E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

NAGAPATTINAM - 611 002.

(Affiliated to Anna University, Chennai |Accredited by NAAC with 'A++'Grade Accredited by NBA | Approved by AICTE, New Delhi)

M.E. ENVIRONMENTAL ENGINEERING (R 2024)

First Year – Second Semester Curriculum

Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
Theory Course									
2402CP201	Machine Learning Techniques	3	0	0	3	40	60	100	PCC
2402CP202	Advanced Database Technologies	3	0	0	3	40	60	100	PCC
2402CP203	Software Project Management and Testing	3	0	0	3	40	60	100	PCC
	Program Elective–III	3	0	0	3	40	60	100	PEC
	Program Elective–IV	3	0	0	3	40	60	100	PEC
	Audit Course–II	2	0	0	0	100	0	100	AC
Laboratory Course									
2402CP204	Machine Learning Techniques Laboratory	0	0	4	2	50	50	100	PCC
2402CP205	Database Technology Laboratory	0	0	4	2	50	50	100	PCC
2404CP206	Mini Project with Seminar	0	0	4	2	50	50	100	EEC
Total		17	0	12	21	450	450	900	

PROGRAM ELECTIVE COURSES (PEC)
SEMESTER - II, ELECTIVE –III

SL. NO.	COURSECODE	COURSETITLE	CATEGORY	PERIODSPERWEEK			TOTAL CONTACTPERIODS	CREDITS
				L	T	P		
1.	2403CP011	Cyber Security	PEC	3	0	0	3	3
2.	2403CP012	Speech Recognition and Synthesis	PEC	3	0	0	3	3
3.	2403CP013	Applied Cryptography	PEC	3	0	0	3	3
4.	2403CP014	Biometric Technologies	PEC	3	0	0	3	3
5.	2403CP015	Block chain Technologies	PEC	3	0	0	3	3

SEMESTER - II, ELECTIVE–IV

SL. NO.	COURSECODE	COURSETITLE	CATEGORY	PERIODSPERWEEK			TOTAL CONTACTPERIODS	CREDITS
				L	T	P		
1.	2403CP016	Soft Computing	PEC	3	0	0	3	3
2.	2403CP017	Internet of Things	PEC	3	0	0	3	3
3.	2403CP018	Cloud Computing	PEC	3	0	0	3	3
4.	2403CP019	Deep Learning	PEC	3	0	0	3	3
5.	2403CP020	Quantum Computing	PEC	3	0	0	3	3

2402CP201	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basics of Probability, Statistics, Data Mining and Artificial Intelligence

COURSE OBJECTIVES:

1. To introduce the basic concepts and Techniques of Machine Learning
2. To become familiar with supervised and Unsupervised learning's and their applications
3. To learn different aspects of reinforcement learning and graphical models
4. To understand the basic concepts of deep learning

COURSE OUTCOMES:

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

CO1:	Understand and outline problems for each type of machine learning.
CO2:	Classify the concepts of supervised learning algorithms with patterns to predicts label values on additional unlabeled data
CO3:	Interpret associated rules and independent component analysis in unsupervised learning algorithms
CO4:	Analyze Reinforcement learning algorithms based on behavioral approach and training models
CO5:	Design and implement various graphical models for different types of machine learning applications.
CO6:	Apply deep learning, Neural network model algorithms to handle uncertainty and solve engineering problems

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	1	-	-	-	-	-	1	1	1	2
CO2	2	2	2	2	2	-	-	-	-	-	1	1	1	2
CO3	2	3	2	2	2	-	-	-	-	-	1	1	1	2
CO4	1	2	2	2	2	-	-	-	-	-	1	1	1	2
CO5	2	2	2	3	2	-	-	-	-	-	1	1	1	2
CO6	1	2	1	1	3	-	-	-	-	-	1	1	1	2

COURSE CONTENTS:

MODULE I	INTRODUCTION	9Hours

Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for MachineLearning- Probability theory – Probability Distributions.		
MODULE II	**SUPERVISED LEARNING**	**9 Hours**
ProbabilisticGenerative Models, Probabilistic Discriminative Models, Linear Regression – Least square-under fitting- over fitting, Tree based Methods-Decision Tree Learning- Random Forest- Ensemble Methods, Bagging, Boosting– Bayesian Learning, Naïve Bayes –- Support Vector Machines		
MODULE III	**UNSUPERVISED LEARNING**	**9Hours**
Association rules- Clustering- K-means – Hierarchical clustering- EM Algorithm–Dimensionality Reduction, Linear Discriminant Analysis, Principal Components Analysis, Independent Components Analysis.		
MODULE IV	**REINFORCEMENT LEARNING AND GAPHICAL MODELS**	**9 Hours**
Reinforcement learning – Model based learning- Markov Decision processes, Temporal Difference Learning Exploration- SARSA- Q Learning. Graphical Models-Markov Random Fields –Conditional Independence properties –Hidden Markov Models		
MODULE V	**DEEP LEARNING**	**9Hours**
Neural Networks- Perceptron –Multilayer Perceptron, Feed- forward Network, Error Back propagation Convolution neural networks- Recurrent neural networks- create and deploy neural networks using TensorFlow and Keras. Case Studies: Diabetic Retinopathy Detection, Fraud detector, Rental Price Optimization.		
		TOTAL: 45 HOURS

REFERENCES:

1. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman andHall, CRC Press,Second Edition, 2014.
2. AlpaydinEthem, “Introduction to Machine learning”, MIT press, Fourth Edition, 2020
3. Kevin Murphy “Machine Learning: A probabilistic Perspective”, MIT Press 2012
4. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
5. Josh Patterson and adam Gibson, “ Deep Learning: A Practitioners approach”, O’Reily Media Inc, 2017
6. https://nptel.ac.in/courses/106106139
7. https://www.vktr.com/ai-disruption/5-machine-learning-case-studies/

2402CP202	ADVANCED DATABASE TECHNOLOGIES	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic knowledge about DBMS

COURSE OBJECTIVES:

1. Exemplify the data models and to conceptualize a database system using ER diagrams.
2. Interpret the concepts of parallel and distributed databases
3. Understand the emerging database technologies.

COURSE OUTCOMES:

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

CO1:	Design a Relational Database for an Enterprise.
CO2:	Design a Distributed Database, Active Database and Temporal Database for an Enterprise.
CO3:	Gain the knowledge in advanced databases.
CO4:	Comprehend the use of XML Database, Web Database, Spatial Database, Multimedia Database and Deductive Database.
CO5:	Use MongoDB, NoSQL Database to Maintain Data of an Enterprise.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	1	-	2	-	-	-	-	-	-	2	3
CO2	1	1	3	1	-	2	-	-	-	-	-	-	2	2
CO3	3	1	3	3	-	3	-	-	-	-	-	-	2	3
CO4	2	1	3	3	-	2	-	-	-	-	-	-	2	3
CO5	2	1	3	3	-	2	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I	RELATIONAL MODEL	9 Hours

Relational model - Entity relationship model: Constraints - Removing redundant attributes in entity sets- Entity-relationship diagrams - Reduction to relational schemas - Entity relationship design issue- Extended E-R features - Alternative notations for modeling Data - Normalization and database design: First normal form, second normal form, third normal form- Boyce codd normal form-Fourth Normal Form – Fifth Normal Form.

MODULE II	PARALLEL AND DISTRIBUTED DATABASES	9 Hours

Parallel Databases – I/O Parallelism - Inter-Query and Intra-Query Parallelism– Inter-Operation and Intra-operation Parallelism – Performance evaluation for Parallel DB Systems –Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Load balancing tools for DDB – DDB Security.

MODULE III	ADVANCED DATABASES	9 Hours

ODMG model-ODL-OQL-Object relational and extended - Relational systems: Object relational features in SQL / Oracle. XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity – Java Database Connectivity – Accessing Relational Database using PHP – Analytical Operations involved in Processing Spatial Data –Spatial Data Types and Models–Spatial Operators and Spatial Queries– Spatial Data Indexing–Multimedia Database Concepts -.

MODULE IV	ACTIVE TEMPORAL AND DEDUCTIVE DATABASES	9 Hours

Introduction to Deductive Databases–Prolog/Datalog Notation– Clausal Form and Horn Clauses–Interpretations of Rules. Event Condition Action Model – Design and Implementation Issues for Active Databases – Termination, Confluence, Determination and Modularization – Temporal Databases –Interpreting Time in Relational Databases – Deductive Databases – Data log Queries

MODULE V	NOSQL DATABASES	9 Hours

NoSQL Database vs.SQL Databases – CAP Theorem –Migrating from RDBMS to NoSQL- Apache Cassandra – MongoDB – CRUD Operations– MongoDB Sharing – MongoDB Replication – Web Application Development using MongoDB with PHP and Java.
TOTAL: 45 HOURS
REFERENCES:
1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2016.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, Seventh Edition, McGraw Hill Education 2020
3. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams Publishing, 2014.
4. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
5. V.S.Subramanian, “Principles of Multimedia Database Systems”, Harcourt India Pvt. Ltd.,2001
6. C.J.Date, A.KannanandS.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006
7. https://archive.nptel.ac.in/content/storage2/courses/downloads_new/106106156

2402CP203	SOFTWARE PROJECT MANAGEMENT AND TESTING	L	T	P	C
		3	0	3	3

PREREQUISITE:

Basic knowledge about software engineering process

COURSE OBJECTIVES:

1. To provide a strong foundation on the concept of software project development.
2. To learn the concepts on project management and evaluation.
3. To study the various test design strategies.
4. To understand the levels of testing and defect classes

COURSE OUTCOMES:

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

CO1:	Explain the concept of software project lifecycle.
CO2:	Describe planning and Risk management.
CO3:	Explore cost estimation techniques.
CO4:	Explain various types of testing.
CO5:	Understand the automation tools for testing process.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	-	-	-	-	-	-	1	2	3
CO2	2	2	3	2	2	-	-	-	-	-	-	2	2	2
CO3	2	2	2	2	3	-	-	-	-	-	-	2	2	3
CO4	2	2	2	3	3	-	-	-	-	-	-	3	2	3
CO5	2	3	2	2	3	-	-	-	-	-	-	3	2	3

COURSE CONTENTS:

MODULE I	PROJECT EVALUATION AND PROJECT LIFE CYCLE	9 Hours

Understanding software projects –Project management vs. product management –stages of project management – Software project life cycle -Managerial issues- Introduction to Extreme programming.

MODULE II	ACTIVITY PLANNING AND RISK MANAGEMENT	9 Hours

Project initiation –Identifying project –Developing project character –Identifying stack holders –Requirement analysis –Gathering requirements –Requirements types –Project scope planning –Resource breakdown structure (RBS) – Manpower planning –Quality planning – Time and Cost estimates –Risk management planning –Procurements for the project.

MODULE III	COST ESTIMATION TECHNIQUES	9 Hours

Software effort estimation techniques: KLOC/SLOC estimation, expert opinion, top-down and bottom-up approach, use-case point estimates, object point estimates, Delphi technique – Project test plan –Software quality assurance (SQA) –Software quality control (SQC) –cost of quality –Software quality Metrics –SEI-CMMi model.

MODULE IV	INTRODUCTION - SOFTWARE TESTING	9 Hours

Software testing fundamentals–Minimizing Risks –Writing a policy –Building a Structured approach –Developing a test strategy –Building the software testing process – Software testing guidelines-Introduction to Software Licensing.

MODULE V	ORGANIZATION AND DEVELOPMENT OF TESTING APPROACH	9 Hours

Developing Test plan – Profile the software project –Understand project risk –Testing technique–Unit testing and analysis –Build and Inspect Test Plan. Software test automation – Design and Architecture for Automation - Automation testing - Automation Tools – Selenium and Junit.

TOTAL: 45 HOURS

REFERENCES:

1. William E Perry, “Effective Methods for Software Testing”, John Wiley & Sons, USA, 2008.
2. Watts. S. Humphrey, “Managing the software process”, Addison Wesley, 2011.

3. Ian Somerville, “Software Engineering”, Addison-Wesley,8thedition, 2006.
4. Steve McConnell, Code Complete, Second Edition, Microsoft Press. 5.Richard E. Fairley, Software Engineering Concepts, McGraw-Hill,1985
5. https://archive.nptel.ac.in/courses/106/105/106105218/

2402CP204	MACHINE LEARNING TECHNIQUES LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

Basic knowledge about Weka Tool

COURSE OBJECTIVES:

1. To apply the concepts of Machine Learning to solve real-world problems.
2. To implement basic algorithms in clustering & classification applied to text & numeric data.
3. To implement algorithms emphasizing the importance of bagging & boosting in classification & regression.
4. To implement algorithms related to dimensionality reduction.
5. To apply machine learning algorithms for Natural Language Processing applications.

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

CO1:	Use Weka tool for implementing machine learning algorithms related to numeric data
CO2:	Learn the application of machine learning algorithms for text data
CO3:	Apply dimensionality reduction algorithms for image processing applications and apply CRFs in text processing applications
CO4:	Use fundamental and advanced neural network algorithms for solving real- world data
CO5:	Implement machine learning algorithms related to numeric data

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	3	1	-	-	-	-	-	-	-	2	2	3
CO2	2	-	3	1	-	-	-	-	-	-	-	2	2	2
CO3	2	-	2	2	-	-	-	-	-	-	-	2	2	3
CO4	2	-	2	2	-	-	-	-	-	-	-	2	2	3
CO5	2	-	2	3	-	-	-	-	-	-	-	2	2	3

COURSE CONTENTS:

EXPERIMENT 1	Solving Regression & Classification using Decision Trees
EXPERIMENT 2	Root Node Attribute Selection for Decision Trees using Information Gain
EXPERIMENT 3	Bayesian Inference in Gene Expression Analysis
EXPERIMENT 4	Pattern Recognition Application using Bayesian Inference
EXPERIMENT 5	Bagging in Classification
EXPERIMENT 6	Bagging, Boosting applications using Regression Trees
EXPERIMENT 7	Data & Text Classification using Neural Networks
EXPERIMENT 8	Using Weka tool for SVM classification for chosen domain application
EXPERIMENT 9	Data & Text Clustering using K-means algorithm
EXPERIMENT 10	Data & Text Clustering using Gaussian Mixture Models

2402CP205	DATABASE TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

Basic knowledge about the database tool

COURSE OBJECTIVES:

1. To study and implement the basic SQL commands
2. To implement the database design in PL/SQL.
3. To implement distributed database, active databases and parallel databases

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

CO1:	Execute the basic SQL commands in ORACLE
CO2:	Implement intelligent databases in MYSQL and ORACLE
CO3:	Execute the basic SQL commands in ORACLE
CO4:	Develop PL/SQL programs in ORACLE
CO5:	Work with parallel databases using simulation tool.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	3	1	-	-	-	-	-	-	-	2	2	3
CO2	2	-	3	1	-	-	-	-	-	-	-	2	2	2
CO3	2	-	2	2	-	-	-	-	-	-	-	2	2	3
CO4	2	-	2	2	-	-	-	-	-	-	-	2	2	3
CO5	2	-	2	3	-	-	-	-	-	-	-	2	2	3

COURSE CONTENTS:

EXPERIMENT 1	Working basic SQL commands (DDL, DML, DCL, and TCL)
EXPERIMENT 2	Executing Single Row and Group functions
EXPERIMENT 3	Running SQL queries on Join and Integrity constraints
EXPERIMENT 4	Implement Simple programs using PL/SQL blocks
EXPERIMENT 5	Apply the concepts of Exception handling in PL/SQL block
EXPERIMENT 6	Create Cursors and package in PL/SQL block
EXPERIMENT 7	Use the concept of Procedures and Function in PL/SQL block
EXPERIMENT 8	Implement Distributed Database for Bookstore
EXPERIMENT 9	Active Database -Implementation of Triggers and Assertions for Bank Database
EXPERIMENT 10	Implement Parallel Database of University Counseling for Engineering colleges

2402CP206	MINI PROJECT WITH SEMINAR	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

	1. To develop knowledge to formulate a real world problem and project's goals
	2. To identify the various tasks of the project to determine standard procedures
	3. To identify and learn new tools
	4. To understand the various procedures for validation of the product and analysis the cost effectiveness
	5. To understand the guideline to Prepare report for oral demonstrations.

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

CO1:	Self-learning various topics.
CO2:	Survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
CO3:	Write technical reports
CO4:	Develop oral and written communication skills to present and defend their work in-front of technically qualified audience.

GUIDE LINES:

A Mini Project shall be undertaken by the students individually in consultation with the respective faculty and Head of the Department, as specified in the curriculum. Periodically four reviews are conducted and are evaluated by the faculty in charge. A student is expected to make a presentation about the mini-project during the final evaluation and submit the project report.

2403CP011	CYBER SECURITY	L	T	P	C
		3	0	0	3

PREREQUISITE:

Knowledge of information systems and networks

COURSE OBJECTIVES:

1. To understand the nature of threats and cyber security management goals and technology.
2. To understand the landscape of hacking and perimeter defense mechanisms.
3. To develop strategies for cyber security and protecting critical infrastructure.
4. To understand policies to mitigate cyber risks.
5. To understand the IT Act, scheme, amendments and emerging cyber law.

COURSE OUTCOMES:

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

CO1:	Analyze and evaluate the cyber security needs of an organization.
CO2:	Analyze the security issues in networks and computer systems to secure an infrastructure
CO3:	Design operational cyber security strategies and policies.
CO4:	Apply critical thinking and problem-solving skills to detect current and future attacks on an organization's computer systems and networks
CO5:	Understand the functionality of cyber security tools

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	2	-	-	-	-	-	-	2	3
CO2	2	3	2	3	2	2	-	-	-	-	-	-	2	2
CO3	2	2	2	2	-	2	-	-	-	-	-	-	2	3
CO4	3	3	2	2	2	2	-	-	-	-	-	-	2	3
CO5	3	2	2	2	2	2	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I **OVERVIEW OF CYBER SECURITY** **9 Hours**

Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security Standards – CIA Triad – Cyber security Framework

MODULE II **ATTACKS AND COUNTERMEASURES** **9 Hours**

Malicious Attacks, Threats, and Vulnerabilities – Scope of cyber-attacks – Tools used to attack computer systems – security breach – Risks, vulnerabilities and threats. Malware – malicious software attack – social engineering attack – wireless network attack – web application attack Access control - Audit – Authentication - Biometrics - Denial of Service Filters - Ethical Hacking – Firewalls - Scanning, Security policy, Threat Management - Applying software update and patches - Intrusion Detection Systems -Virtual Private Networks –Cryptographic Techniques

MODULE III **SECURING THE INFRASTRUCTURE** **9 Hours**

Infrastructure Security in the Real World - Understanding Access-Control and Monitoring Systems - Understanding Video Surveillance Systems - Understanding Intrusion-Detection and Reporting Systems

MODULE IV **SECURING LOCAL HOSTS AND NETWORKS** **9 Hours**

Local Host Security in the Real World - Securing Devices - Protecting the Inner Perimeter - Protecting Remote Access Local Network Security in the Real World - Networking Basics - Understanding Networking Protocols - Understanding Network Servers - Understanding Network Connectivity Devices - Understanding Network Transmission Media Security

MODULE V TOOLS **9 Hours**

Zenmap – Hydra –Kismet – John the Ripper – Airgeddon – Deauther Board – Aircrack-ng – EvilOSX

TOTAL: 45 HOURS
REFERENCES:
1. William Stallings, Effective Cyber security: A Guide to Using Best Practices and Standards, 1st edition, 2019.
2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers, 2018.
4. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Addison-Wesley, 2016.
5. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, CRC Press, 2015.
6. https://nptel.ac.in/courses/106106248

2403CP012	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic Concepts of Natural Language processing

COURSE OBJECTIVES:

1. To understand the mathematical foundations needed for speech processing.
2. To understand the basic concepts and algorithms of speech processing and synthesis
3. To familiarize the students with the various speech signal representation, coding and recognition techniques
4. To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

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

CO1:	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word.
CO2:	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals.
CO3:	Justify the use of formant and concatenative approaches to speech synthesis.
CO4:	Identify the appropriate approach of speech synthesis depending on the language to be processed
CO5:	Determine the various encoding techniques for representing speech.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	2	-	3	2	-	-	2	3
CO2	3	2	3	2	2	2	-	-	2	2	3	-	3	2
CO3	2	3	3	-	-	2	-	-	-	-	-	-	2	2
CO4	3	2	2	2	2	-	2	-	3	2	2	-	3	2
CO5	3	3	3	-	-	-	2	-	2	2	1	-	2	3

COURSE CONTENTS:

MODULE I	**FUNDAMENTALS OF SPEECH PROCESSING**	**9 Hours**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

MODULE II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	**9 Hours**

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

MODULE III	**SPEECH RECOGNITION**	**9 Hours**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

MODULE IV	**TEXT ANALYSIS**	9 Hours

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-tosound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation

MODULE V	**TEXT TO SPEECH SYNTHESIS**	**9 Hours**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Feature space for speaker recognition-similarity measuresEvaluation of TTS Systems, Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody.

TOTAL: 45 HOURS
REFERENCES:
1. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Prentice Hall Signal Processing Series, 1993
2. Joseph Mariani, "Language and Speech Processing", Wiley, 2009.
3. SadaokiFurui, "Digital Speech Processing: Synthesis, and Recognition", Second Edition, (Signal Processing and Communications), Marcel Dekker, 2000.
4. Thomas F.Quatieri, "Discrete-Time Speech Signal Processing", Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing – A guide to Theory, Algorithm and System Development", Prentice Hall PTR, 2001.
6. https://archive.nptel.ac.in/courses/117/105/117105145/

2403CP013	APPLIED CRYTOGRAPHY	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic knowledge about calculus and linear algebra

COURSE OBJECTIVES:

1. To analyze the concepts of cryptographic techniques
2. To apply the mathematical representation of cryptographic algorithms
3. algorithms To implement the symmetric and asymmetric encryption algorithms

COURSE OUTCOMES:

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

CO1:	Analyze the taxonomy of cryptography primitives.
CO2:	Analyze the usage of random number generators in Encryption and Decryption.
CO3:	Apply the Symmetric key and public key encryption techniques.
CO4:	Develop Hash algorithms to ensure the authentication.
CO5:	Enhance the security through digital signature.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	2	-	-	-	-	-	-	2	3
CO2	2	1	3	2	-	2	-	-	-	-	-	-	2	2
CO3	1	1	3	2	-	2	-	-	-	-	-	-	2	3
CO4	3	1	3	3	-	2	-	-	-	-	-	-	2	3
CO5	1	1	3	1	-	1	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I INTRODUCTION **9 Hours**

Cryptography goals -Taxonomy of cryptography primitives -Background on functions -Basic terminology - Block ciphers, stream cipher, substitution ciphers, transposition ciphers -Composition of ciphers -Digital signature -Public key cryptography -Hash functions -Protocol and mechanism- Key establishment and management -Pseudo random numbers -Classes of attack.

MODULE II RANDOM GENERATORS **9 Hours**

Pseudo random bits and sequences -Random bit generation -Pseudorandom bit generation -ANSI x9.17 Generator -FIPS 186 Generator- statistical tests -Cryptographically secure pseudorandom bit generation - RSA pseudorandom bit generator - Blum-Blum-Shub pseudorandom bit generator.

MODULE III ENCRYPTION ALGORITHMS **9 Hours**

Block cipher -DES -Product ciphers and Feistel ciphers - DES algorithm- DES properties and strength- FEAL -IDEA -SAFER -Blowfish and Two fish encryption, linear and differential cryptanalysis. Public key encryption -RSA public key encryption- Elliptic curve cryptosystems, Homomorphic encryption, Diffie-Hellman key exchange algorithm, Elgamal Cryptosystem.

MODULE IV HASH ALGORITHMS 9 Hours

Hash function and data integrity -Classification and framework -Basic constructions and general results - Un keyed hash functions -Keyed hash functions -data integrity and message authentication -Advanced attacks and hash function- Cryptographic hash functions MD5, SHA

MODULE V DIGITAL SIGNATURES **9 Hours**

Digital signatures - notion of existential unforgability under chosen message attacks, Schnorr signature scheme. Zero Knowledge Proofs and Protocols.

TOTAL: 45 HOURS

REFERENCES:

1. B. Schneier, Applied Cryptography, 2nd edition, J. Wiley and Sons

2. N. Ferguson, B. Schneier and T. Kohno, Cryptography Engineering: Design, Principles and Practical Applications, Wiley Publishing.
3. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd ed, Pearson, 2007.
4. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007.
5. William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI, March 2013.
6. Jonathan Katz and Yehuda Lindell, “Introduction to Modern Cryptography”, 2nd edition, CRC Press, 2015.
7. Stallings, Cryptography & Network Security, Pearson Education, 4thEdition 2006.
8. Jeffrey Heffstein, Jill Pipher, J.H.Silverman, “An Introduction to Mathematical Cryptography”, Springer science & Business Media, Dec 2008.
9. Paar C, Pelzl J. Understanding cryptography: a textbook for students and practitioners. Springer Science & Business Media, 2009.
10. https://archive.nptel.ac.in/courses/106/105/106105162/

2403CP014	BIOMETRIC TECHNOLOGIES	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic knowledge about biological or behavioral features.

COURSE OBJECTIVES:

1. To understand the importance of biometric system in the organization
2. To Design a biometric recognition system using facial and finger print recognition technique
3. To implement the 3D BIOMETRIC system for security applications

COURSE OUTCOMES:

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

CO1:	Analyze the functionalities and applications of Biometric system.
CO2:	Apply the finger print and facial recognition technique for real time application.
CO3:	Design an IRIS recognition system using biometric system.
CO4:	Analyze the functions and applications of behavioral biometric.
CO5:	Implement the 3D BIOMETRIC Technology in their applications.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	2	-	-	-	-	-	-	2	3
CO2	2	1	3	2	-	2	-	-	-	-	-	-	2	2
CO3	1	1	3	2	-	2	-	-	-	-	-	-	2	3
CO4	3	1	3	3	-	2	-	-	-	-	-	-	2	3
CO5	1	1	3	1	-	1	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I **INTRODUCTION** **9 Hours**

Person Recognition -Biometric systems-Biometric functionalities: verification, identification – Biometric systems errors - The design cycle of biometric systems - Applications of Biometric systems -Security and privacy issues

Image processing basic: what is image, acquisition, type, point operations, Geometric transformations.

MODULE II **FINGER PRINT AND FACIAL RECOGNITION** **9 Hours**

Fingerprint recognition, Enhancement, Thinning, minutiae, CN number, matching

FACE RECOGNITION: Introduction- Image acquisition: 2D sensors, 3D sensors- Face detection- Feature extraction-matching.

MODULE III **IRIS AND OTHER TRAITS** **9 Hours**

Design of IRIS recognition system- IRIS segmentation- normalization - encoding and matching- IRIS quality -performance evaluation -other traits- ear detection - ear recognition - gait feature extraction and matching - challenges- hand geometry -soft biometrics

MODULE IV **BEHAVIORAL BIOMETRICS** 9 Hours

Introduction -Features- classification of behavioral biometrics -properties of behavioral biometrics - signature -keystroke dynamics -voice- merits -demerits -applications- error sources-types -open issues - future trends

MODULE V **3D BIOMETRIC** **9 Hours**

Classification of 3D biometric imaging methods -3D biometric Technologies- 3D palm print capturing systems-3D information in palm print- Feature Extraction from 3D palm print -matching and fusion - security applications

TOTAL: 45 HOURS

REFERENCES:

1. Khalid saeed with Marcin Adamski, Tapalina Bhattasali, Mohammed K. Nammous, Piotrpanasiuk, mariusz Rybnik and soharab H.Sgaikh, "New Directions in Behavioral Biometrics", CRC Press 2017.
2. David Zhang, Guangming Lu, "3D Biometrics Systems and Applications", Springer 2013.
3. James wayman, Anil K.Jain, Arun A. Ross, Karthik Nandakumar, "Introduction to Biometrics", Springer,2011.
4. John Vacca, "Biometrics Technologies and Verification Systems", Elsevier, 2007.
5. Rafael C. Gonzalez, Richard Eugene Woods, "Digital Image Processing using MATLAB", 2nd Edition, Tata McGraw-Hill Education 2010.
6. https://nptel.ac.in/courses/106104119

2403CP015	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

PREREQUISITE:

Strong programming skills, basic knowledge on cryptography and data structures, understanding the concept of TCP/IP

COURSE OBJECTIVES:

1. To share information amongst all parties that access it via an application.
2. To create a decentralized, secure, and transparent system for recording and verifying transactions or data.
3. To increase trust, security, transparency among member organizations by improving the traceability of data across a business network.

COURSE OUTCOMES:

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

CO1:	Explain cryptocurrencies and their relationship with the blockchain technology
CO2:	Explain the different steps in the use of Bitcoins.
CO3:	Relate Web 3 and Hyper ledger to concepts in blockchain technologies.
CO4:	Apply block chains to different real-life problems
CO5:	Implement a simple application using Ethereum.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	-	2	-	-	-	-	-	-	2	3
CO2	2	1	3	2	-	2	-	-	-	-	-	-	2	2
CO3	1	1	3	2	-	2	-	-	-	-	-	-	2	3
CO4	3	1	3	3	-	2	-	-	-	-	-	-	2	3
CO5	1	1	3	1	-	1	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I **INTRODUCTION** **9 Hours**

Blockchain: Overview-History and Origin of Block chain - Technical Concepts of Block chain Systems: - Physical Ledger Technology and Security - Digital Ledger Technology, Digital Security Technology: - Cryptographic Hash Functions - Digital Signatures

MODULE II FOUNDATIONS **9 Hours**

Centralization vs. Decentralization of Blockchain - Distributed Ledger Technology (DLT) Technical Concepts: Mining - Distributed Consensus- Incentives - Proof of Work - Cryptosystems in practiceDistributed Networks – Attacks - Consensus Protocols

MODULE III WEB3 AND HYPERLEDGER **9 Hours**

Web 3 Contract deployment – POST requests – Frontend – Development framework – Hyperledger Projects – Protocol – Reference architecture – Hyperledger Fabric – Corda.

MODULE IV SMART CONTRACTS & ETHEREUM 9 Hours

Smart Contracts – Definition – Recardian contracts - Ethereum blockchain –Ethereum network – Components of Ethereum ecosystem –Programming languages - Ethereum development environment - Non-Fungible Token (NFT)

MODULE V ALTERNATIVE BLOCKCHAINS AND APPLICATIONS **9 Hours**

Alternative block chains – Applications, Internet of Things, Government, Health, Finance – Scalability – Privacy

TOTAL: 45 HOURS

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016
3. Alex Leverington, "Ethereum Programming" Packt Publishing Limited, 2017.
4. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly Publishing, 2014.
5. Roger Wattenhofer, "The Science of the Blockchain" Create Space Independent Publishing Platform, 2016
6. Arshdeep Bahga and Vijay Madisetti, "Blockchain Applications : A Hands-On Approach", 2017
7. https://archive.nptel.ac.in/courses/106/105/106105235/

2403CP016	SOFT COMPUTING	L	T	P	C
		3	0	0	3

PREREQUISITE:

A string mathematical background, programming skills

COURSE OBJECTIVES:

1. To conceptualize the working of human brain using neural networks.
2. Summarize and apply the methodologies involved in solving problems related to Fuzzy Logic, Various fuzzy systems and Rough sets.
3. To Provide the mathematical background for carrying out the optimization and familiarizing genetic algorithm for seeking global optimum in self-learning situation.
4. Develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

COURSE OUTCOMES:

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

CO1:	Describe human intelligence and AI Explain how intelligent system works
CO2:	Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO3:	Design neural networks for pattern classification and regression problems
CO4:	Apply genetic algorithms to optimization problems
CO5:	Develop some familiarity with current research problems and research methods in Soft Computing Techniques

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	2	-	-	-	-	-	-	2	3
CO2	2	3	2	3	2	2	-	-	-	-	-	-	2	2
CO3	2	2	2	2	-	2	-	-	-	-	-	-	2	3
CO4	3	3	2	2	2	2	-	-	-	-	-	-	2	3
CO5	3	2	2	2	2	2	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I	**INTRODUCTION TO FUZZY COMPUTING**	**9 Hours**

Fuzzy Logic and Approximate Reasoning: Conventional and fuzzy sets: Basic concepts of fuzzy logic Fuzzy expressions: Basic principles of fuzzy logic and fuzzy inference rules, fuzzy relations, fuzzy operators, realization of fuzzy systems using fuzzy relations Application of fuzzy logic in vision, pattern recognition, robotics and linguistics. Approximate reasoning in Experts Systems, Fuzzy sets in approximate reasoning, Fuzzy propositions in approximate reasoning. Transition Modifier rules, Basic principles of approximate reasoning and rules of inference.

MODULE II	**FUNDAMENTALS OF NEURAL NETWORKS**	**9 Hours**

Neuron, Nerve Structure and Synapse – Artificial Neuron and its Model – Activation Functions – Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks – Various Learning Techniques: Perception and Convergence Rule, Auto-Associative and Hetero-Associative Memory

MODULE III	**BACK PROPAGATION NETWORKS AND COMPETITIVE NEURAL NETWORKS**	**9 Hours**

Back Propagation Networks Architecture: Perceptron Model- Single Layer Artificial Neural Network, Multilayer Perception Model – Back Propagation Learning Methods – Effect of Learning Rule CoEfficient – Factors Affecting Back Propagation Training – Kohenen's Self Organizing Map – SOM Architecture, learning procedure – Application; Learning Vector Quantization, learning by LVQ – Adaptive Resonance Theory – Learning procedure – Applications.

MODULE IV	**GENETIC ALGORITHM**	9 Hours

Basic Concepts – Working Principle – Procedures of GA – Flow Chart of GA – Genetic Representation: (Encoding) Initialization and Selection – Genetic Operators: Mutation, Generational Cycle – Applications. Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them -Multi-Objective Evolutionary Algorithm (MOEA) -Non-Pareto approaches to solve MOOPs - Pareto-based approaches to solve MOOPs - Some applications with MOEAs.		
MODULE V	**APPLICATIONS**	**9 Hours**
Control systems; Speech systems; Image processing; Natural language processing and decision making, Handwritten Script Recognition; Automotive Systems and Manufacturing; Decision Support System; Bioinformatics; Investment and trading.		
	TOTAL: 45 HOURS	

REFERENCES:

1. Jang J.S.R., Sun C.T and Mizutani E, “Neuro Fuzzy and Soft computing”- A Computational Approach to Learning and Machine Intelligence, PHI Learning Private Limited, Indian Reprint , 2014.
2. H. J. Zimmermann: Fuzzy set theory and its application, 2nd revised edition, Allied Publishers Ltd.
3. S. Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall of India, 2010.
4. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education, 2008.
5. J.S.R. Jang, C.T. Sun, E. Mizutani, “Neuro-Fuzzy and Soft Computing”, Pearson Education, 2004
6. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
7. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
8. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
9. Neural Networks and Learning Machines Simon Haykin (PHI)
10. https://archive.nptel.ac.in/courses/106/105/106105173/

2403CP017	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basics of programming knowledge

COURSE OBJECTIVES:

1. Understand the components and protocols used in IoT.
2. To Understand the IOT Reference Architecture and Real World Design Constraints.
3. Ability to understand the Security requirements in IoT

COURSE OUTCOMES:

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

CO1:	Explain the underlying architectures and models in IoT.
CO2:	Analyze different connectivity technologies for IoT.
CO3:	Develop simple applications using Arduino / Raspberry Pi.
CO4:	Apply data analytics techniques to IoT.
CO5:	Study the needs and suggest appropriate solutions for Industrial applications.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3	4	-	1	-	-	-	-	-	-	2	3
CO2	3	-	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	-	3	2	-	-	-	-	-	-	-	-	2	3
CO4	3	3	2	3	-	-	-	-	-	-	-	-	2	3
CO5	3	2	2	2	-	2	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I **INTRODUCTION** **9 Hours**

Evolution of IoT- IoT Networking Components- Addressing Strategies in IoT- IoT Sensing and Actuation- IoT Processing Topologies and Types-IoT Architectures.

MODULE II **CONNECTIVITY** **9 Hours**

Communications Criteria –PHY/MAC layer- Network Layer–Transport Layer –Application Transport Methods– Application Layer-Interoperability in IoT.

MODULE III **SYSTEM DEVELOPMENT** **9 Hours**

Design Methodology –Case study –Basic blocks of IoT device- Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi

MODULE IV **SECURITY IN IoT** 9 Hours

Introduction to SDN, SDN for IoT, Data Handling and Analytics, –Big Data Analytics Tools and Technology –Cloud of Things-Edge Streaming Analytics –Network Analytics, Applications. Security history, challenges, variations –Risk Analysis Structures –Application in Operational Environment.

MODULE V **IoT IN INDUSTRY** **9 Hours**

Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT , Case Study: Agriculture, Healthcare, Activity Monitoring

TOTAL: 45 HOURS

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, 2017
2. Olivier Hersent, David Boswarthick, Omar Elloum, “The Internet of Things Key applications and Protocols”, Wiley, 2012
3. Michael Miller, “The Internet of Things”, Pearson Education, 2015.
4. ArshdeepBahga, Vijay Madisetti, “Internet of Things –A hands-on approach”, Universities Press, 2015
5. 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
6. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011
7. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly(SPD), 2014
8. Sudip Misra, Chandana Royand Anandarup Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0”, CRC Press.
9. https://nptel.ac.in/courses/106105166

2403CP018	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basics of programming skills, security and privacy, Databases

COURSE OBJECTIVES:

1. To understand the concepts of cloud computing.
2. To familiarize themselves with the lead players in cloud.
3. To get aware of the emergence of cloud as the next generation computing paradigm.

COURSE OUTCOMES:

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

CO1:	Identify architecture, infrastructure and delivery models of cloud computing.
CO2:	Apply suitable virtualization concept for implementing the cloud services.
CO3:	Identify required cloud mechanisms while designing cloud environment.
CO4:	Make use of specialized cloud architecture to deliver cloud service
CO5:	Choose the appropriate technologies, algorithms and approaches for the related issues.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	1	1	2	-	-	-	-	-	-	2	3
CO2	3	1	3	3	1	2	-	-	-	-	-	-	2	2
CO3	3	1	3	2	1	2	-	-	-	-	-	-	2	3
CO4	3	1	3	3	1	3	-	-	-	-	-	-	2	3
CO5	1	1	3	2	1	3	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I **INTRODUCTION** **9 Hours**

Introduction- Historical Development – Cloud Computing Architecture – The Cloud Reference Model– Cloud Characteristics –Cloud Deployment Models: Public, Private and Community, Hybrid Clouds- Cloud Delivery Models: IaaS, PaaS, SaaS – Open Source Private Cloud Software: Eucalyptus, Open Nebula, OpenStack.

MODULE II **VIRTUALIZATION** **9 Hours**

Data Center Technology – Virtualization – Characteristics of Virtualized Environments - Compute and Storage Virtualization – Implementation Levels of Virtualization – Tools and Mechanisms: Xen, VMWare.

MODULE III **CLOUD COMPUTING MECHANISM** **9 Hours**

Cloud Infrastructure Mechanism: Cloud Storage, Cloud Usage Monitor, Resource Replication – Specialized Cloud Mechanism: Load Balancer, SLA Monitor, Pay-per-use Monitor, Audit Monitor, Failover System, Hypervisor, Resource Cluster, Multi Device Broker, State Management Database.

MODULE IV **SPECIALIZED CLOUD ARCHITECTURE** 9 Hours

Workload distribution architecture-Resource Pooling Architecture-Dynamic scalability-Cloud bursting-hypervisor clustering-service quality metrics & SLA.

MODULE V **SECURITY IN THE CLOUD** **9 Hours**

Basic Terms and Concepts – Threat Agents – Cloud Security Threats –Cloud Security Mechanism: Encryption-Identity and Access Management-Cloud Based Security Groups-Hardened Virtual Server Images.

TOTAL: 45 HOURS

REFERENCES:

1. Thomas Erl, Zaigham Mahood, Ricardo Puttini, “Cloud Computing, Concept, Technology & Architecture”, Prentice Hall, 2022.

2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw- Hill, 2020.
3. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach", Tata McGraw-Hill Edition, 2010
4. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach",Universities Press(India) Private Limited, 2014
5. Tom White, "Hadoop : The Definitive Guide", O'Reilly Media, 4th Edition, 2015.
6. John Rittinghouse & James Ransome, "Cloud Computing, Implementation, Management and Strategy", CRC Press, 2010.
7. https://nptel.ac.in/courses/106105167

2403CP019	DEEP LEARNING	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic skills in programming skill, linear algebra, calculus,probability

COURSE OBJECTIVES:

1. To understand the basic ideas and principles of Neural Networks.
2. To understand the basic concepts of Big Data and Statistical Data Analysis.
3. To understand and implement Deep Learning Architectures.
4. To appreciate the use of Deep Learning Applications.

COURSE OUTCOMES:

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

CO1:	Understand the role of Applied Mathematics and the need of Deep learning.
CO2:	To optimize and generalize deep neural networks for better performance.
CO3:	To design and implement Convolutional and recurrent Neural Networks and Critically analyse in Image and text Related Projects
CO4:	To design and implement Deep Learning Applications.
CO5:	To learn deep generative networks implications in unsupervised learning.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1	-	-	-	-	-	-	-	2	3
CO2	3	3	3	3	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	-	2	3
CO4	3	3	3	3	3	2	-	-	-	-	-	-	2	3
CO5	2	3	3	1	2	1	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I	**BASICS FOR DEEP LEARNING**	**9 Hours**

Mathematical Preliminaries of Deep learning: Linear Algebra, Probability and Information Theory, Numerical Computations – Machine Learning Basics: Learning Algorithms, Overfitting Vs Under fitting, maximum likelihood estimation - MSE, Activation functions and Cost functions –Challenges motivating Deep Learning.

MODULE II	**INTRODUCTION TO DEEP LEARNING**	**9 Hours**

Basic concept of Neurons – Perceptron Learning – Multilayer Perceptrons -Deep Feed Forward Networks - Back Propagation – Data representation for Neural Networks - Datasets for deep learning- cross validation - Bias-Variance Tradeoff- Linear Classifiers, Linear Machines with Hinge Loss-Gradient based optimization – Regularization for Deep learning : Parameter norm Penalties, data set augmentation, Dropout, Multi task learning, Early stopping – Hyper parameters for deep learning.

MODULE III	**CONVOLUTIONAL NEURAL NETWORKS**	**9 Hours**

CNN Architectures – Convolution – Pooling – Training a Convnet: weights initialization - batch normalization - hyper parameter optimization and batch normalization - Transfer Learning – Pretraining, fine-tuning – Pretrained CNN networks – Visualizing CNN Learning – Case Study: Image Classification using CNNs .

MODULE IV	**SEQUENCE MODELING USING RECURRENT NETS**	9 Hours

Recurrent Neural Networks (RNN) - Bidirectional RNN - Long Short-Term Memory (LSTM) - GRU – Attention and Applications -GPT, BERTs and Variants -Encoder-decoder sequence to sequence architectures – Recursive Neural Networks - Performance metrics for text processing- Case Study – Text generation with LSTM, Speech Processing and Image Captioning using RNNs.

MODULE V	**UNSUPERVISED AND DEEP GENERATIVE MODELS**	**9 Hours**

Types of Auto encoder - Variational Auto encoders - Generative Adversarial Networks : GAN framework , Generator training, Discriminator training, Convergence of GAN, KL-Divergence for GAN– Boltzmann Machines– Restricted Boltzmann Machine-Deep Boltzmann Machines- Deep Belief Networks-Boltzmann Machine for Real valued data Case Study: Text-to-Image Synthesis using GAN, Image generation with Generative Adversarial Networks.
TOTAL: 45 HOURS
REFERENCES:
1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
4. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018
5. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.
6. https://nptel.ac.in/courses/106106184

2403CP020	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

PREREQUISITE:

Basic Concepts of Linear algebra and probability

COURSE OBJECTIVES:

1. To serve as an introduction to the quantum computational model
2. To understand basic quantum algorithms and analyzing them
3. To able To understand the components of computing in a Quantum world
4. To gain knowledge on mathematical representation of quantum physics and operations.

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

CO1:	Understand the basics of quantum computing.
CO2:	Understand the background of Quantum Mechanics.
CO3:	Analyze the computation models.
CO4:	Model the circuits using quantum computation. Environments and frameworks.
CO5:	Understand the quantum operations such as noise and error-correction.

COs Vs POs & PSOs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	2	1	1	-	-	-	-	-	-	1	1
CO2	1	2	-	2	1	1	-	-	-	-	-	-	1	2
CO3	3	3	-	2	1	1	-	-	-	-	-	-	1	2
CO4	3	3	-	2	1	1	-	-	-	-	-	-	2	3
CO5	3	3	-	2	1	1	-	-	-	-	-	-	2	3

COURSE CONTENTS:

MODULE I	QUANTUM MECHANICS AND QUANTUM COMPUTATION	**9 Hours**

The postulates of quantum mechanics, The density operator, The Schmidt decomposition and purifications, EPR and the Bell inequality, Quantum circuits : Quantum algorithms, Single qubit operations, Controlled operations. Measurement, Universal quantum gates, Summary of the quantum circuit model of computation, Simulation of quantum systems.

MODULE II	QUANTUM COMPUTERS AND ALGORITHMS	**9 Hours**

Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics, Ion traps, Nuclear magnetic resonance, Other implementation schemes, The quantum Fourier transform and its applications, Quantum search algorithms

MODULE III	QUANTUM INFORMATION	**9 Hours**

Quantum noise and quantum operations : Classical noise and Markov processes, Quantum operations, Examples of quantum noise and quantum operations, Applications of quantum operations, Limitations of the quantum operations formalism, Distance measures for quantum information : Distance measures for classical information. quantum states and quantum channel preserve information.

MODULE IV	QUANTUM ERROR-CORRECTION	9 Hours

Introduction, The Shor code, Theory of quantum error-correction, Constructing quantum codes, Stabilizer codes, Fault-tolerant quantum computation

MODULE V	ENTROPY AND INFORMATION THEORY	**9 Hours**

Entropy : Shannon Entropy, Basic properties of entropy, Von Neumann entropy, Strong sub additivity, Quantum information theory : Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels, Entanglement as a physical resource, Quantum cryptography

TOTAL: 45 HOURS
REFERENCES:
1. Michael A. Nielsen, Issac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, Tenth Edition 2010.
2. Parag K Lala, Quantum Computing, A Beginners Introduction, Mc Graw Hill Education, First edition 2020.
3. Chris Bernhardt, Quantum Computing for Everyone, The MIT Press, Reprint edition 2020.
4. Jack D. Hidary's Quantum Computing: An applied approach, Springer, 2019.
5. Eric Johnston, Nic Harrigan, and Mercedes Gimeno Segovia, Programming Quantum Computers: Essential Algorithms and Code, O′reilly, 2019.
6. Pierpaolo Marturano, Quantum Computing, De Gruyter Oldenbourg Publishing, 2023.
7. https://nptel.ac.in/courses/106106232