



(An Autonomous College under VTU)
Department of CSE (Data Science)

VII Semester
Scheme and Syllabus
With effect from Academic Year 2023-24

Vision

To prepare the next generation practitioners and researcher for data centric world by bringing together interdisciplinary faculty across the globe.

Mission

M1: To provide Skill Based Education to master the students in problem solving and analytical skills to enhance their niche expertise in the field Data Science

M2: To educate the students with latest technologies to update their knowledge in the field of Data Science

M3: To enable students to experience the Content Based Learning with premier quality data science education, research and industrial collaboration

M4: To enable students to become leaders in the Industry and Academia Nationally as well as internationally

M5: To guide students in research on Data Science, with the aim of having an ethical impact on society by tackling societal grand challenges

PROGRAM OUTCOMES (POs): Graduates of the Computer Science and Engineering – Data Science Program will be able to achieve the following

POs:

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and Computer Science and Engineering principles to the solution of complex problems in Computer Science and Engineering.

PO2: Problem Analysis: Identify, formulate, research literature, and analyses complex Computer Science and Engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex Computer Science and Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of Complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions related to Computer Science and Engineering problems.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex

Computer Science and Engineering activities with an understanding of the limitations.
PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Computer Science and Engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional Computer Science and Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Computer Science and Engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex Computer Science and Engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage Computer Science and Engineering projects and in multidisciplinary environments.

PO12: Life Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO)

PSO1: Ability to analyse complex computing issues and apply the principles to achieve related solution.

PSO2: Ability to design, implement and evaluate computing based solutions to meet range of computing requirements based in the data science.

PSO3: Ability to effectively communicate within diverse work group related to professional framework.

Program Educational Objectives (PEOs)

PEO 1: To make students competent for higher studies and employable, to meet industrial requirements.

PEO 2: To develop students having core competence in science, mathematics and fundamentals of Data Science to address ever changing industrial requirements globally.

PEO 3: To create academically conducive environment to learn engineering skills in the domains such as Data Analytics, Data Modelling, Data Visualization and Allied Technologies.

PEO 4: To enrich students with professional ethics, leadership qualities, and entrepreneurial skills.

PEO 5: An ability to engage in lifelong learning for effective adaptation to technological developments.

Seventh Semester B.E. CSE (Data Science) – Scheme

SL. No	Course Code	Course Name	Total Credits	L: T: P: S (Hrs./Week)	Online	Offline	Marks
1	20CDI71	Deep Learning (IC)	4	3 : 0 : 2 : 0	-	100%	100
2	20CDI72	Cryptography & Network Security (IC)	4	3 : 0 : 2 : 0	-	100%	100
3	20CDT73X	Professional Electives 4	3	3 : 0 : 0 : 0	-	100%	100
4	20CDT74X	Professional Electives 5	3	3 : 0 : 0 : 0	-	100%	100
5	20CDT75X	Industrial Elective 1	3	3 : 0 : 0 : 0	-	100%	100
6	20CDP76	Project Phase I	3	0 : 0 : 6 : 0	-	100%	100
		Total	20	15 : 0 : 10 : 0			600

Note: Internship has to be completed compulsorily before VIII Semester

Professional Elective 4

SL. No	Course Code	Course Name
1	20CDT731	Intelligence DBMS
2	20CDT732	Business Intelligence
3	20CDT733	Human Computer Interaction

Professional Elective 5

SL. No	Course Code	Course Name
1	20CDT741	Data Modulation & Simulation
2	20CDT742	Natural Language Processing
3	20CDT743	Virtual Reality & Augmented Reality

Industrial Elective 1

SL. No	Course Code	Course Name
1	20CDT751	Ethical Hacking
2	20CDT752	Advanced Cloud Computing
3	20CDT753	Precision Agriculture (AI, IoT and ML)

DEEP LEARNING (IC)					
Course Code	L : T : P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDI71	3:0:2:0	4	CIE:50 SEE:50	3hrs	IC
Prerequisites: Data Mining, Data warehouse, Database, Big data, Cloud computing, Testing.					
Course Objectives: In this course, students will learn the fundamentals of deep learning, and the main research activities in this field. Moreover, students will learn to implement, train, and validate their own neural network, and they will improve their understanding of the on-going research in computer vision and multimedia field.					
Syllabus					
Module – I					
Machine Learning: Machine Learning - Examples of machine learning applications - Types of machine learning –Supervised Learning: Classification - Decision Trees, Neural Networks. Unsupervised Learning: Clustering- Clustering Methods-Graph Clustering. 08 Hours					
Module – II					
Fundamentals of Neural Networks: Basics of Neural Networks- Neural Network Representation- History and cognitive basis of neural computation- Perception's- Perceptron Learning Algorithm- Multilayer Perceptron's (MLPs)- Representation Power of MLPs- Back Propagation. 08 Hours					
Module – III					
Deep Learning Fundamentals and Strategies: Introduction to deep Learning-History of Deep Learning- Perspectives and issues in deep learning – Deep Neural Networks - Unsupervised deep learning - Deep reinforcement learning - Deep learning strategies. 08 Hours					
Module – IV					
CNN and RNN: Foundations on CNN, Convolutional Neural Networks (CNNs): LeNet, AlexNet, ZF- Net, VGGNet, GoogLeNet, ResNet—Recurrent Neural Networks- Optimization in deep learning: Gradient Descent(GD)-Momentum Based GD. 08 Hours					
Module – V					
Deep Learning Tools: CUDA Tool Kit: Introduction, Programming Model, Programming interface, PerformanceGuidelines- NVIDIA- NVIDIA Architecture- Case Study: Tensor Flow, Caffe, Theano, Torch. 08 Hours					
Textbooks					
<ol style="list-style-type: none"> 1. Goodfellow, I., Bengio, Y., and Courville, A., ,Deep Learning', MIT Press,2016.. 2. EthemAlpaydin, ,Introduction to Machine Learning', MIT Press,2014. 3. Li Deng and Ding Yu, ,Deep Learning Methods and Applications', Now Publishers,2014. 					
Reference Books					
<ol style="list-style-type: none"> 1. Tom M Mitchell, ,Machine Learning' , First Edition, McGraw Hill Education, 2013 2. Yegnanarayana, B,Artificial Neural Networks', PHI Learning Pvt. Ltd,2009. 3. Satish Kumar, ,Neural Networks: A Classroom Approach', Tata McGraw-Hill Education,2004. 4. Christopher Bishop, ,Pattern Recognition and Machine Learning' 2e,Springer, 2006. 					
Course Outcomes:					
Students undergoing this course are able to:					
CO1. Discuss the concepts of machine learning algorithms.					
CO2. Understand the fundamentals of neural networks.					
CO3. Explain the different Strategies and Perspectives of Deep learning fundamentals.					
CO4. Illustrate the concepts of CNN and RNN models.					
CO5. Apply the knowledge in deep learning tools.					

Course Objectives

1. Implement the various deep learning algorithms in Python.
2. Learn to work with different deep learning frameworks like Keras, Tensor flow, PyTorch, Caffe etc.

List of Exercises / Experiments

1. Demonstrate and implement decision tree algorithm.
2. Demonstrate and implement K-means clustering algorithm.
3. Build an algorithm to demonstrate and implement back propagation neural network.
4. Build an algorithm to demonstrate and implement feed forward networks.
5. Implementation of Multi-layer neural network on example dataset.
6. Implementation of Convolutional neural network on example dataset.
7. Implementation of RNN model on example dataset.
8. Implementation of LSTM on example dataset.
9. Demonstrate the use of VGG Net for object recognition.
10. Demonstration of CUDA tool kit using Google colab.

References

Francois Chollet, —Deep learning with Python— – Manning Publications.

CRYPTOGRAPHY & NETWORK SECURITY (IC)					
Course Code	L : T : P : S	Credits	Exam Marks	Exam Duration	Course Type
20CDI72	3 : 0 : 2 : 0	4	CIE:50 SEE:50	3 Hours	IC
Prerequisites: Students should have the knowledge of Computer Networks, Mathematics and Algorithm Concepts.					
Course Objectives: As a student will be able to learn: <ul style="list-style-type: none"> Acquire the knowledge of basic concepts of cryptography and network security and classify attacks on a network. Understand and analyze the different process for hiding the information with conventional cryptographic algorithms. Comprehend various block cipher cryptosystems. Learn the concepts of public cryptosystems and key management Systems. Understand and apply authentication techniques to provide secure communication. 					
Syllabus					
Module – I					
Introduction: Service and mechanisms-security services , Security Mechanism, The OSI security architecture, A Model for Network Security.					
Symmetric Ciphers: Symmetric cipher model, substitution techniques.					08 Hours
Module – II					
Symmetric Ciphers: Transposition techniques, Steganography Block Ciphers and DES: Simplified DES. Block cipher principles, DES, Strength of DES, Block cipher design principles.					
					08 Hours
Module – III					
Advanced Encryption Standard - AES Encryption process. AES Transformation Function: Cipher-Substitute Bytes, Transformation, Shift Row Transformation, Mix Column Transformation, Add Round Key Transformation, AES key expansion.					
					08 Hours
Module – IV					
Asymmetric Ciphers - Public key cryptography and RSA: Principles of public key cryptosystems, RSA algorithm. Other public key cryptosystems and key management: Daffier-Hellman key exchange, Elgamal cryptographic system.					
					08 Hours
Module – V					
Network and Internet Security- Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Protocol. Electronic Mail Security: Internet Mail Architecture, PGP.					
					08 Hours
Course Outcomes: At the end of this course, students will be able to CO1: Describe the basic concepts of cryptography and network security and classify attacks on a network, symmetric ciphers and substitution techniques. CO2: Apply and integrate the different process for hiding the information with conventional cryptographic algorithms, transposition techniques and block ciphers. CO3: Illustrate the various block cipher cryptosystems like DES and AES. CO4: Analyze public cryptosystems and key management systems CO5: Demonstrate and analyze authentication techniques to provide secure communication.					
Textbooks: <ul style="list-style-type: none"> Cryptography and Network Security: William Stallings, Pearson Education, 2003 Behrouz A Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 2nd Edition, Special Indian edition, Tata McGraw-Hill, 2011. 					

Reference Books:

- Cryptography and Network Security, AtulKahate, TMH, 2003

Reference Online Resources:

- <https://nptel.ac.in/course.php>

List of Experiments**1. Caesar Cipher:**

Implement a simple Caesar cipher encryption and decryption algorithm..

2. Public Key Cryptography:

Introduce RSA encryption and decryption.

Generate public and private keys and encrypt/decrypt messages.

3. Establish a shared secret between two parties that can be used for secret communication to exchange data over a public network using **Diffie-Hellman algorithm.**

4. Implement Simplified DES - Key Generation Simulation Program using C Programming

5. Implement Hill Cipher program using c

6. Secure Email

Configure email clients for encrypted communication using PGP/GPG.

Exchange encrypted emails.

INTELLIGENCE DBMS					
Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDT731	3:0:0:0	3	CIE:50 SEE:50	3 hours	PE4
Prerequisites: Database Management System					
Course Objective Upon completion of this course, the student will be able to: Grasp the basic concepts of knowledge and expert systems. Illustrate information retrieval and multidimensional indexing. Acquire the elements of data mining and knowledge discovery in databases.					
Syllabus					
Module – I					
Introduction to IDBS Informal definition of the domain - General characteristics of IDBSs - Data models and the relational data model –A taxonomy of intelligent database systems - Guidelines for using intelligent database systems. 08 Hours					
Module – II					
Semantic Data Models Nested and semantic data models – Introduction - The nested relational model - Semantic models - Hyper-semantic data models - Object-oriented approaches to semantic data modeling – Object oriented database systems - Basic concepts of a core object-oriented data model - Comparison with other data models - Query languages and query processing - Operational aspects – Systems - The ODMG standard - The object-relational data model - Java and databases – Conclusions - Active database systems - Basic concepts – Issues – Architectures - Research relational prototypes—the Starburst Rule System - Commercial relational approaches. 08 Hours					
Module – III					
Knowledge-Based Systems- AI Context Characteristics and classification of the knowledge-based systems – Introduction - The resolution principle - Inference by inheritance – Conclusion - Deductive database systems - Basic concepts - DATALOG language - Deductive database systems and logic programming systems—differences - Architectural approaches - Research prototypes - Updates in deductive databases - Integration of deductive database and object database technologies - Constraint databases - Conclusions. 08 Hours					
Module – IV					
Advanced Knowledge-Based Systems Introduction - Architectural solutions - The 'general bridge' solution - Extending a KBS with components proper to a DBMS - The 'tight coupling' approach – Conclusion - Advanced solutions: Introduction - A 'knowledge level' approach to the interaction with an IAS- TELOS - a language for implementing very large 'integral approach' systems- The CYC project - Other projects based on a 'conceptual representation' approach - Lexical approaches to the construction of large KBs. 08 Hours					
Module – V					
Applications in IDBS Introduction - Temporal databases - Basic concepts - Temporal data models - Temporal query languages – Ontologies -Ontology theoretical foundations - Environments for building ontologies - Structured, semi-structured and unstructured data - Multimedia database - Semi-structured data - Mediators – Motivation – Architecture - Application of mediators to heterogeneous systems – Proposals - Multi- Agents systems - Main issues in designing a multi-agent system - Open problems. Internet indexing and retrieval - Basic indexing methods - Search engines or meta-searchers - Internet spiders - Data mining - Data mining tasks - Data mining tools - Medical and legal information systems - Medical information systems - Legal information systems – Conclusions. 08 Hours					

COURSE OUTCOMES

Upon completion of this course, the students will be able to,

- Understand the concepts of Intelligent database.
- Make study of the Database installation then create the database with user and apply SQL.
- Understand the concepts of knowledge-based systems and apply with AI
- Design and create the small applications
- Analyze and Implement for various real-time applications in Intelligent Database System

TEXT BOOKS

- Elisa Bertino, Barbara Catania, Gian Piero Zarri, -Intelligent Database Systems, Collection ACM Press.

REFERENCE BOOKS

- Ngoc Thanh Nguyen, Radoslaw Katarzyniak, and Shyi-Ming Chen (Eds.), "Advances in Intelligent Information and Database Systems ", Springer, 2010.

E BOOKS

<https://www.eyrolles.com/Informatique/Livre/intelligent-database-systems-9780201877366/>

MOOC

<https://www.coursera.org/learn/database-management>

BUSINESS INTELLIGENCE					
Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDT732	3:0:0:0	3	CIE:50 SEE:50	3 hours	PE4
Prerequisite: Excel, Database, charts and visualization					
Course Objectives:					
The Course Objectives are to:					
<ul style="list-style-type: none"> • Introduce a managerial perspective of Business Intelligence (BI), and Analytics and Decision Support. • Provide introduction to three levels of analytics: descriptive, predictive and prescriptive, • Provide exposure to analytics techniques and their applications, • Introduce to specific software tools that can be used for developing applications, and • Provide introduction to emerging technologies that are likely to impact on the development and use BI applications. 					
Module – I					
An Overview of Business intelligence, Analytics and Decision Support: Changing Business Environments and Computerized Decision Support; Framework for Business intelligence (BI); Intelligence Creation, Use, and BI Governance; Transaction Processing versus Analytic Processing; Successful BI Implementation; Analytics Overview; and Introduction to Big Data Analytics.					
Text book 2: chapter 1					08 Hours
Module – II					
Data Warehousing: Data Ware Housing(DW) Definitions and Concepts: What is data warehouse, characteristics, types of data warehouse; DW Process Overview, DW Architectures; Data Integration, and the Extraction, Transformation and Load (ETL) Processes;					
Business Reporting, Visual Analytics, and Business Performance Management: Business reporting definitions and concepts: what is business report, Data and information visualization, Different types of charts and graphs.					
Text book 1: chapter 3 & 4					08 Hours
Module – III					
Data mining: Data Mining definitions, characteristics and benefits, data in data mining, how data mining works, Data mining Applications; DM Process, DM Methods: Classification, clusters for DM, Association rule data mining.					
Text book 2: chapter 4					08 Hours
Module – IV					
Text and Web Analytics: Text mining definition and concepts, Natural Language Processing; TM Applications, TM Process; Sentiment Analysis; web mining tools, Web Mining (WM) Overview; web content mining and web structure mining, Web Usage Mining (Web Analytics).					
Text book 2: chapter 5					08 Hours
Module – V					
Big Data Analytics: Definition of Big Data; Fundamentals of Big Data Analytics; Big Data Technologies; Data Scientist; Big Data and Warehousing; Big Data Vendors.					
Business Analytics (BA):Emerging trends and Future Impacts: Location-Based Analytics for Organizations; Analytics Applications for Consumers; Recommendation Engines; Cloud Computing BI					
Text book 1: chapter 13, 14					08 Hours
Textbooks:					
1. Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence and analytics: system for decision support, 10th Edition, Pearson.					
2. Ramesh Sharda, Dursun Delen, Efraim Turban, david king, Business Intelligence: A Managerial Approach, 2 nd edition, Prentice Hall publisher.					

Reference Books:

1. Jiawei Han and Michelinekambe, Jian Pei, ,Data Mining: Concepts and Techniques, 3rded. The Morgan Kaufmann Publishers.
2. Michael Steinbach, Pang-Ning Tan, and Vipin Kumar, ,Introduction To Data Mining', Pearson International Edition,2006.
3. James Allen,' Natural Language Understanding', 2nd Ed., The Benjamin/Cummings Publishing Company Inc.
4. Daniel Jurafsky, James.H.Martin,, Speech and Language Processing', 2nd Edition, Pearson Education Inc.

Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes
CO1	Outline of Business intelligence, Analytics and Decision Support
CO2	Summarize the concepts of warehousing and descriptive level of analytics as business
CO3	Explain the predictive level of analytics through data mining

HUMAN COMPUTER INTERACTION					
Course Code	L : T : P :S	Credits	Exam Marks	Exam Duration	Course Type
20CDT733	3 : 0 : 0 : 0	3	CIE:50 SEE:50	3Hours	PE4
Prerequisites: User Interface and graphics					
Course Objectives:					
<ul style="list-style-type: none"> • To learn the foundations of Human Computer Interaction. • To become familiar with the design technologies for individuals and persons with disabilities. • To be aware of mobile HCI. • To learn the guidelines for user interface. 					
Syllabus					
Module – I					
FOUNDATIONS OF HCI: The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. – Case Studies. 08 Hours					
Module – II					
DESIGN & SOFTWARE PROCESS: Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design. 08 Hours					
Module – III					
MODELS AND THEORIES: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. – Case Studies. 08 Hours					
Module – IV					
MOBILE HCI: Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. – Case Studies. 08 Hours					
Module – V					
WEB INTERFACE DESIGN: Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Case Studies. 08 Hours					
Course Outcomes:					
Upon completion of the course, the students should be able to:					
<ol style="list-style-type: none"> 1. Design effective dialog for HCI 2. Design effective HCI for individuals and persons with disabilities. 3. Assess the importance of user feedback. 4. Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites. 5. Develop meaningful user interface. 					
Textbooks:					
<ul style="list-style-type: none"> • Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, —Human Computer Interaction, 3rd Edition, Pearson Education, 2004 (UNIT I, II & III) • Brian Fling, —Mobile Design and Development, First Edition, O_Reilly Media Inc., 2009 (UNIT – IV) • Bill Scott and Theresa Neil, —Designing Web Interfaces, First Edition, O_Reilly, 2009. (UNIT-V) 					
Reference Books:					
<ul style="list-style-type: none"> • The essential guide to user interface design, Wilbert O Galitz, Wiley DreamaTech. • Designing the user interface. 3rd Edition Ben Shneidermann , Pearson Education Asia. 					

DATA MODULATION AND SIMULATION

Course Code	L : T : P	Credits	Exam Marks	Exam Duration	Course Type
20CDT741	3 : 0 : 0 : 0	3	CIE:50 SEE:50	3Hours	PE5

Prerequisites:

Basic knowledge of signals and systems, Probability and statistics, Digital signal processing fundamentals

Course Description:

This course explores the principles of data modulation and simulation techniques used in various communication systems. It covers the theoretical foundations and practical applications of data modulation, transmission, and simulation.

Course Objectives:

- Explain the basic system concept and definitions of system
- Discuss techniques to model and to simulate various systems

Syllabus

Module – I

Introduction to Communication Systems, Basic concepts of communication systems, Types of communication signals, Overview of modulation and demodulation, Analog Modulation Techniques: Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Modulation index and bandwidth calculations. **08 Hours**

Module – II

Digital Modulation Techniques, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) Pulse Position Modulation (PPM), Quadrature Amplitude Modulation (QAM), Phase Shift Keying (PSK) Frequency Shift Keying (FSK), Noise in Communication Systems. **08 Hours**

Module – III

Channel Coding and Error Correction, Introduction to error detection and correction codes Block codes (e.g., Hamming codes), Convolutional codes, Turbo codes and LDPC codes Forward Error Correction (FEC). **08 Hours**

Module – IV

Simulation of Communication Systems, Monte Carlo simulation techniques, MATLAB or other simulation tools, Advanced Topics: Spread Spectrum Modulation, OFDM (Orthogonal Frequency Division Multiplexing). **08 Hours**

Module – V

Software-Defined Radio (SDR), Cognitive Radio, Introduction to wireless communication Types (Satellite Communication, Infrared Communication, Broadcast Radio, Microwave Communication. Wi-Fi, Mobile Communication Systems, Bluetooth Technology). **08 Hours**

Text Book:

1. "Principles of Communication Systems" by Taub and Schilling
2. "Digital Communications" by John G. Proakis and Masoud Salehi
3. "Wireless Communications: Principles and Practice" by Theodore S. Rappaport

Reference Book:

1. "Communication Systems" by Simon Haykin
2. "Simulation of Communication Systems: Modeling, Methodology, and Techniques" by Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan
3. "Digital Modulation Techniques" by Fuqin Xiong

Course Outcomes (COs):

1. Explain the system concept and apply functional modeling method to model the activities of a static system
2. Describe the behavior of a dynamic system and create an analogous model for a dynamic system;
3. Illustrate the operation of a dynamic system and make improvement according to the simulation results.
4. Analyze a system and to make use of the information to improve the performance.
5. Apply the concepts of SDR and Cognitive radio and to understand types of wireless communication.

NATURAL LANGUAGE PROCESSING					
Course Code	L : T : P	Credits	Exam Marks	Exam Duration	Course Type
20CDT742	3 : 0 : 0 : 0	3	CIE:50 SEE:50	3Hours	PE5
<p>Course Learning Objectives: This course (20CDT742) will enable students to:</p> <p>CO1. Learn the leading trends and systems in natural language processing</p> <p>CO2. Student will be able to understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.</p> <p>CO3. Student will be able to understand the significance of pragmatics for natural language understanding</p> <p>CO4. Students will be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.</p>					
Syllabus					
Module – I					
<p>Overview and language modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages-NLP Applications. Language Modeling: Various Grammar-based Language Models-Statistical Language Model.</p> <p>Textbook 1: Ch. 1,2 RBT: L1, L2, L3</p> <p style="text-align: right;">08 Hours</p>					
Module – II					
<p>Word level and syntactic analysis: Morphological Parsing-Spelling Error Detection and correction- Words and Word classes-Part-of Speech Tagging.</p> <p>Textbook 1: Ch. 3,4 RBT: L1, L2, L3</p> <p style="text-align: right;">08 Hours</p>					
Module – III					
<p>Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation.</p> <p>Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.</p> <p>Textbook 2: Ch. 3,4,5 RBT: L1, L2, L3</p> <p style="text-align: right;">08 Hours</p>					
Module – IV					
<p>Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems,</p> <p>Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Matrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.</p> <p>Textbook 2: Ch. 6,7,8,9 RBT: L1, L2, L3</p> <p style="text-align: right;">08 Hours</p>					
Module – V					
<p>INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation</p> <p>Textbook 1: Ch. 9,12 RBT: L1, L2, L3</p> <p style="text-align: right;">08 Hours</p>					
<p>Text Book:</p> <ol style="list-style-type: none"> 1. Tanveer Siddiqui, U.S.Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008. 2. Anne Kao and Stephen R.Poteet (Eds), “Natural Language Processing and Text Mining”, Springer-Verlag Lond on Limited 2007. 					

Reference Book:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark. T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Course Outcomes (COs):

- Analyze the natural language text.
- Define the importance of natural language.
- Understand and the concepts of Text mining.
- Understand NLP tasks such as text classification, spam filtering, spell checking.
- Illustrate information retrieval techniques.

Question Paper Pattern:

- The question paper will have ten questions.
- There will be 2 questions from each module.
- Each question will have questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

VIRTUAL REALITY & AUGMENTED REALITY

Course Code	L : T : P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDT743	3:0:0:0	3	100	3hrs	PE5

Prerequisites: Computer Graphics & Human-Computer Interaction techniques

Course Description:

This course is designed to provide students with an overview of the basic principles of virtual reality (VR) and virtual environment technology (VET). There is a strong emphasis on the use of this technology as a tool for conducting scientific research and as a platform for real-world applications. Students in the course will be given an opportunity to interact directly with immersive virtual environment technology and will gain first-hand experience by developing a VR-based research demo / application as a final project and paper.

Course Objectives:

- Understand how the design of AR technology relates to human perception and cognition.
- Discuss applications of AR to the conduct of scientific research, training, and industrial design.
- Gain first-hand experience with using virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.
- Learn the fundamental aspects of designing and implementing experiments using VR.
- Learn about various virtual environments.

Syllabus

Module – I

Introduction to Augmented Reality (A.R)

What Is Augmented Reality - Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies-Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality. Augmented Reality Concepts- How Does Augmented Reality Work? Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience. Exemplar/Case Studies Timeline of evolution of AR from VR. **08 Hours**

Module – II

Augmented Reality Hardware

Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception, Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion. Exemplar/Case Studies Study the design of an AR application with C# and Unity. **08 Hours**

Module – III

Computer Vision for Augmented Reality & A. R. Software

Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking Augmented Reality Software - Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application. Exemplar/Case Studies Study all the available AR toolkits. **08 Hours**

Module – IV

Introduction to Virtual Reality

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark. Virtual Environment: Input: Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3D Menus & 3D Scanner etc. Output: Visual /Auditory / Haptic Devices. **08 Hours**

Module – V

Virtual Environment

Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems. Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system.

Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft. **08 Hours**

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Describe how AR systems work and list the applications of AR.

CO2: Understand and analyze the hardware requirement of AR.

CO3: Use computer vision concepts for AR and describe AR techniques

CO4: Analyze and understand the Virtual Reality

CO5: Acquire knowledge of Virtual environment

Learning Resources

Text Books:

- Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India
- Anand R., -Augmented and Virtual Reality, Khanna Publishing House, Delhi.

Reference Books:

- Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley 2016
- Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
- Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

e-Books:

- <https://arbook.icg.tugraz.at/Schmalstieg-2016-AW>
- https://www.researchgate.net/publication/221911335_Understanding_Virtual_Reality_Technology_Advances_and_Applications

MOOC Courses:

- <https://www.coursera.org/learn/ar>
- <https://www.udemy.com/share/101XPi/>

ETHICAL HACKING					
Course Code	L : T : P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDT751	3:0:0:0	3	100	3hrs	IE1
Prerequisite : Computer security, hacking, testing and decoding					
Course Objectives:					
Students undergoing this course are exposed to					
<ul style="list-style-type: none"> Ethical Hacking ethically penetrates into network systems using various tools to test the strength of a network. Ethical Hacking course shows how to test, scan, hack and secure networks and systems. Get in-depth theoretical knowledge and rich practical experience in hacking test networks 					
Syllabus					
Module – I					
Ethical Hacking: Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering. 08 Hours					
Module – II					
Introduction to Computer Systems and Networks, information systems and networks (including wireless networks) and their role in industry business and society, System and Network Vulnerability and Threats to Security, various types of attack and the various types of attackers in the context to the vulnerabilities associated with computer and information systems and networks. 08 Hours					
Module – III					
Physical Security, Steganography, Cryptography, Wireless Hacking, Firewall & Honeypots, IDS&IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing. 08 Hours					
Module – IV					
Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hackingan introduction to basic ethical hacking tools and usage of these tools in a professional environment in a form of project. 08 Hours					
Module – V					
An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking. Ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking. 08 Hours					
Text Books:					
<ul style="list-style-type: none"> Hands- On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, JamesCorley. Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, NickValenteen. 					
Reference Books:					
<ul style="list-style-type: none"> The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) [Paperback] Hands On Ethical Hacking and Network Defense *Print Replica+*Kindle Edition+ 					

Course Outcomes:**Upon the successful completion of the course, learners will be able to**

CO Nos.	Course Outcomes
CO1	Understanding the basics of networking with the introduction on the system attacks
CO2	Describes attacks in terms of industry, society and information systems
CO3	Describes various types of securities and vulnerabilities
CO4	Demonstration of the ethical hacking tools
CO5	Summarizing the legal and professional responsibilities of ethical hacking

ADVANCED CLOUD COMPUTING					
Course Code	L:T:P:S	Credits	Exam Marks	Exam Duration	Course Type
20CDT752	3:0:0:0	3	CIE:50 SEE:50	3 hours	IE1
Course Objectives: This course will enable students to: <ul style="list-style-type: none"> Identify the security and compliance benefits of by using the AWS Cloud. Understand the access control and management features of AWS. Learn about data encryption methods to secure all types of sensitive data. Get knowledge about the important steps for managing various AWS resources. Study the AWS services to protect network security. 					
Syllabus					
Module – I					
Introduction to AWS: AWS history, AWS Infrastructure, AWS services, AWS ecosystem Programming, management console and storage on AWS: Basic Understanding APIs - AWS programming interfaces, Web services, AWS URL naming, Matching interfaces and services, Elastic block store - Simple storage service(S3), Glacier - Content delivery platforms. 08 Hours					
Module – II					
AWS identity services, security and compliance: Users, groups, and roles - Understanding credentials, Security policies, IAM abilities and limitations, AWS physical security - AWS compliance initiatives, Understanding public/private keys, Other AWS security capabilities. 08Hours					
Module – III					
AWS computing and marketplace: Elastic cloud compute (EC2) - Introduction to servers, Imaging computers, Auto scaling, elastic load balancing, cataloging the marketplace, AMIs, Selling on the marketplace. AWS networking and databases: Virtual private clouds, Cloud models, Private DNS servers (Route 53), Relational database service – Dynamo DB, ElastiCache, Redshift. 08 Hours					
Module – IV					
Other AWS services and management services: Analytics services, Application services, Cloud security, Cloud Watch, Cloud Formation, Cloud Trail, Ops Works. 08 Hours					
Module – V					
AWS billing and Dealing with disaster: Managing costs, Utilization and tracking, Bottom line impact, Geographic and other concerns, Failure plans, Examining logs. 08 Hours					
Course Outcomes On completion of this course, the students will be able to: CO1: Discuss system virtualization and outline its role in enabling the cloud computing system model. CO2: Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS. CO3: Design various management and other distinguish services of AWS. CO4: Develop security and compliances for AWS. CO5: Analyze the billing of resources and other paradigm: how to deal with disasters.					
Text Books: <ul style="list-style-type: none"> Barrie Sosinsky. John Wiley & Sons. Cloud Computing Bible.. First Edition January 2011. ISBN-13: 978-0470903568. Bernard Golden Amazon Web Services For Dummies. For Dummies publication; 1 edition (9 August 2013)ISBN-13: 978- 1118571835 RajkumarBuyya, Cloud Computing: Principles and Paradigms, John Wiley & Sons, First Edition(3 January 2011).ISBN: 9780470887998 					
Reference Books: <ul style="list-style-type: none"> Amazon.com Mashups by Francis Shanahan, Wrox, Wiley Publishing Inc., ISBN-13: 978-0470097779, ISBN-10: 0470097779 					

- Amazon Web Services in Action by Michael Wittig and Andreas Wittig, Dreamtech Press, ISBN: 9789351198758
- Building Applications in the Cloud: Concepts, Patterns and Projects by Christopher M. Moyer, Pearson Addison-Wesley Professional, ISBN-10: 0321720202, ISBN-13: 978-0321720207
- Cloud Computing Design Patterns by Thomas Erl, Prentice Hall, ISBN-10: 0133858561, ISBN-13: 978-0133858563

E-Resources

- Amazon Security overview whitepaper- <https://aws.amazon.com/whitepapers>
- IAM Getting started Guide <http://docs.aws.amazon.com/IAM/latest/UserGuide/getting-started.html>

PRECISION AGRICULTURE (AI, IoT and ML)

Course Code	L : T : P :S	Credits	Exam Marks	Exam Duration	Course Type
20CDT753	3:0:0:0	3	CIE:50 SEE:50	3 Hours	IE1

Prerequisites:

Basic Computer Knowledge Linear Algebra Statistics and Probability Calculus Graph Theory Programming Skills – Language such as Python, R, MATLAB, C ++ or Octave Data, Hardware.

Descriptions:

This course is aimed to provide an interdisciplinary, integrative overview of latest development in the domain of smart farming.

Course Objectives:

This course will enable students to:

- Detailed description of latest tools and technologies available for the Agriculture 5.0.
- Describe different type of hardware, platforms and techniques for use in smart farming.
- Learn different modeling techniques in precision agriculture.
- Make data driven based decision making & support systems.
- Learn policies and regulations for adopting AI & ML techniques in Agriculture.

Syllabus

Module – I

Introduction to Precision Agriculture: History of Precision Agriculture and its Global, Precision Agriculture – Introduction, Need and Scope of Precision Agriculture, Components of Precision Agriculture, Tools and Techniques, Site-Specific Crop Management (SSCM, Variable Rate Application (VRA) and Variable Rate Technology (VRT, Adoption of Smart Precision Agriculture, Some Misconceptions about Precision Agriculture.

Smart Intelligent Precision Agriculture: Modern Day Agriculture, Digitization of Agriculture-Digital Farming, Transition to Smart Intelligent Precision Agriculture, Benefits of Smart Intelligent Precision Agriculture. **08 Hours**

Module – II

Adoption of Wireless Sensor Network (WSN) in Smart Precision Agriculture: Sensors and Wireless Sensor Network, Evolution of Wireless Sensor Networks, Introduction of WSN in Agriculture, Features of Agriculturally Based Sensors, Types of Sensors Used for WSN Agricultural System, Intelligent Sensors Versus Smart Sensors, Impact of the Wireless Sensors on Traditional Agriculture, Sensor Based Variable Rate Application,, Applications of WSN in Precision Agriculture, Security Issues and Challenges for WSN Implementation.

IoT (Internet of Things) Based Agricultural Systems: Introduction, Architecture of IoT, Brief Overview of IoT Network, Characteristics of Internet of Things, Inter-Operability Challenges, Applications of IoT in Smart Agriculture, Challenges for the Implementation of IoT in Smart Farming, Security and Privacy Issues of an IoT, Fusion of Cloud Platform with IoT. **08 Hours**

Module – III

AI (Artificial Intelligence) Driven Smart Agriculture: Artificial Intelligence (AI) – Introduction, Categories of AI, Subsets of AI, Life Cycle of an Artificial Intelligence-Based, Prerequisites for Building an ML/AI-Based Agricultural Model, Advantages of A.I in Agriculture. **Machine Learning (ML) Driven Agriculture:** Cognitive Technologies, Introduction to Machine Learning, Types of ML, Artificial Neural Networks and Deep Learning, General Applications of Machine Learning, Scope of Artificial Intelligence and Machine Learning in Agriculture, Applications of A.I and M.L in Agriculture. **08 Hours**

Module – IV

Data-Driven Smart Farming: Introduction, Collection and Management of Real-Time Agricultural Big Data, Transforming Field Data into Meaningful Insights, Processing and Predictive Analysis of Agricultural Data, Predictive Modeling.

Decision-Making and Decision-Support Systems: Introduction, Intelligent Agricultural Decision Support Systems (ADSS), Features and Workings of an Intelligent Agricultural Decision Support System (ADSS), Intelligent Decision-Making using AI, ML, and IoT for Farmers. **08 Hours**

Module – V

Agriculture 5.0 – The Future: Introduction to Agriculture 4.0, Nanotechnology and Smart Farming, Blockchain -Securing the Agriculture Value Chain, Edge-Fog Computing for Smart Farming, Role of Big Data in Agriculture, Transition to Agriculture.

Social and Economic Impacts: Societal and Economic Impact of AI, ML, and IoT in Intelligent Precision Farming, Existence of Forums for Innovation and Commercialization of Intelligent Precision Farming Technology (IPFT).

Environmental Impact and Regulations: Potential Impact on the Environment with Different IPFT, Policy Making and Governance.

08 Hours

Course Outcomes:

On completion of the course, students will be able to:

1. Describe about Artificial Intelligence in precision agriculture
2. Analyze the WSN and IoT based Agricultural systems
3. Design AI and ML Driven system for agriculture
4. Describe the key aspects of data driven and decision making & support systems.
5. Discuss AI, its current scope and limitations, and societal implications.

Text books:

- Latief Ahmad and Firasath Nabi: **Agriculture 5.0**, Artificial intelligence, IoT and machine learning, Taylor & Francis, 1st edition, 2021.
- [Rajesh Singh](#), [Anita Gehlot](#), [Mahesh Kumar Prajapat](#), Bhupendra Singh, **Artificial Intelligence In Agriculture**, 2021.

Reference books:

- [K.C. Ting](#), [S. Panigrahi](#) : Artificial Intelligence for Biology and Agriculture, 1998.
- [GurjitKaur](#), [PradeepTomar](#) : Artificial Intelligence and IoT-Based Technologies for Sustainable Farming and Smart Agriculture, 2019.