applied, Descriptive, Analytical, and Empirical) • Research Process and Problem Formulation • Defining Research Objectives and Hypothesis Formation 		
2	Research Design and Data Collection (4 Hours) <ul style="list-style-type: none"> • Research Design: Exploratory, Descriptive, and Experimental Research • Data Collection Methods: Primary and Secondary Data • Sampling Techniques and Sample Size Determination • Literature Review: Importance and Techniques 		
3	Data Analysis and Interpretation (4 Hours) <ul style="list-style-type: none"> • Introduction to Data Analysis Techniques (Qualitative & Quantitative) • Statistical Tools for Research (Mean, Median, Mode, Regression, Correlation) • Data Visualization Techniques (Graphs, Charts, and Tables) • Research Ethics and Plagiarism 		
4	Intellectual Property Rights (IPR) (4 Hours) <ul style="list-style-type: none"> • Introduction to IPR and its Importance in Research • Types of Intellectual Property: Patents, Copyrights, Trademarks, and Trade Secrets • Patent Filing Process and Copyright Laws • Case Studies on Intellectual Property and Technology Patents 		
5	Research Report Writing and Publication (4 Hours) <ul style="list-style-type: none"> • Research Paper Writing: Structure, Referencing, and Citation Styles • Journal Selection and Impact Factor • Conference Paper Writing and Presentation Skills • Research Funding and Grant Proposal Writing 		
Reference Books:			
1.			

Code: CA-402		Paper: Deep Learning and Neural Network										Credit: 3			
Contacts Hours/Week: 3		Total Contact Hours: 30													
Course Objectives:															
This course enables the students to:															
1	Understand the core concepts of Deep Learning and Neural Networks.														
2	Learn to design, train, and optimize neural networks using Python and Tensor-Flow/Py-Torch.														
3	Explore various deep learning architectures and their applications.														
4	Gain hands-on experience through practical projects.														
Course Outcome:															
After the completion of this course, students will be able to:															
CO1	Explain the core concepts of deep learning, including neural networks, activation functions, and back-propagation.														
CO2	Implement and optimize deep learning models using Tensor-Flow and Py-Torch, applying techniques such as regularization, dropout, and hyper-parameter tuning.														
CO3	Utilize Convolutional Neural Networks (CNNs) for image processing, Recurrent Neural Networks (RNNs) for sequential data, and advanced models like GANs and Transformers.														
CO4	Design and develop a deep learning project in areas such as image recognition, natural language processing, or healthcare, demonstrating problem-solving and model evaluation skills.														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
CA-E 402H															
Module	COURSECONTENT														
1	Introduction to Deep Learning & Neural Networks(6L) <ul style="list-style-type: none"> • Introduction to Artificial Intelligence, Machine Learning, and Deep Learning • Basics of Neural Networks – Perceptron, Activation Functions • Forward and Back propagation – How Neural Networks Learn 														
2	Training Deep Neural Networks(6L) <ul style="list-style-type: none"> • Loss Functions and Optimization Algorithms (Gradient Descent, Adam, etc.) • Hyper-parameter Tuning – Learning Rate, Batch Size, Regularization • Over-fitting & Under-fitting – Dropout, Batch Normalization 														
3	Deep Learning Architectures(12L) <ul style="list-style-type: none"> • Convolutional Neural Networks (CNN) – Basics & Applications in Image Processing • Recurrent Neural Networks (RNN) – Sequence Data, Time-Series Forecasting • Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU) 														
4	Advanced Topics in Deep Learning(6L) <ul style="list-style-type: none"> • Generative Adversarial Networks (GANs) – Basics & Applications • Transfer Learning – Using Pre-trained Models (VGG, ResNet, BERT) • Deep Learning for Natural Language Processing (NLP) – Word Embeddings, Transformers 														
Reference Books:															
1. Good fellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning															
2. Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow															
3. Chollet, F. (2021). Deep Learning with Python															

Code: CA-403		Paper: Compiler Design										Credit:3			
Contacts Hours/Week:3		Total Contact Hours:30													
Course Objectives:															
This course enables the students to:															
1	Understand the fundamental concepts of compilers, including lexical analysis, syntax analysis, and code generation.														
2	Analyze different parsing techniques, including top-down and bottom-up parsing, to construct syntax analyzers.														
3	Apply finite automata concepts for lexical analysis and token specification.														
4	Evaluate the efficiency of different intermediate code generation and optimization techniques.														
5	Design a simple compiler using compiler construction tools.														
Course Outcome:															
After the completion of this course, students will be able to:															
CO1	Explain the phases of compilation and the role of compilers in program translation.													(L2)	
CO2	Construct lexical analyzers and syntax analyzers using formal grammars and automata theory.													(L3)	
CO3	Implement top-down and bottom-up parsing techniques for syntax analysis.													(L3)	
CO4	Analyze intermediate code generation and optimization techniques for efficient compilation.													(L4)	
CO5	Develop a small compiler or a compiler phase using tools like Lex and YACC.													(L5)	
CO-PO Mapping for CA-E402B (Compiler Design)															
COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	0	0	1	1	1	2	3	2	
CO2	3	3	3	3	3	1	0	0	1	1	2	2	3	3	
CO3	3	3	3	3	3	2	1	0	1	1	2	2	3	3	
CO4	2	2	3	3	3	1	1	0	1	2	2	2	3	3	
CO5	2	2	2	3	3	2	2	1	2	1	2	1	3	3	3
Module	COURSECONTENT														
1	Introduction to Compilation: (5L) Introduction to compilers, Compilers, translators, interpreters, byte-code compilers, Importance of compiler design techniques Cousins of compilers, Model of compilation, phases of compilation Passes, front end and back end Compiler construction tools														
2	Lexical Analysis: (5L) Role of lexical analyzer, Input buffering, Specification of tokens using regular expressions, Transition diagrams, Deterministic and Non-Deterministic finite automata, Lexical analyzer generators, lex														
3	Syntax Analysis and Top Down Parsing: (5L) Role of the parser, Context Free Grammars, BNF Derivation, parse trees, Eliminating ambiguity and left recursion, left factoring Recursive descent parsing, Predictive parsing, Construction of predictive parsing tables.														
4	Bottom Up Parsing: (5L) Rightmost and leftmost derivations, Handles and handle pruning Shift-reduce parsing, Operator precedence parsing, LR parsing, Construction of SLR parsing tables Construction of Canonical LR parsing tables Construction of LALR parsing tables, Parser generator tools, yacc														
5	Intermediate Code Generation And Other Topics: (5L) Syntax-directed translation, Symbol table management, Error handling, Intermediate code generation														
6	Synthesis: (5L) Code generation, Code optimization														
Reference Books:															
<ul style="list-style-type: none"> Aho A. V., Sethi R., Ullman J. D. : Compilers - Principles, Techniques and Tools, Addition-Wesley Publishing Company, 1988 Dhamdhare D. M. : Compiler Construction, MacMillan India Limited, 1997 Holub A. I. : Compiler Design in C, Prentice Hall of India Private Limited, 1993 Appel A. W. : Modern Compiler Implementation in C, Foundation Books, 2000 															

Code: CA-404	Paper: CLOUD COMPUTING	Credit: 3
Contacts Hours/Week: 3	Total Contact Hours: 30	

Course Objectives: This course enables the students to:	
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Course Outcome:
After the completion of this course, students will be able to:

CO1	Recall the basic principles of cloud computing, like various cloud models, service types, main features, benefits, and limitations of cloud computing.	[BL1]
CO2	Compare the differences between IaaS, PaaS, SaaS, and IDaaS.	[BL4]
CO3	Implement different concepts related to abstraction and virtualization.	[BL3]
CO4	Evaluate the solution options provided by top companies like Amazon and Google.	[BL5]
CO5	Assess various options for cloud storage, cloud safety, and data protection.	[BL5]

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1	1	2	3	1	1	3	3	2
CO2	2	3	2	2	2	1	1	1	2	2	1	1	3	3	2
CO3	2	2	3	3	3	2	2	1	2	3	1	1	3	2	1
CO4	3	3	2	3	2	2	1	1	3	2	1	1	2	3	1
CO5	3	2	3	2	3	3	1	2	2	2	1	1	3	3	2
CA-E-305B	3	3	3	3	3	2	1	1	2	2	1	1	3	3	2

Module	COURSECONTENT
1	Basics of Cloud Computing: Defining the concept of the cloud, exploring types of clouds like the NIST Cloud Reference Model and Cloud Cube Model, understanding deployment types such as Public, Private, Hybrid, and Community Clouds. Reviewing service models like Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Container as a Service (CaaS). Discussing the features, advantages, and challenges of cloud computing.
2	Cloud Services and/or Applications: IaaS: Core concepts, characteristics, Virtual Machine Instances and Images, examples of IaaS solutions. PaaS: Core concepts, characteristics, tools, and development environments with examples. SaaS: Basic concepts, characteristics, Open SaaS and SOA, examples of SaaS solutions. IDaaS (Identity as a Service): Overview and key features. CaaS (Container as a Service): Introduction and applications.
3	Cloud Solution Offerings: Concepts of Abstraction and Virtualization; Virtualization: Taxonomy of Virtualization Techniques; Hypervisors: Machine Reference Model for Virtualization. Solution Offerings from Industry Leaders; Amazon: some AWS Components and Services – Compute (EC2), Storage [Simple Storage Service (S3), Elastic Block Store (EBS), Simple Queue Service (SQS)], Database (Relational, NoSQL, Simple DB), Content Distribution (CloudFront), Deployment (Elastic Beanstalk) Google: quick look at Google Applications Portfolio – AdWords, Analytics, overview of GWT, a few Google APIs, some key services of GAE. Azure
4	Cloud Storage and Security: Cloud-based Storage: Block Devices and File Devices, Managed Storage and Unmanaged Storage, File Systems – GFS and HDFS. Cloud Security: Security Concerns, Security Boundary, Security Service Boundary, Security Mapping Overview, Data Security – Storage Access, Storage Location, Tenancy, Encryption, Auditing, Compliance, Identity Management (awareness of Identity Protocol Standards).

Text Books:

- Mastering Cloud Computing - Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill.

Reference Books:

1. Cloud Computing Bible - Barrie Sosinsky, Wiley India Pvt. Ltd.
2. Introduction to Cloud Computing Architecture: White Paper, Sun Microsystems Inc.

Code: CA-405		Paper: Data Warehousing and Data Mining											Credit: 3		
Contacts Hours/Week: 3		Total Contact Hours: 30													
Course Objectives:															
After successful completion of this course, students will be able to:															
1	Understand the fundamental concepts of Data Warehousing, its architecture and its components, ETL processes.														
2	Understand the importance of OLAP, OLTP, and their integration in modern business intelligence systems.														
3	Learn about various Data Mining techniques, including classification, clustering, association, and regression.														
4	Gain knowledge of various Data Mining tools and techniques for data exploration and pattern extraction.														
5	Understand the fundamentals of Web Mining and its different types.														
Course Outcome:															
After the completion of this course, students will be able to:															
CO1	Understand the Fundamental Concepts of Data Warehousing [BL-2]														
CO2	2 Understand and Apply OLAP (Online Analytical Processing) Concepts [BL-2]														
CO3	3 Gain Proficiency in Data Mining Techniques [BL-3]														
CO4	4 Apply Data Mining Techniques to Real-World Problems [BL-6]														
CO5	5 Explore Web Structure Mining for Website Analysis														
CO-PO Mapping for CA-E402E (Advanced DBMS)															
COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	1	1	2	3	1	1	3	3	2
CO2	2	3	2	2	3	3	1	1	2	2	1	1	3	3	2
CO3	2	2	3	2	3	3	2	1	2	3	1	1	3	2	1
CO4	2	3	3	3	2	2	1	1	2	2	1	1	2	3	1
CO5	3	2	2	3	2	2	1	2	2	2	1	1	3	3	2
CA-E-402D	2.4	2.4	2.4	2.6	2.4	2.4	1.2	1.2	2	2.4	1	1	2.8	2.8	1.6
Module	COURSE CONTENT														
1	Introduction to Data Warehousing: The need for data warehousing, Data warehouse definition, evaluation and purpose, Business intelligence and Data Warehousing, Data warehouse architecture, Data warehouse database, Metadata, Access tools, Data marts, Three-tier Architecture and its Benefits, Data Warehouse vs. Operational Database Systems, ETL process.														(6L)
2	Online analytical processing (OLAP): Need for OLAP, Characteristics of OLAP Systems, OLAP Operations: Roll-up, Drilldown, Slice and Dice, Pivot, Types of OLAP: MOLAP, ROLAP, HOLAP Data Modeling Techniques: Star Schema, Snowflake Schema, Fact and Dimension Tables, OLTP vs. OLAP: Differences and Use Cases														(5L)
3	Introduction to data mining: Overview of Data Mining: Definition, Types, Applications and Process of Data Mining, Data Preprocessing: Cleaning, Integration, Transformation, and Reduction, Data Mining Techniques Overview: Classification, Clustering, Association and Regression														(3L)
4	Classification and Regression: Classification: Concept and Techniques: Decision Trees, k-NN and Naive Bayes, Evaluation Metrics: Accuracy, Precision, Recall, F1-Score Regression: Linear Regression, Logistic Regression, Evaluation: Mean Squared Error and R Squared														(7L)

5	Clustering and Association Rules: Clustering: Types of Clustering: K-means, Hierarchical Clustering, Applications of Clustering Association Rule Mining: Apriori Algorithm, FP-growth, Evaluation Metrics: Support, Confidence, Lift Applications of Clustering and Association Mining	(5L)
6	Web Mining: (4L) Web Mining, Web content mining, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	(4L)
<p>Reference Books:</p> <ul style="list-style-type: none"> • Data warehousing, Data mining and OLAP by Alex Berson & amp; Stephon J. Smith, Tata McGraw Hill. • Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India. • Principles and Implementation of Data Ware housing, Rajeev Parida Fire Wall Media, Lakshmi Publications. • Data Mining and Warehousing, Ikvinderpal Singh, Khanna Book Publishing 		

Code: CA-406		Paper: Advanced DBMS						Credit: 3				
Contacts Hours/Week: 3		Total Contact Hours: 30										
Course Objectives:												
This course enables the students to:												
1	Understand advanced SQL and PL/SQL concepts like recursion, triggers, and procedures.											
2	Apply normalization techniques to achieve higher normal forms in database design.											
3	Analyze indexing techniques and query optimization strategies for performance improvement.											
4	Evaluate distributed database concepts, including fragmentation, replication, and concurrency control.											
5	Explore emerging trends in database management											
Course Outcome:												
After the completion of this course, students will be able to:												
CO1	Explain recursive queries, triggers, procedures, and other PL/SQL concepts. (L2)											
CO2	Implement normalization techniques and functional dependency concepts in database design. (L3)											
CO3	Analyze indexing and query optimization methods for efficient database performance. (L4)											
CO4	Evaluate distributed database techniques for query processing and concurrency control. (L5)											
CO5	Demonstrate knowledge of advanced DBMS trends, including cloud and block chain databases. (L6)											
CO-PO Mapping for CA-E402E (Advanced DBMS)												
COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	0	0	1	1	1	2
CO2	3	3	3	3	3	2	0	0	1	1	2	2
CO3	3	3	3	3	3	2	1	0	1	1	2	2
CO4	2	2	3	3	3	2	2	0	1	2	2	2
CO5	2	2	2	3	3	2	2	1	2	1	2	1
Module	COURSECONTENT											
1	Advanced SQL & PL/SQL (7L) Recursive queries, Cursor, Trigger, Exception, Procedure, Function, Package.											
2	Database Design (5L) Multivalued dependencies, Join dependencies, theory of normalization-4NF, 5NF, 6NF, DKNF. Dependency Preservation and Minimal set of Functional Dependency.											
3	Indexing & Query Optimization (5L) B-Trees and B+ Trees, Hashing techniques, Query optimization strategies											
4	Distributed Databases (5L) Data Fragmentation, Replication, Allocation, Distributed Query Processing, Concurrency Control in Distributed Databases											
5	Backup & Recovery (4L) Database failures and recovery techniques, Log-based recovery, check-pointing, Encryption techniques, Privacy-preserving											
6	Emerging Trends in DBMS (4L) Cloud-based databases, Blockchain-based databases, In-memory databases.											
Reference Books:												
<ul style="list-style-type: none"> Silverchatz, Korth & Sudarshan-Data Base System Concepts, TMH. Elmasri, Navathe-Fundamentals of Database Systems, Pearson CJ date-An Introduction to Database, Addison-Wesley Publishing Company 												

Code: CA-407		Paper: Image Processing										Credit: 3			
Contacts Hours / Week: 3		Total Contact Hours: 30													
Course Objectives:															
This course enables the students to:															
1	Introduce the fundamentals of digital image processing.														
2	Study image enhancement techniques in the spatial and frequency domains.														
3	Explore image restoration and compression techniques.														
4	Introduce image segmentation and feature extraction methods.														
5	Study morphological image processing and its applications.														
6	Explore deep learning and machine learning techniques in image processing.														
Course Outcome:															
After the completion of this course, students will be able to:															
CO1	Explain the basic concepts, mathematical foundations, and applications of image processing.														[BL2]
CO2	Apply spatial and frequency domain enhancement techniques to improve image quality.														[BL3]
CO3	Implement image restoration and compression techniques for efficient storage and noise removal.														[BL3]
CO4	Develop segmentation and feature extraction algorithms for object detection and pattern recognition.														[BL4]
CO5	Apply morphological transformations for shape analysis and image processing applications.														[BL3]
CO6	Implement deep learning and machine learning models for image classification and recognition.														[BL5]
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										3	3	2	
CO2	3	3	2		3							2	3	3	
CO3	3	3	3	2	3							2	3	3	
CO4	3	3	3	3	3				2			2	3	3	
CO5	3	3	2	3	3				2			2	3	3	3
CO6	3	3	3	3	3				3		2	3	3	3	3
CA-E402F	3.00	2.83	2.17	1.83	2.50	0	0	0	1.17	0	0.33	2.33	3.00	2.83	1.00
Module	COURSE CONTENT														
1	Fundamentals of Digital Image Processing (5L) Introduction to Digital Image Processing, Applications of Image Processing, Digital Image Representation, Image Sampling and Quantization, Color Models (RGB, HSV, CMY, YCbCr)														
2	Image Enhancement in Spatial and Frequency Domains (5L) Point Processing: Contrast Stretching, Histogram Equalization, Spatial Filtering: Smoothing and Sharpening Filters, Fourier Transform and Frequency Domain Processing, Low-pass and High-pass Filtering.														
3	Image Restoration and Compression (5L) Image Degradation and Noise Models, Noise Removal Techniques: Mean, Median, Adaptive Filters, Image Compression Techniques: Lossless Compression: Huffman Coding, Run-Length Encoding, Lossy Compression: JPEG, MPEG, Wavelet-based Compression.														
4	Image Segmentation and Feature Extraction (5L) Edge Detection: Sobel, Prewitt, Canny Operators, Thresholding and Region-Based Segmentation, Watershed Algorithm, Feature Extraction: Shape Descriptors, Texture Analysis, PCA.														
5	Morphological Image Processing and Applications (4L) Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss Transform, Object Representation and Description, Case Studies: Medical Image Processing, Remote Sensing														
6	Deep Learning and Machine Learning for Image Processing (6L) Introduction to Convolutional Neural Networks (CNN), Transfer Learning for Image Classification, Object Detection: YOLO, Faster R-CNN, Image Segmentation using U-Net, AI-based Image Processing Applications.														

Reference Books:

- Digital Image Processing, 4th Edition, Rafael C. Gonzalez, Richard E. Woods, Pearson, 2018.
- Fundamentals of Digital Image Processing, Pearson, 1989.
- Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill, 2009.
- Digital Image Processing, 6th Edition, Bernd Jähne, Springer, 2005.
- Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2010.
- Deep Learning, Good fellow, Bengio, Courville, MIT Press, 2016.

Code: CA-408	Paper: Blockchain Technology and Its Applications	Credit: 3
Contacts Hours/Week: 3	Total Contact Hours: 30	

Course Objectives: This course enables the students to:	
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Course Outcome: After the completion of this course, students will be able to:	
CO1	Remember the basic cryptographic methods such as encryption, hashing, and digital signatures that are needed for Blockchain. [BL2]
CO2	Explain the blockchain network, mining process, shared agreement system, transactions, privacy, rewards, splits (forks), and the difference between private and public blockchains in a simple way. [BL1]
CO3	Understand the blockchain network, how mining works, shared agreement systems (distributed consensus), transactions, privacy, rewards, chain splits, and the difference between private and public blockchains. [BL2]
CO4	Learn how crypto currencies like Bit coin and Ethereum work, including their main principles and processes. [BL4]
CO5	Design blockchain-based applications for areas like the Internet of Things (IoT), e-governance, land registration, medical record management, domain name services, and more. [BL3]

CO-PO Mapping for CA-E402G															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1	1	2	3	1	1	3	3	2
CO2	2	3	2	2	2	1	1	1	2	2	1	1	3	3	2
CO3	2	2	3	3	3	2	2	1	2	3	1	1	3	2	1
CO4	3	3	2	3	2	2	1	1	3	2	1	1	2	3	1
CO5	3	2	3	2	3	3	1	2	2	2	1	1	3	3	2
CA-E-305B	3	3	3	3	3	2	1	1	2	2	1	1	3	3	2

Module	COURSE CONTENT														
1	Blockchain Security with Cryptography: Hashing, Signature Schemes, Encryption Schemes and Elliptic Curve Cryptography. Foundations of Blockchain: Introduction, Advantage over Conventional Distributed Database, Blockchain Network, Mining Mechanism, Distributed Consensus, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain Application, Soft & Hard Fork, Private and Public Blockchain.														10L]

2	Block chain Consensus Protocols: The Consensus Problem, Asynchronous Byzantine Agreement, AAP protocol and its Analysis, Nakamoto Consensus on Permission less, Nameless, Peer-to-Peer Network, Abstract Models for Blockchain, Garay Model, RLA Model, Proof of Work (PoW) as Random Oracle, Formal Treatment of Consistency, Liveness and Fairness, Proof of Stake (PoS) based Chains, Hybrid Models (PoW + PoS).	10L]
3	Crypto currency: Bitcoin - Wallet, Blocks, Merkle Tree, Hardness of Mining, Transaction Verifiability, Anonymity, Forks, Double Spending, Mathematical Analysis of Properties of Bitcoin. Ethereum - Ethereum Virtual Machine (EVM), Wallets for Ethereum, Solidity, Smart Contracts, Some Attacks on Smart Contracts.	10L]
4	Crypto currency Regulation: Domain Specific Applications of IoT: Home Automation, Smart City Applications, Environment Applications, Healthcare Applications. Web of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence.	10L]
<p>Text Books:</p> <ul style="list-style-type: none"> Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks - Imran Bashir, Packt Publishing Ltd. <p>Reference Books:</p> <ul style="list-style-type: none"> Blockchain Technology Explained: The Ultimate Beginner's Guide about Blockchain Wallet, Mining, Bi Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA and Smart Contracts - Alan T. Norman, CreateSpace Independent Publishing Platform. Mastering Bitcoin: Unlocking Digital Cryptocurrencies - Antonopoulos, O'Reilly. 		

Code: CA-409		Paper: Distributed Systems											Credit: 3		
Contacts Hours / Week: 3		Total Contact Hours: 30													
Course Objectives:															
This course enables the students to:															
1	Apply knowledge of distributed systems techniques and methodologies.														
2	Explain the design and development of distributed systems and distributed systems applications.														
3	Use the application of fundamental Computer Science methods and algorithms in the development of distributed systems and distributed systems applications.														
4	Discuss the design and testing of a large software system, and to be able to communicate that design to others.														
Course Outcome:															
After the completion of this course, students will be able to:															
CO1	Understand the design principles in distributed systems and the architectures for distributed systems.														[BL3]
CO2	Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, voting etc.														[BL4]
CO3	Analyze fault tolerance and recovery in distributed systems and algorithms for the same.														[BL4]
CO4	Analyze the design and functioning of existing distributed systems and file systems.														[BL4]
CO5	Implement different distributed algorithms over current distributed platforms														[BL5]
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		2	2									2	3	3
CO2	2		2	2									2	3	3
CO3	2		2	2									2	3	3
CO4	3	3	3	3									2	3	3
CO5	3		3	2	3								2	3	3
CA-E 402H	2.40	.60	2.40	2.20	.60	0	0	0	0	0	0	0	2.00	3.0	3.0
Module	COURSE CONTENT														
1	Basic Concepts (5L) Definition of a distributed systems, Examples, Resource sharing and the Web, Challenges, System models, Architectural and fundamental models, Networking Inter process communication, External data representation and marshaling, Client-server and Group communication.														
2	Communication in Distributed System (7L) System Model – Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction – Request-reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches -Distributed objects – Case study: Enterprise Java Beans -from objects to components														
3	Peer to Peer Services and File System (6L) Peer-to-peer Systems – Introduction – Napster and its legacy – Peer-to-peer – Middleware – Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction – File service architecture – Andrew File system. File System: Features-File model -File accessing models – File sharing semantics Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.														
4	Synchronization and Replication (7L) Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Global states – Coordination and Agreement – Introduction – Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda.														

5	Process & Resource Management (5L) Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach.
Reference Books: <ul style="list-style-type: none">• George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.• Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.• Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.• Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.• Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003.	

Code: CA-410		Paper: Remote Sensing and GIS											Credit: 3		
Contacts Hours/Week: 3		Total Contact Hours: 30													
Course Objectives:															
This course enables the students to:															
1		Understand basic concepts of Remote Sensing and GIS.													
2		Learn about different types of sensors and satellite imagery.													
3		Gain hands-on experience with GIS software.													
4		Apply GIS and Remote Sensing in real-world scenarios.													
Course Outcome:															
After the completion of this course, students will be able to:															
CO1		Demonstrate a clear understanding of the principles of Remote Sensing (RS) and Geographic Information Systems (GIS), including data acquisition, processing, and analysis.													
CO2		Apply remote sensing techniques to interpret satellite imagery and extract meaningful spatial information for various applications.													
CO3		Perform spatial analysis using GIS tools, including map creation, geo-referencing and spatial data manipulation for decision-making.													
CO4		Develop and present a GIS-based project addressing real-world problems in areas such as environmental management, urban planning, agriculture, and disaster management.													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															
CA-E 402H															
Module	COURSECONTENT														
1	Introduction to Remote Sensing and GIS(6L) <ul style="list-style-type: none"> • Overview of Remote Sensing (RS) & GIS, history, and applications • Basic concepts: Electromagnetic spectrum, energy interactions, and satellite orbits • Types of remote sensing (active vs. passive), resolution (spatial, spectral, temporal, radiometric) 														
2	Data Acquisition and Image Interpretation(8L) <ul style="list-style-type: none"> • Remote sensing platforms & sensors (Landsat, Sentinel, MODIS, etc.) • Aerial photography and satellite image interpretation techniques • Pre-processing of remote sensing data (georeferencing, radiometric & atmospheric corrections) 														
3	Introduction to GIS and Spatial Data(10L) <ul style="list-style-type: none"> • Basics of GIS: Data models (vector & raster), spatial data sources • Coordinate systems, map projections, and georeferencing • Data input, storage, and manipulation in GIS 														
4	GIS Analysis and Remote Sensing Applications(6L) <ul style="list-style-type: none"> • Spatial analysis techniques (buffering, overlay, interpolation) • Image classification techniques (supervised & unsupervised) • Land use/land cover mapping using remote sensing data 														

Reference Books:

1. Jensen, J. R. (2016). Remote Sensing of the Environment: An Earth Resource Perspective
2. Lillesand, T., Kiefer, R. W., & Chipman, J. (2015). Remote Sensing and Image Interpretation
3. Chang, K. (2016). Introduction to Geographic Information Systems