



Estd. 1995

**SETHU INSTITUTE OF TECHNOLOGY
(An Autonomous Institution)**

Pulloor, Kariapatti – 626 115

M.E. COMPUTER SCIENCE & ENGINEERING

REGULATION 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM & SYLLABUS

(1st SEMESTER To 4th SEMESTER)

Approved in the Academic Council Meeting held on 21.09.2019

CHAIRPERSON

**Chairperson
Board of Studies
Computer Science & Engineering
Sethu Institute of Technology
Kariapatti - 626 115**

CHAIRMAN

ACADEMIC COUNCIL

**CHAIRMAN
ACADEMIC COUNCIL
Sethu Institute of Technology
Pulloor, Kariapatti - 625 115**

Program Outcome (POs)

Post graduates in engineering will be able to:

1. **Scholarship of Knowledge:** Demonstrate a degree of mastery over the area as per the specialization of the program, higher than the requirements in the appropriate bachelor program (Cognitive - Apply)
2. **Critical Thinking:** Analyze complex engineering problem critically and provide feasible/optimal solution after considering public health, safety, societal and environmental factors in the core area of expertise. (Cognitive Domain - Analyze)
3. **Problem Solving and Research Skill:** Independently carry out research /investigation and development work to solve practical problems (Cognitive -Create)
4. **Modern Tool Usage:** Apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations. (Cognitive - Apply)
5. **Communication:** Write and present a substantial technical report/document (Affective Domain - Organization)
6. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with continuous enthusiasm and commitment to improve knowledge and competence. (Affective Domain-Characterization)

SETHU INSTITUTE OF TECHNOLOGY, Pulloor, Kariapatti – 626 115

M.E. Degree Programme

CBCS CURRICULUM

Regulations 2019

(Applicable to the students admitted from the Academic Year 2019-2020 onwards)

Master of Engineering in COMPUTER SCIENCE AND ENGINEERING

OVERALL COURSE STRUCTURE

Category	Total No. of Courses	Credits	Percentage
Programme-CORE	8	20	28.57
Programme- ELECTIVE	5	15	21.43
Open Elective	1	3	4.28
Project Work	3	29	41.43
Mandatory Credit Course	1	3	4.28
Audit Course	2	-	-
TOTAL	20	70	100

COURSE CREDITS – SEMESTER WISE

Branch	I	II	III	IV	TOTAL
M.E(CSE)	16	16	22	16	70

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19PCS101	Advanced Data Structures and Algorithms	3	0	0	3
2.	19PCS102	Advanced Database Technologies	3	0	0	3
3.		Program Elective I	3	0	0	3
4.	19PGM701	Research Methodology and IPR	3	0	0	3
5.	19PGM801	Pedagogy Studies(Audit Course I)	2	0	0	0
PRACTICAL						
6.	19PCS103	Advanced Data Structures Laboratory	0	0	4	2
7	19PCS104	Advanced Database Technologies Laboratory	0	0	4	2
Total			14	0	8	16
Total Number of Credits: 16						

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19PCS201	Image Processing and Analysis	3	0	0	3
2.	19PCS202	Cloud Computing Technologies	3	0	0	3
3.		Program Elective II	3	0	0	3
4.	19PGM802	English for Research Paper Writing(Audit Course 2)	2	0	0	0
PRACTICAL						
5.	19PCS203	Image Processing and Analysis Laboratory	0	0	4	2
6.	19PCS204	Cloud Computing Technologies Laboratory	0	0	4	2
7.	19PCS205	Mini Project with Seminar	0	0	6	3
Total			11	0	14	16
Total Number of Credits: 16						

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Program Elective III	3	0	0	3
2.		Program Elective IV	3	0	0	3
3.		Program Elective V	3	0	0	3
4.		Open Elective	3	0	0	3
PRACTICAL						
5.	19PCS301	Dissertation-I /Industrial Project	0	0	20	10
Total			12	0	20	22
Total Number of Credits: 22						

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	19PCS401	Dissertation II	0	0	32	16
Total			0	0	32	16
Total Number of Credits: 16						

TOTAL NO. OF CREDITS: 70

PROGRAM ELECTIVES

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19PMA501	Mathematical foundations of Computer Science	3	0	0	3
2	19PCS502	Data Warehouse and Data Mining	3	0	0	3
3	19PCS503	Operating System Design	3	0	0	3
4	19PCS504	Big Data Analytics	3	0	0	3
5	19PCS505	Machine Learning Techniques	3	0	0	3
6	19PCS506	Multicore Architecture	3	0	0	3
7	19PCS507	Data Storage Technologies and Networks	3	0	0	3
8	19PCS508	Web Analytics and Development	3	0	0	3
9	19PCS509	Digital Forensics	3	0	0	3
10	19PCS510	Biometrics	3	0	0	3
11	19PCS511	Soft Computing	3	0	0	3
12	19PCS512	Security in Computing	3	0	0	3
13	19PCS513	Deep Learning Techniques	3	0	0	3
14	19PCS514	Introduction to Intelligent Systems	3	0	0	3
15	19PCS515	Essentials of Human Computer Interaction	3	0	0	3
16	19PCS516	Optimization Techniques	3	0	0	3
17	19PCS517	Compiler for High Performance Computing	3	0	0	3
18	19PCS518	Cluster and Grid Computing	3	0	0	3
19	19PCS519	Parallel Algorithms	3	0	0	3
20	19PCS520	Wireless Access Technologies	3	0	0	3
21	19PCS521	Video Analytics	3	0	0	3
22	19PCS522	Social Network Analysis	3	0	0	3
23	19PCS523	Software Architectures and Design	3	0	0	3
24	19PCS524	Embedded Software Development	3	0	0	3
25	19PCS525	Smart Sensors and Internet of Things	3	0	0	3

OPEN ELECTIVES

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	19PCD601	Industrial Safety	3	0	0	3
2	19PCS602	Business Analytics	3	0	0	3
3	19PCM603	IOT for Smart Applications	3	0	0	3
4	19PPE604	Bioenergy from Waste	3	0	0	3
5	19PSE605	Smart City Technologies	3	0	0	3

Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

SEMESTER-I

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19PCS101	Advanced Data Structures and Algorithms	3	0	0	3
2.	19PCS102	Advanced Database Technologies	3	0	0	3
3.		Program Elective I	3	0	0	3
4.	19PGM701	Research Methodology and IPR	3	0	0	3
5.	19PGM801	Pedagogy Studies(Audit Course I)	2	0	0	0
PRACTICAL						
6.	19PCS103	Advanced Data Structures Laboratory	0	0	4	2
7.	19PCS104	Advanced Database Technologies Laboratory	0	0	4	2
Total			14	0	8	16
Total Number of Credits: 16						

19PCS101	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn advanced search structures and advanced heap structures - To introduce various advanced concurrent structures - To impart knowledge in graph algorithms - To learn various advanced algorithms					
UNIT I	ADVANCED SEARCH STRUCTURES	9			
Review of elementary data structures -Binary Search tree – AVL tree-Splay tree - Red Black trees – Interval tree - 2-D tree – Digital Search tree – Multi way Trie - Skip list					
UNIT II	ADVANCED HEAP STRUCTURES	9			
Min heap - Min-Max heap - Double ended heap – Leftist Heaps - Binomial Heaps – Fibonacci Heaps – Skew Heaps - Interval Heap.					
UNIT III	ADVANCED CONCURRENT STRUCTURES	9			
Concurrent hashing – closed-address hash sets – lock-free hash sets – open-addressed hash sets – lock-based concurrent skip lists – lock-free concurrent skip lists – concurrent priority queues – bounded priority queue – unbounded priority queue – concurrent heap – skip list based unbounded priority queues. .					
UNIT IV	GRAPH ALGORITHMS	9			
Graph: Definitions and Elementary Algorithms, Matroids: Introduction to greedy paradigm, Algorithm to compute a maximum weight maximal independent set, Application of MST. Flow-Networks: Maxflow-Mincut theorem, Ford-Fulkerson method to compute maximum flow, Edmond-Karp maximum-flow algorithm.					
UNIT V	ADVANCED ALGORITHMS	9			
Introduction to Approximation algorithms: Vertex cover - Travelling Salesman Problem - knapsack problem. Introduction to Randomized algorithms – Randomized Searching and Sorting - Online hiring problem. Introduction to Parallel algorithms – parallel sorting algorithms - Odd-even transposition sort - Quick sort based parallel sort.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain the advanced data structure concepts incorporated to handle non-linear data structures.(Understand) - Apply appropriate advanced data structure and algorithms to provide solutions for given problems. (Apply) - Analyze the performance of the data structure and algorithms based on the complexity of an algorithm. (Analyze) - Use modern IT tools in order to implement various data structures and algorithms.(Modern IT Tools) - Develop algorithms to perform operations on data structures to solve real world problems					

efficiently. (Create)

- Write and Present a technical report specifying the functionalities confined to the data structures and algorithms (Affective Domain)

REFERENCES:

1. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", Universities Press, 2007.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Prentice Hall of India, New Delhi, 2007
3. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, 2003.
4. V. Aho, J. E. Hopcroft, and J. D. Ullman, "The Design and Analysis of Computer Algorithms", Addison-Wesley, 1975.
5. David P. Williamson, David B. Shmoys, "The Design of Approximation Algorithms", Cambridge University Press, 2011.
6. Rajeev Motwani and PrabhakarRaghavan, "Randomized Algorithms", Cambridge University Press, 1995.

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the advanced data structure concepts incorporated to handle non-linear data structures.(Understand)		2				
Apply appropriate advanced data structure and algorithms to provide solutions for given problems. (Apply)		3				
Analyze the performance of the data structure and algorithms based on the complexity of an algorithm. (Analyze)		3				
Use modern IT tools in order to implement various data structures and algorithms.(Modern IT Tools)		3		3		
Design a solution for real time engineering problems using data structure algorithms that meet specified needs. (Create)		3				
Write and Present a technical report specifying the functionalities confined to the data structures and algorithms (Affective Domain)		3				

19PCS102	ADVANCED DATABASE TECHNOLOGIES	L	T	P	C
		3	0	0	3
OBJECTIVES : - To acquire knowledge on parallel and distributed databases and its applications. - To study the usage and applications of Object Oriented and Intelligent databases. - To understand the emerging databases like Mobile, XML, Cloud and Big Data.					
UNIT I	PARALLEL AND DISTRIBUTED DATABASES	9			
Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies					
UNIT II	INTELLIGENT DATABASES	9			
Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy – Applications - Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases - Recursive Queries in SQL - Spatial Databases- Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.					
UNIT III	OBJECT AND XML DATABASES	9			
Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance. XML Databases: XML - Related Technologies - XML Schema - XML Query Languages - Storing XML in Databases - XML and SQL.					
UNIT IV	MOBILE AND MULTIMEDIA DATABASES	9			
Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols - Multimedia Databases - Image Databases – Audio Databases - Video Databases.					
UNIT V	EMERGING TECHNOLOGIES	9			
Web Databases - Geographic Information Systems - Biological Data Management - Cloud Based Databases: Data Storage Systems on the Cloud - Cloud Storage Architectures - Cloud Data Models- Query Languages - Introduction to Big Data-Storage - Analysis.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Acquire the knowledge on the concepts of traditional and emerging databases.(Understand) - Interpret the real world data by using suitable databases(Apply) - Demonstrate an enhanced awareness of recent developments in database technologies. (Apply) - Design and develop substantial real life database applications for a scenario, with a professional approach to the system documentation.(Create) - Build appropriate database models for various application and in various types of platform (Create) - Express the findings of the working model through a novel presentation(Affective Domain)					

REFERENCES:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2011.
2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley, 2007.
3. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.
4. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition 2004.

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Acquire the knowledge on the concepts of traditional and emerging databases.(Understand)		3				
Interpret the real world data by using suitable databases(Apply)		3				
Demonstrate an enhanced awareness of recent developments in database technologies. (Apply)		3				
Design and develop substantial real life database applications for a scenario, with a professional approach to the system documentation.(Create)		3		3		
Build appropriate database models for various application and in various types of platform (Create)		3				
Express the findings of the working model through a novel presentation(Affective Domain)		3				

19PCS103	ADVANCED DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2
OBJECTIVES: • To acquire the knowledge of advanced tree structures and heap structures • To explore the advanced concurrent data structures such as hash table, priority queue and skip list • To impart the knowledge about graph algorithms • To learn to apply principles of efficient algorithm design and learn various advanced algorithms					
LIST OF EXPERIMENTS					
1. AVL Tree 2. Red black Tree 3. Tries 4. Min Heap and Max Heap 5. Deaps 6. Leftist Heap 7. hashing and concurrent hashing 8. Flow-network algorithms 9. Approximation algorithms / randomized algorithms. 10. Parallel sorting algorithms					
TOTAL: 60 Periods					
COURSE OUTCOMES: After successful completion of this course, the students will be able to: • Implement basic operations for efficient data processing in data structures.(Apply) • Implement programs on advanced algorithm used for Dynamic memory allocation.(Apply) • Analyze appropriate operations that handle collision in data storage and retrieval techniques.(Analyze) • Develop an algorithm for real time data processing applications. (Create)					

HARDWARE AND SOFTWARE REQUIRMENTS

HARDWARE REQUIREMENTS:

Personal Computers – 20 Numbers

SOFTWARE REQUIREMENTS:

Operating System: Linux (any flavor) / Windows

Any C++ compiler compatible with Linux / Windows

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Implement basic operations for efficient data processing in data structures.(Apply)		2				
Implement programs on advanced algorithm used for Dynamic memory allocation.(Apply)		3				
Analyze appropriate operations that handle collision in data storage and retrieval techniques.(Analyze)		3				
Design a solution for real time data processing applications. (Create)		3		3		

19PCS104	ADVANCED DATABASE TECHNOLOGIES LABORATORY	L	T	P	C
		0	0	4	2
OBJECTIVES: - To experiment with parallel and distributed databases and its applications. - To study and experiment the applications of Object Oriented and Intelligent databases. - To study and experiment with Active and Deductive databases - To study and experiment with ETL tool for consolidation of data warehouse					
LIST OF EXPERIMENTS					
Query Optimizer: Implement query with optimizer by accessing the meta data. Distributed Database: Create a distributed database and run various queries. Use stored procedures. Object-Oriented Database: Create OQL Queries to access the data from Object Oriented Database. Parallel Database: Access database from a programming language such as Java or Python. Active Databases: Create an Active Database including Triggers and assertions. Deductive Database: Create a knowledge database with facts and extract data using rules. ETL Tool: Use ETL tool to extract data from your transactional system to create a consolidated data warehouse or data mart for reporting and analysis. Sanssouci / Oracle Database: Store and retrieve voluminous data using SanssouciDB / Oracle DB. NoSQL: Expose supermarket and genre information stored in Oracle NoSQL Database and access NoSQL data from Oracle Database using SQL queries. Integrating Web Database: Build Web applications using Java servlet API for storing data in databases that can be queried using variant of SQL. TOTAL: 60Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Apply optimization techniques for relational algebraic expressions (Apply) - Develop web applications using variant of SQL(Apply) - Create Active and Deductive database to extract the data(Create) - Design and Develop modern database applications, including database development environment and tools(Create)					

SOFTWARE AND HARDWARE REQUIREMENT

HARDWARE REQUIREMENTS:

Standalone desktops 20 Nos (or) Server supporting 20 terminals or more

SOFTWARE REQUIREMENTS:

Front end: VB or Equivalent

Back end: Oracle / SQL / MySQL / PostGress / DB2 or Equivalent

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Apply optimization techniques for relational algebraic expressions (Apply)		2		2		
Create Active and Deductive database to extract the data(Create)		3		3		
Design and Develop modern database applications, including database development environment and tools(Create)		3		3		
Develop web applications using variant of SQL(Apply)		3		3		

SEMESTER-II

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	19PCS201	Image Processing and Analysis	3	0	0	3
2.	19PCS202	Cloud Computing Technologies	3	0	0	3
3.		Program Elective II	3	0	0	3
4.	19PGM802	English for Research Paper Writing(Audit Course 2)	2	0	0	0
PRACTICAL						
5.	19PCS203	Image Processing and Analysis Laboratory	0	0	4	2
6.	19PCS204	Cloud Computing Technologies Laboratory	0	0	4	2
7.	19PCS205	Mini Project with Seminar	0	0	6	3
Total			11	0	14	16
Total Number of Credits: 16						

19PCS201	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To impart the knowledge in spatial domain processing and frequency domain processing in digital images. - To know the segmentation and compression methodologies in digital images. - To explain the methods of image representation					
UNIT I	DIGITAL IMAGE FUNDAMENTALS	9			
Introduction to image processing – image sensing and acquisition –image Acquisition- image sampling and quantization – representing digital images-spatial and gray level resolution-Basic relationship between pixels-neighbors of pixel-Adjacency-connectivity-distance measures-image operations on a pixel basis- Color models – pseudo colors – full-color image processing					
UNIT II	SPATIAL AND FREQUENCY DOMAIN PROCESSING	9			
Image enhancement in spatial domain-gray level transformations- histogram processing – Enhancement using Arithmetic/logic operations – spatial filtering –smoothing spatial filters-sharpening spatial filters - Introduction to the Fourier transform and frequency domain concepts, low pass filter, high pass filter.					
UNIT III	SEGMENTATION AND FEATURE EXTRACTION	9			
Detection of discontinuities – edge linking and boundary detection –Thresholding –region based segmentation –segmentation by morphological watersheds – the use of motion in segmentation – representation and description-boundary descriptor-regional descriptors – Classification of features-General features-Domain specific features –types of feature extraction methods-feature selection					
UNIT IV	IMAGE COMPRESSION	9			
Compression-fundamentals-redundancy in images –coding redundancy –image compression models – basic compression methods – error free compression-variable length coding-bit plane coding-lossless predictive coding- lossy compression- lossy predictive coding-image compression standards-digital image watermarking.					
UNIT V	IMAGE REPRESENTATION AND RECOGNITION	9			
Boundary representation-Chain code-Polygonal approximation-signature-boundary segments-boundary description-shape number- Fourier descriptor-moments-regional descriptors-topological feature-texture-pattern and pattern classes-recognition based on matching.					
TOTAL:45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
- Explain the image formation and the role of visual system plays in perception of gray and color image data. (Understand) - Apply various Image Processing Techniques to solve problems in different domains (Apply) - Analyze a wide range of problems and provide solutions related to the image processing systems through appropriate algorithms.(Analyze) - Evaluate the performance of Image processing techniques based on various parameters which makes the image suitable for further analysis. (Evaluate) - Develop an algorithm to manipulate various image processing techniques to solve real time					

problems. (Create)

- Prepare a Presentation to analyze various Image Processing Techniques for Real time Applications (Affective Domain)

REFERENCES:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Third Edition, Pearson, 2008.
2. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
3. W. Burger and M. Burge, "Digital Image Processing: An Algorithmic Introduction using Java", Springer, 2008.
4. John C. Russ, "The Image Processing Handbook", Sixth Edition, CRC Press, 2011.
5. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
6. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packet Publishing, 2012.
7. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the image formation and the role of visual system plays in perception of gray and color image data. (Understand)		2				
Apply various Image Processing Techniques to solve problems in different domains (Apply)		3				
Analyze a wide range of problems and provide solutions related to the image processing systems through appropriate algorithms. (Analyze)		3				
Evaluate the performance of Image processing techniques based on various parameters which makes the image suitable for further analysis. (Evaluate)		3				
Design a solution for real time problems using various image processing techniques. (Create)		3		3	2	
Prepare a Presentation to analyze various Image Processing Techniques for Real time Applications (Affective Domain)		3				

19PCS202	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3
OBJECTIVES : • The student will also learn how to apply trust-based security model to real-world security Problems. • An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures. • Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.					
UNIT I	INTRODUCTION TO CLOUD COMPUTING	8			
Cloud Computing introduction and its overview, Types of clouds, Risks in Cloud Computing, Novel applications of cloud computing, Various Services offered by Cloud, Benefits and Challenges in cloud.					
UNIT II	CLOUD COMPUTING ARCHITECTURE AND ITS DEPLOYMENT MODEL	9			
Requirements, Introduction Cloud computing architecture, Virtualization in Cloud computing and its types, Network Virtualization, Storage Virtualization, CPU Virtualization, Role of Hypervisor in Virtualization and its types, The SPI Framework for Cloud Computing / The Cloud Services Delivery Model, Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise					
UNIT III	SECURITY ISSUES IN CLOUD COMPUTING	9			
Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management					
UNIT IV	SECURITY MANAGEMENT AND PRIVACY ISSUES IN THE CLOUD	10			
Security Management Standards, Security Management in the Cloud, Availability Management for SaaS, PaaS, IaaS. Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S.Laws and Regulations, International Laws and Regulations					
UNIT V	AUDIT AND COMPLIANCE	9			
Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud					
TOTAL: 45Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Illustrate the taxonomy, types of cloud models, its components, its working principles and their services [Understand] • Review the various privacy issues and employ various privacy protecting principles in cloud computing [Apply] • Exercise the auditing to provide better compliance in the cloud environment [Apply] • Distinguish the various privacy issues and quantify the privacy Risk management laws and Regulations [Analyze]					

- Evaluate the cloud security standards, Protocols and practices to resolve the cloud security issues [Evaluate]
- Express the efficient way of finding the ways to create a cloud based environment for the given Application [Affective Domain]

REFERENCES:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009.

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Illustrate the taxonomy, types of cloud models, its components, its working principles and their services[Understand]		2				
Review the various privacy issues and employ various privacy protecting principles in cloud computing [Apply]		2				
Exercise the auditing to provide better compliance in the cloud environment [Apply]		2			2	
Distinguish the various privacy issues and quantify the privacy Risk management laws and Regulations [Analyze]		3				
Evaluate the cloud security standards, Protocols and practices to resolve the cloud security issues [Evaluate]		3				
Express the efficient way of finding the ways to create a cloud based environment for the given Application [Affective Domain]		3				2

19PCS203	IMAGE PROCESSING AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2
OBJECTIVES: To familiarize the processing and analysis of digital images.					
LIST OF EXPERIMENTS					
1. Basic Operations on Image a. Negation of an image b. Histogram c. Neighborhood operations d. conversion between color spaces. 2. Histogram Equalization. 3. Filtering in Spatial Domain 4. Filtering in Frequency Domain. 5. Segmentation using Region Spilt and merge. 6. Boundary Extraction 7. Compression Algorithms 8. Chaincode Detection 9. Extraction of Texture Feature 10 Image Recognition					
TOTAL: 60Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to - Apply basic operations on Image for extracting useful information.(Apply) - Perform various Image Processing techniques in digital images for wide applications (Apply) - Analyze various Image Processing techniques for recognizing and employing effective solutions (Analyze) - Develop any real application using digital Image Processing techniques.(Create)					

SOFTWARE AND HARDWARE REQUIREMENT

HARDWARE REQUIREMENTS:

Standalone desktops 20Nos (or) Server supporting 20 terminals or more

SOFTWARE REQUIREMENTS: Open Source Scilab

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Apply basic operations on Image for extracting useful information.(Apply)		2				
Perform various Image Processing techniques in digital images for wide applications (Apply)		3				
Analyze various Image Processing techniques for recognizing and employing effective solutions (Analyze)		3				
Design solutions to real application using digital Image Processing techniques.(Create)		3		2	2	

19PCS204	CLOUD COMPUTING TECHNOLOGIES LABORATORY	L	T	P	C
		0	0	4	2
OBJECTIVES: - To learn how to use Cloud Services - To implement Virtualization - To implement Task Scheduling algorithms - To implement Energy-conscious model - To build Private Cloud					
LIST OF EXPERIMENTS					
- Study and Usage of Google Apps. - Implement Virtual OS using virtual box. - Simulate VM allocation algorithm using CloudSim - Simulate Task Scheduling algorithm using CloudSim - Simulate Energy-conscious model using CloudSim - Setup a Private Cloud Using Open Stack or Eucalyptus. - Install and configure Open Stack Object Storage - Swift in Ubuntu - Implement Open Stack Nova-Compute - Implement Open Stack Image services – Glance. - Implement Map Reduce concept for an application TOTAL: 60Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Apply virtuality to model the virtual environment and to improve the process of sharing the available resources among the connected devices [Apply] - Simulate the virtual resources to build and manage private and public clouds to conserve the energy in an efficient manner [Apply] - Create virtual machines from available Physical Resources using the suitable platform in order to facilitate the execution of various processes in a more sophisticated way. [Create] - Develop a novel framework to emphasis the core functionalities of various Cloud based Applications [Create]					

HARDWARE AND SOFTWARE REQUIRMENTS

HARDWARE REQUIREMENTS: Computers Required – 20 Nos.

SOFTWARE REQUIREMENTS: Eucalyptus or Open Nebula or equivalent

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Apply Virtuality to model the virtual environment and to improve the process of sharing the available resources among the connected devices [Apply]		2				
Simulate the virtual resources to build and manage private and public clouds to conserve the energy in an efficient manner [Apply]		3		2		
Create virtual machines from available Physical Resources using the suitable platform in order to facilitate the execution of various processes in a more sophisticated way. [Create]		3		2	1	
Develop a novel framework to emphasis the core functionalities of various Cloud based Applications[Create]		3			2	

19PCS205	MINI PROJECT WITH SEMINAR	L	T	P	C
		0	0	6	3
Teaching Scheme Lectures: 6hrs/week		Examination Scheme Marks :100			
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Explain contemporary / emerging technology for various processes and systems. • Share knowledge effectively in oral and written form and formulate documents.					
SYLLABUS CONTENTS: The students are required to search / gather the material / information on a specific a topic Comprehend it and present / discuss in the class.					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Identification of a domain specific scholarly topic(Apply) • Investigate and tabulate details and history about the selected topic(Analyse) • Application of the selected topic in domain or real life(Create) • Technical report writing of the implementation(Affective Domain) • Demonstrating the communication skills by good presentation and engaging the audience(Affective Domain)					

SEMESTER-III

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.		Program Elective III	3	0	0	3
2.		Program Elective IV	3	0	0	3
3.		Program Elective V	3	0	0	3
4.		Open Elective	3	0	0	3
PRACTICAL						
5.	19PCS301	Dissertation-I /Industrial Project	0	0	20	10
Total			12	0	20	22
Total Number of Credits: 22						

19PCS301	DISSERTATION-I /INDUSTRIAL PROJECT	L	T	P	C
		0	0	20	10
Every candidate shall be permitted to undertake a research based project work of his/her choice related to his / her discipline in consultation with the Head of the Department. The project shall be supervised by a faculty member of the Department in which the candidate registered a course. In case of a Dissertation work at Industrial / Research organization, the Dissertation work shall be jointly supervised by the faculty supervisor and an expert from the organization. He / She shall be required to undergo three reviews in a semester to assess the progress of the project work. The project work shall be evaluated based on the Dissertation report submitted by the candidate and Viva-voce examination conducted by a committee consisting of an external examiner, internal examiner, and the supervisor of the candidate.					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Application of different skills learned in the program for implementation(Apply) • Evaluate the performance of the work with existing methodologies(Evaluate) • Technical report writing and Publication of research work in referred journals(Affective Domain) • Communicate and present the work to the relevant audience(Affective Domain)					

SEMESTER-IV

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	19PCS401	Dissertation II	0	0	32	16
Total			0	0	32	16
Total Number of Credits: 16						

19PCS401	DISSERTATION-II	L	T	P	C
		0	0	32	16
Every candidate shall be permitted to undertake a research based project work of his/her choice related to his / her discipline in consultation with the Head of the Department. The Dissertation shall be supervised by a faculty member of the Department in which the candidate registered a course. In case of a Dissertation work at Industrial / Research organization, the Dissertation work shall be jointly supervised by the faculty supervisor and an expert from the organization. He / She shall be required to undergo three reviews in a semester to assess the progress of the project work. The Dissertation work shall be evaluated based on the Dissertation report submitted by the candidate and Viva-voce examination conducted by a committee consisting of an external examiner, internal examiner, and the supervisor of the candidate. In addition to that, the candidate should publish his/her work and the details have to be submitted at the time of Viva-voce.					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Enhance the knowledge of the research objectives and research process by surveying relevant literature (Apply) • Investigate and tabulate details and history about the selected research topic (Analyse) • Devise a mechanism to solve selected research topic (Create) • Foresee how their current and future work will influence/impact the economy, society and environment (Evaluate) • Technical report writing and Publication of research work in referred journals (Affective Domain) • Demonstrating and communicating the work to the relevant audience (Affective Domain)					

ELECTIVES

19PMA501	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	L	T	P	C
		3	0	0	3
OBJECTIVES : • To understand the mathematical fundamentals that is prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics Machine learning. • To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency. • To study various sampling and classification problems.					
UNIT I	NUMBER THEORY	9+1			
Divisibility: properties of divisibility, fundamental theorem of arithmetic, division algorithm, Euclidean algorithm, extended Euclidean algorithm. Arithmetical functions - Mobius function, Euler - totient function. Congruence - basic properties of congruence, residue classes and complete residue system, linear congruences.					
UNIT II	GRAPH THEORY	8+1			
Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition, Networks- Maximum flow problems.					
UNIT III	STOCHASTIC PROCESSES	9+1			
Introduction-Markov chains- applications, Discrete Even Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing systems					
UNIT IV	RANDOM SAMPLES	8+1			
sampling distributions of estimators, Methods of Moments and Maximum Likelihood					
UNIT V	STATISTICAL INFERENCE	9+1			
Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over fitting model assessment.					
TOTAL : 48 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • To understand the basic notions of discrete and continuous probability. • To understand the methods of statistical inference, and the role that sampling distributions play in those methods. • To be able to perform correct and meaningful statistical analyses of simple to moderate Complexity.					

REFERENCES:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley
5. Operations Research: Applications and Algorithms by Wayne L. Winston
6. GUPTA S.C , KAPOOR V.K. "Fundamental of Mathematical Statistics" 10th Edition ,Sultan Chand and Sons , New Delhi 2002

19PCS502	DATA WAREHOUSE AND DATA MINING	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce data warehousing and mining techniques. - To provide the knowledge of Cluster Analysis for Pattern Matching - To make the students aware of the application of data mining in Time series data mining, Data Stream mining and web mining,					
UNIT I	DATA WAREHOUSING AND MINING FREQUENT , SEQUENTIAL PATTERNS	8			
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods					
UNIT II	CLUSTER ANALYSIS	9			
Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns					
UNIT III	TIMESERIES DATA MINING	9			
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;					
UNIT IV	DATA STREAM MINING	10			
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;					
UNIT V	WEB MINING	9			
Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.					
TOTAL:45Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Analyse various frequent pattern and sequential pattern mining methods for the problems. - Perform cluster analysis for classification and prediction problems. - Extract patterns from time series data and its application in real world. - Identify the methods for processing and mining stream data. - Utilize web mining and classification methods.					

REFERENCES:

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

19PCS503	OPERATING SYSTEM DESIGN	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn the fundamentals of Operating Systems - To gain knowledge on Process management and memory management concepts - To know the components and management aspects of Distributed , Real time and Mobile operating systems					
UNIT I	INTRODUCTION	8			
Basics of Operating Systems: Definition – Generations of Operating systems – Types of Operating Systems- OS Service- System Calls, OS structure: Layered – Monolithic- Microkernel Operating Systems – Concept of Virtual Machine					
UNIT II	PROCESS MANAGEMENT AND MEMORY MANAGEMENT	10			
Overview of process - Process scheduling criteria - process scheduling algorithms - Process Synchronization – Semaphores - Monitors , Memory Management– Fragmentation- Paging -Virtual Memory – Demand Paging– Case Study					
UNIT III	I/O MANAGEMENT AND FILE MANAGEMENT	9			
I/O devices-Device controllers- Interrupt handlers - Device drivers, File concepts and methods-Directory structure - File System structure - Allocation methods - Free-space management - directory implementation ,Secondary Storage – Disk scheduling- Case Study					
UNIT IV	DISTRIBUTED OPERATING SYSTEMS	9			
Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols -Case Study					
UNIT V	REAL TIME AND MOBILE OPERATING SYSTEMS	9			
Basic Model of Real Time Systems – Characteristics - Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems – Micro Kernel Design - Client Server Resource Access –Case Study					
TOTAL:45Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to: - Interpret the basics in operating Systems. - Apply the suitable algorithms for various problem related to process scheduling and memory management - Illustrate the I/O and File Management Concepts. - Describe the concepts of Distributed Operating Systems. - Familiarize with the Real Time And Mobile Operating Systems					

REFERENCES:

1. Advanced concept in operating system: M. Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings
3. Operating Systems: Gary J.Nutt Addison Wesley, 2004.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson, 2006.

19PCS504	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To study big data for business intelligence and learn business case studies for big dataAnalytics. - To impartthe knowledge in NoSQL big data management. - To perform map-reduce analytics using Hadoop and related tools					
UNIT I	INTRODUCTION TO BIG DATA AND TECHNOLOGIES	9			
Big Data and its importance - Four V's of Big Data - Drivers for Big data, Big data analytics- Structure of Big Data -Fraud - Risk of Big Data - industry examples of big data- Credit risk management, health care, big data technologies - Introduction to Hadoop - open source technologies - cloud and big data, mobile business intelligence - Crowd sourcing analytics- inter and trans firewall analytics.					
UNIT II	NOSQL - DATA MANAGEMENT FOR BIG DATA	9			
Introduction to NoSQL- aggregate data models, aggregates - key-value and document data models, relationships, graph databases – schemaless databases - materialized views - distribution models shading- master-slave replication- peerpeer replication- sharing and replication- consistency- relaxing consistency - version stamps - map-reduce- partitioning and combining - composing map-reduce calculations.					
UNIT III	HDFS(HADOOP DISTRIBUTED FILE SYSTEM)	9			
Data format, analyzing data with Hadoop, scaling out - Hadoop streaming - Hadoop pipes - design of Hadoop distributed file system (HDFS) - HDFS concepts - Java interface - data flow - Hadoop I/O - data integrity – compression – serialization – Avro - file-based data structures.					
UNIT IV	MAPREDUCE	9			
MapReduce workflows - unit tests with MRUnit - test data and local tests- anatomy of MapReduce job run, classic Map-reduce – YARN - failures in classic Map-reduce and YARN - job scheduling - shuffle and sort- task execution- MapReduce types - input formats- output formats.					
UNIT V	BIG DATA FRAMEWORKS	9			
Hbase - data model and implementations - Hbase clients - Hbase examples – praxis – Cassandra- Cassandra data model - Cassandra examples - Cassandra clients - Hadoop integration. Pig- Grunt- pig data model- Pig Latin→- developing and testing - Pig Latin scripts. Hive - data types and file formats- HiveQL data definition - HiveQL data manipulation- HiveQL queries.					
TOTAL:45Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain the varies concepts of Big Data and different types of frame work to handle Big Data (Understand) - Apply the concepts of Hadoop, YARN and Map Reduce Programming for Big Data Applications. (Apply) - Analyze and differentiate SQL and No - SQL databases and the varies Big data framework with respect to their architecture(Analyze) - Analyze the performance of different types of data analytic techniques on real time streaming(Analyze) - Develop applications using Hadoop and Map Reduce Framework(Create)					

- Write a project report to analyze and summaries the usage of social networks like Facebook, Twitter, and LinkedIn for different users. (Affective Domain)

REFERENCES:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced AnalyticsII, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, —Intelligent Data AnalysisII, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.
7. Vinesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the varies concepts of Big Data and different types of frame work to handle Big Data (Understand)		3				
Apply the concepts of Hadoop, YARN and Map Reduce Programming for Big DataApplications. (Apply)		3		2		
Analyze and differentiate SQL and No - SQL databases and the varies Big data framework with respect to their architecture(Analyze)		3				
Evaluate the performance of different types of data analytic techniques on real time streaming(Analyze)		3				
Develop applications using Hadoop and Map Reduce Framework(Create)		3		3	2	
Write a project report to analyze and summaries the usage of social networks like Facebook, Twitter, and LinkedIn for different users. (Affective Domain)		2				

19PCS505	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
OBJECTIVES: - To learn the foundations of various learning models. - To know and analyze various machine learning algorithms and techniques - Explore supervised and unsupervised learning paradigms of machine learning. - To explore Deep learning techniques and various feature extraction strategies.					
UNIT I	FOUNDATIONS OF LEARNING	9			
Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation-generalization tradeoff – bias and variance – learning curve					
UNIT II	SUPERVISED LEARNING (REGRESSION/CLASSIFICATION)	9			
Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking					
UNIT III	UNSUPERVISED LEARNING	9			
Unsupervised Learning Clustering: K-means / Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)-Independent Component Analysis-Apriori algorithm-Singular value decomposition					
UNIT IV	EVALUATING MACHINE LEARNING ALGORITHMS	9			
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests) Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data					
UNIT V	OTHERS LEARNING	9			
Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.. Applications of Machine Learning in the Real world Environments Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain the various learning models and methods to facilitate the automation learning (Understand) - Applying the suitable strategy to identify the pros and cons of various Learning techniques (Apply) - Employing the various supervised and unsupervised algorithms to derive the solution for the complex Problems (Analyze) - Experiment different Learning Techniques to obtain the optimal solution for the Real world problems (Evaluate) - Create a module to test and analyze complex datasets employed in various complex Engineering Problems (Create)					

- Express the suitable way of obtaining the solution for the given real time problem and responds to the others suggestion. (Affective Domain)

REFERENCES:

1. Tom M Mitchell, —Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. EthemAlpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014
4. Hastie, Trevor, Tibshirani, Robert, Friedman, Jerome, The Elements of Statistical Learning. Data Mining, Inference, and Prediction, Second Edition, February 2009, Springer.
5. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019.
6. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.
7. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
8. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the various learning models and methods to facilitate the automation learning [Understand]		2				
Applying different strategies to observe the suitability of various Learning techniques [Apply]		2				
Employing the various supervised and unsupervised algorithms to derive the solution for the complex Problems [Analyze]	2	3				
Experiment different Learning Techniques to obtain the optimal solution for the Real world problems [Evaluate]		3		2		
Create a framework to test and analyze complex datasets employed in various		3		2		1

complex Engineering Problems [Create]						
Express the suitable way of obtaining the solution for the given real time problem and responds to the others suggestion [Affective Domain]		2	2			1

19PCS506	MULTICORE ARCHITECTURE	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce the recent trends in the field of Computer Architecture and identify performance related parameters - To explain the need for parallel processing - To outline the different types of multicore architectures and familiarize the students in multicore programming					
UNIT I	NEED FOR MULTICORE ARCHITECTURES	9			
Fundamentals of Computer Design -Measuring and Reporting Performance -Instruction Level Parallelism and its Exploitation -Concepts and Challenges – Limitations of ILP – Multithreading – SMT and CMP Architectures – The Multicore era.					
UNIT II	MULTIPROCESSOR ISSUES	9			
Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – Models of Memory Consistency Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.					
UNIT III	MULTICORE ARCHITECTURES	9			
Homogeneous and Heterogeneous Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture – GPGPU Architectures.					
UNIT IV	MEMORY HIERARCHY DESIGN	9			
Introduction -Optimizations of Cache Performance -Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines -Design of Memory Hierarchies -Case Studies.					
UNIT V	MULTICORE PROGRAMMING	9			
Parallel Programming models – Shared Memory Programming – Message Passing Interface – Open MP Program Development and Performance Tuning.					
TOTAL:45Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Identify the limitations of ILP and the need for multicore architectures - Discuss the issues related to multiprocessing and suggest solutions - Point out the salient features of different multicore architectures and how they exploit parallelism - Explain the different parallel programming models - Develop programs using open MP and optimize them					

REFERENCES:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier, 5th Edition, 2012.
2. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann / Elsevier, 2011.
3. Michael J Quinn, Parallel Programming in C with MPI and OpenMP, Tata McGraw Hill, 2003.
4. Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris", Pearson, 2011.
5. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/Software Approach", Morgan Kaufmann / Elsevier, 1997.

19PCS507	DATA STORAGE TECHNOLOGIES AND NETWORKS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce the fundamentals of Storage Media Technologies - To acquire the knowledge of Storage Area networks - To impart the concept of large storages and its issues					
UNIT I	STORAGE MEDIA AND TECHNOLOGIES	9			
Storage Media and Technologies – Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.					
UNIT II	USAGE AND ACCESS	9			
Usage and Access – Positioning in the Memory Hierarchy, Hardware and Software Design for Access, Performance issues.					
UNIT III	LARGE STORAGES	9			
Large Storages – Hard Disks, Networked Attached Storage, Scalability issues, Networking issues. Case study: Recent Trends related to Copy data management.					
UNIT IV	STORAGE ARCHITECTURE	8			
Storage Architecture - Storage Partitioning, Storage System Design, Caching, Legacy Systems.					
UNIT V	STORAGE AREA NETWORKS	10			
Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids. Storage QoS–Performance, Reliability, and Security issues. Case study: Software defined storage appliances.					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Learn Storage System Architecture - Illustrate the need for Storage Area Network and Data protection to satisfy the information explosion requirements - Describe the large storages and its issues. - Outline the management of Storage architectures. - Build software designed appliances					

REFERENCES:

1. The Complete Guide to Data Storage Technologies for Network-centric Computing Paperback–Import, Mar 1998 by Computer Technology Research Corporation
2. Data Storage Networking: Real World Skills for the CompTIA Storage by Nigel Poulton

19PCS508	WEB ANALYTICS AND DEVELOPMENT	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn the concepts of web analytics - To gain knowledge about information retrieval - To Learn to Model web applications - To explore use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.					
UNIT I	INTRODUCTION	10			
Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization					
UNIT II	WEB ANALYTICS TOOLS	8			
Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys					
UNIT III	WEB SEARCH AND RETRIEVAL	9			
Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models					
UNIT IV	MAKING Connection	9			
Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity					
UNIT V	CONNECTION	9			
Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain web and social media analytics - Analyze the various web analytics tools - Make use of web analytics processes and metrics to measure online success - Identify the challenges faced by businesses in getting the right data - Become familiar with core research communities, publications, focused on web and social media analytics					

REFERENCES:

- Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analyzing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann, 304.
AvinashKaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.
- Easley, D. & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press.
- <http://www.cs.cornell.edu/home/kleinber/networks-book/>
- Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press.

19PCS509	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3
OBJECTIVES : - Provides an in-depth study of the rapidly changing and fascinating field of computer forensics. - Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes. - Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools - E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics					
UNIT I	DIGITAL FORENSICS SCIENCE AND COMPUTER CRIME	9			
Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics					
UNIT II	CYBER CRIME SCENE ANALYSIS	9			
Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.					
UNIT III	EVIDENCE MANAGEMENT & PRESENTATION	9			
Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.					
UNIT IV	COMPUTER AND NETWORK FORENSICS	9			
Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case, Network Forensics: open-source security tools for network forensic analysis, requirements for preservation of network data.					
UNIT V	MOBILE FORENSICS	9			
Mobile Forensics: mobile forensics techniques, mobile forensics tools. Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008. Case study : Recent trends in mobile forensic technique to seizure electronic evidence					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Interpret relevant legislation and codes of ethics - Analyze Computer forensics and digital detective and various processes, policies and procedures - ExemplifyE-discovery, guidelines and standards, E-evidence, tools and environment. - Examine mobile forensics techniques					

REFERENCES:

1. John Sammons, The Basics of Digital Forensics, Elsevier
2. 2. John Vacca, Computer Forensics: Computer Crime Scene Investigation, Laxmi Publications

19PCS510	BIOMETRICS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To Study the basics of Biometrics and its functionalities - To Study the various Bio metric Technologies - To expose the concept of Biometric Systems - To outline the various measurements of Biometrics - To learn to develop applications with biometric security					
UNIT I	INTRODUCTION	8			
Introduction and Definitions of bio-metrics, Traditional authenticated methods and technologies.					
UNIT II	BIO-METRIC TECHNOLOGIES	10			
Bio-metric technologies: Fingerprint, Face, Iris, Hand Geometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA.					
UNIT III	USE OF BIO-METRIC SYSTEMS	8			
The Law and the use of multi bio-metrics systems.					
UNIT IV	VARIOUS MEASUREMENTS OF BIOMETRICS	10			
Statistical measurement of Bio-metric. Bio-metrics in Government Sector and Commercial Sector. Case studies of 3D face recognition and DNA matching.					
UNIT V	CASE STUDY	9			
Case Studies of bio-metric system, Bio-metric Transaction. Bio-metric System Vulnerabilities.					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Perform R&D on bio-metrics methods and systems. - Classify the various modules constituting a bio-metric system. - Familiarize with different bio-metric traits and to appreciate their relative significance. - Evaluate and design security systems incorporating bio-metrics. - Recognize the challenges and limitations associated with bio-metrics.					

REFERENCES:

1. Biometrics for network security, Paul Reid, Hand book of Pearson
2. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, SpringerVerlag, 2003.
3. A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.
4. J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology,
5. Design and Performance Evaluation, Springer, 2004.
6. Anil Jain, Arun A. Ross, Karthik Nanda kumar, Introduction to biometric, Springer, 2011.
7. Biometric Systems: Technology, Design and Performance Evaluation, J. Wayman, A.K.Jain, D. Maltoni, and D. Maio

19PCS511	SOFT COMPUTING	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario. - To implement soft computing based solutions for real-world problems. - To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms. - To provide student an hand-on experience on MATLAB to implement various strategies.					
UNIT I	INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORK	8			
Introduction To Soft Computing And Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics					
UNIT II	FUZZY LOGIC	10			
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.					
UNIT III	NEURAL NETWORKS	10			
Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks, Recent Trends in deep learning, various classifiers, neural networks					
UNIT IV	GENETIC ALGORITHMS	9			
Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition, Recent trends in Genetic Algorithms.					
UNIT V	MATLAB/PYTHON LIB	8			
Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic., Implementation of recently proposed soft computing techniques.					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Apply machine learning ideas to real world problems. - Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems. - Apply neural network algorithms to machine learning systems. - Apply genetic algorithms to combinatorial optimization problems. - Provide matlab or python solutions to soft computing based problems.					

REFERENCES:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual
4. Andreas C. Müller & Sarah Guido, "Introduction to Machine Learning with Python – A Guide for Data Scientists", O'Reilly Media, Inc, 2016.

19PCS512	SECURITY IN COMPUTING	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn the vulnerabilities and threats in the computing systems - To understand the cryptography based approaches in security - To know the implementation and use of security mechanisms					
UNIT I	SECURITY ISSUES IN COMPUTING	9			
Introduction to computer security–Computer criminals–Methods of defense–Cryptography–Terminology and background-Making encryption algorithms–Data encryption standard: Background and history-Overview of DES algorithm-Fundamentals concepts of DES-Double and triple DES.					
UNIT II	PROGRAM SECURITY AND NETWORK SECURITY	9			
Secure programs-Nonmalicious program errors-Threats in networks-Network security controls-Firewalls: Types- Design of firewall-Personal firewall-Comparison of firewall types.					
UNIT III	DATABASE SECURITY AND DATA MINING SECURITY	9			
Introduction to databases-Security requirements–Reliability and integrity–Sensitive data –Inference: Direct attack and indirect attack–Multilevel database–Data mining-Privacy and sensitivity–Data correctness and integrity –Availability of data.					
UNIT IV	DESIGN AND PROTECTION OF OPERATING SYSTEM	9			
Protected objects and methods of protection-Memory and address protection-Control of access to general objects-User authentication-Trusted system–Security policies–Models of security-Trusted operating system design.					
UNIT V	LEGAL ISSUES IN COMPUTER SECURITY	9			
Protecting programs and data–Information and the law–Rights of employees and employers–Computer crime-Administering security-Security planning–Risk analysis–Organizational security policies.					
TOTAL: 45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain the major Security issues in database and operating system in computing (understand) - Apply basic cryptographic algorithms for encryption and decryption to secure programs and data for the OS.(Apply) - Analyze the security problems in database systems and data mining in security computing.(Analyze) - Evaluate the performance test for Web and Desktop Application through Security Testing Techniques.(Evaluate) - Design the security policies (such as authentication, integrity and confidentiality), as well as database to implement and design the legal issues in computer security.(Create). - Summarize various types of legal issues while adopting security protocols(Affective Domain)					

REFERENCES:

1. Charles B. fleeger and Shari Lawrence Pfleeger, Security in Computing, Fifth Edition, 2015, Pearson Education.
2. William Stallings, Cryptography and Network Security: Principles and Practice, Prentice Hall of India/Pearson Education, New Delhi, Fifth edition, 2011.
3. Dieter Gollmann, Computer Security, John Wiley & Sons Ltd., 2011.
4. Douglas R. Stinson, Cryptography Theory and Practice, CRC, 2006

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the major Security issues in database and operating system with respect to computing (understand)		3				
Apply basic cryptographic algorithms for encryption and decryption to secure programs and data for the OS.(Apply)		3				
Analyze the security problems in database systems and data mining in security computing.(Analyze)		3				
Evaluate the performance test for Web and Desktop Application through Security Testing Techniques.(Evaluate)		3				
Design the security policies (such as authentication, integrity and confidentiality), as well as database to implement and design the legal issues in computer security. (Create)		3		2	2	
Summarize various types of legal issues while adopting security protocols(Affective Domain)		3				

19PCS513	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn feed forward deep networks - To understand convolutional networks and sequence modelling - To study probabilistic models and auto encoders - To expose the students to various deep generative models - To study the various applications of deep learning					
UNIT I	DEEP NETWORKS	9			
Machine Learning Basics: Learning Algorithms – Supervised and Unsupervised learning – Feed forward Deep networks – regularization – Optimization for training Deep models.					
UNIT II	CONVOLUTIONAL NETWORKS AND SEQUENCE MODELLING	9			
Convolutional Networks – Convolution operation – Motivation Pooling – Basic Convolution function – Algorithms – Recurrent and recursive nets : Recurrent neural networks – Bidirectional RNN – Recursive Neural networks – Auto regressive networks – Long term dependencies – Temporal dependencies – Approximate search.					
UNIT III	PROBABILISTIC MODELS AND AUTO ENCODERS	9			
Structured Probabilistic models : Challenges of unstructured modelling – using graphs to describe model structure – Learning about dependencies – inference –Monte Carlo Methods- Deep learning approach : Linear Factor models and Auto encoders.					
UNIT IV	DEEP GENERATIVE MODELS	9			
Restricted Boltzmann Machines – Deep Belief networks – Deep Boltzmann machine – Convolutional Boltzmann machine - Boltzmann Machines for Structured or Sequential Outputs.					
UNIT V	PRACTICAL METHODOLOGY	9			
Performance Metrics - Default Baseline Models - Determining Whether to Gather More Data - Selecting Hyper parameters - Debugging Strategies - Example: Multi-Digit Number Recognition – Applications: Computer vision - Natural language processing.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Explain the basic and advanced concepts used in machine learning and deep learning techniques. (Understand) - Apply various deep learning techniques to provide solutions for real-world applications (Apply) - Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains. (Analyze) - Estimate the performance of the deep learning algorithms and make judgments based on various criteria and standards. (Evaluate) - Design various deep learning models and architectures to solve real world problems. (Create) - Write and present a technical report specifying the findings of the working model following the ethical principles. (Affective Domain)					

REFERENCES:

1. YoshuaBengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015
2. Li Deng, Dong Yu, "Deep Learning: Methods and Applications", now publishers, 2014
3. Special Issue on deep learning for speech and language processing, IEEE Transaction on Audio, Speech and Language Processing, vol. 18, iss. 5, 2010

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the basic and advanced concepts used in machine learning and deep learning techniques. (Understand)	2					
Apply various deep learning techniques to provide solutions for real-world applications (Apply)	3					
Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains. (Analyze)		3				
Estimate the performance of the deep learning algorithms and make judgments based on various criteria and standards. (Evaluate)			3			
Design various deep learning models and architectures to solve real world problems. (Create)			3	3		2
Write and present a technical report specifying the findings of the working model following the ethical principles. (Affective Domain)					2	

19PCS514	INTRODUCTION TO INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn the concepts of intelligent systems. - To study the basics of fuzzy logic - To solve real world problems for which solutions are difficult to express using the traditional algorithmic approach - To include the concept of uncertainty, learning from experience and problem solving strategies.					
UNIT I	BIOLOGICAL FOUNDATIONS TO INTELLIGENT SYSTEMS I	8			
Biological foundations to intelligent systems I: Artificial neural networks, Back propagation networks, Radial basis function networks, and recurrent networks.					
UNIT II	BIOLOGICAL FOUNDATIONS TO INTELLIGENT SYSTEMS II	9			
Biological foundations to intelligent systems II: Fuzzy logic, knowledge Representation and inference mechanism, genetic algorithm, and fuzzy neural networks. Case study: Recent trends in Fuzzy logic.					
UNIT III	SEARCH METHODS	10			
Search Methods Basic concepts of graph and tree search. Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, admissible evaluation functions, hill climbing search. Optimization and search such as stochastic annealing and genetic algorithm.					
UNIT IV	KNOWLEDGE REPRESENTATION AND LOGICAL INFERENCE	9			
Knowledge representation and logical inference Issues in knowledge representation. Structured representation, such as frames, and scripts, semantic networks and conceptual graphs. Formal logic and logical inference. Knowledge-based systems structures, its basic components. Ideas of Blackboard architectures.					
UNIT V	UNCERTAINTY	9			
Reasoning under uncertainty and Learning Techniques on uncertainty reasoning such as Bayesian reasoning, Certainty factors and Dempster-Shafer Theory of Evidential reasoning, A study of different learning and evolutionary algorithms, such as statistical learning and induction learning.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Understand the basic concepts of neural networks - Explain the fundamental principles of fuzzy system - Apply the various search methods - Inferknowledge representation and logical inference - Demonstrate the Learning Techniques on uncertainty					

REFERENCES:

1. Luger G.F. and Stubblefield W.A. (2008). Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th edition.
2. Russell S. and Norvig P. (2009). Artificial Intelligence: A Modern Approach. Prentice-Hall, 3rd edition.

19PCS515	ESSENTIALS OF HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3
OBJECTIVES : - To Learn the foundations of Human Computer Interaction - To familiarize with the design technologies for individuals and persons with disabilities - To be aware of mobile Human Computer interaction. - To learn the guidelines for user interface.					
UNIT I	INTRODUCTION	9			
Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.					
UNIT II	INTERACTIVE DESIGN AND RULES	10			
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.					
UNIT III	COGNITIVE MODELS	9			
Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.					
UNIT IV	MOBILE ECOSYSTEM	9			
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.					
UNIT V	WEB INTERFACES	8			
Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Describe the foundations and theories of Human Computer Interaction and vision. - Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites. - Discuss various models and theories in Human Computer Interaction. - Apply task analysis in user interface design. - Summarize the procedures for Outside the Box.					

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009(UNIT-V)

19PCS516	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3
OBJECTIVES : - The objective of this course is to provide insight to the mathematical formulation of real world problems. - To optimize these mathematical problems using nature based algorithms. And the solution is useful especially for NP-Hard problems.					
UNIT I	ENGINEERING APPLICATION	8			
Engineering application of Optimization, Formulation of design problems as mathematical programming problems.					
UNIT II	STRUCTURE OF OPTIMIZATION ALGORITHMS	9			
General Structure of Optimization Algorithms, Constraints, The Feasible Region.					
UNIT III	BRANCHES OF MATHEMATICAL PROGRAMMING	10			
Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.					
UNIT IV	OPTIMIZATION ALGORITHMS	10			
Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc. Recent trends: Applications of ant colony optimization.					
UNIT V	REAL LIFE PROBLEMS	8			
Real life Problems and their mathematical formulation as standard programming problems. Case study: genetics and linear and quadratic programming in real world applications.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Formulate optimization problems. - Apply the concept of optimality criteria for various types of optimization problems. - Solve various constrained and unconstrained problems in Single variable as well as Multi variable. - Apply the methods of optimization in real life situation.					

REFERENCES:

1. Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.
2. Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
3. An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
4. Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas ISBN 978-0-9759146-2-5.
5. John K. Karlof (2006). Integer programming: theory and practice.CRC Press. ISBN 978-0-8493- 1914-3.
6. H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
7. Michael Jünger; Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the-Art. Springer. ISBN 978-3-540-68274-5.
8. Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

19PCS517	COMPILER FOR HIGH PERFORMANCE COMPUTING	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce the structure of compilers and high performance compiler design - To study the concepts of cache coherence and parallel loops in compilers - To study the compiler optimization techniques					
UNIT I	INTRODUCTION	8			
High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.					
UNIT II	DATA DEPENDENCE AND SCALAR ANALYSIS	8			
Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, and Data Dependence for Scalars. Data Dependence Analysis for Arrays.					
UNIT III	LOOP RESTRUCTURING AND OPTIMIZING FOR LOCALITY	10			
Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis. Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.					
UNIT IV	CONCURRENCY ANALYSIS AND VECTOR ANALYSIS	10			
Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.					
UNIT V	MESSAGE-PASSING MACHINES AND SCALABLE SHARED-MEMORY MACHINES	9			
Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Familiarize with the structure of compiler - Identify the need for data dependency and scalar analysis for compiler - Analyze the loop structures and optimization principles - Examine the concurrency and debugging in compilers - Interpret the shared memory system for optimization					

REFERENCES:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson

19PCS518	CLUSTER AND GRID COMPUTING	L	T	P	C
		3	0	0	3
OBJECTIVES : - To provide an insight for achieving cost efficient high performance system. - To deal with design and architecture of grid and cluster computing.					
UNIT I	INTRODUCTION	9			
Introduction: Cluster and Grid computing, Meta-computing, Web services and Grid Computing, e-Governance and the Grid Technologies and Architectures for Grid Computing: Issues in Data Grids, Functional requirements in Grid Computing, Standards for Grid Computing and Recent technology trends in Large Data Grids. Web Services and the Service Oriented Architecture: Service Oriented Architecture, SOAP and WSDL, Creating Web Services, Server Side.					
UNIT II	OGSA and WSRF	9			
OGSA and WSRF: OGSA for Resource Distribution, Stateful Web Services in OGSA, WSRF, WSRF Specification, Globus Toolkit: History, version, Applications, Approaches and Benefits, Infrastructure Management, Monitoring and Discovery, Security, Data Choreography and Coordination, GT4 Architecture, GT4 Containers. The Grid and Databases: Requirements, Storage Request Broker, Integration of Databases with the Grid, Architecture of OGSADAI for offering Grid Database services.					
UNIT III	CLUSTER COMPUTING	10			
Cluster Computing: Approaches to Parallel Computing, Definition and Architecture of a Cluster, Categories of clusters. Cluster Middleware: Levels and Layers of Single System Image, Design objectives, Resource Management and Scheduling, Cluster programming Environment and Tools. Networking, Protocols & I/O for clusters: Networking and Interconnection/Switching Devices, Design Issues, Design Architecture, HiPPI, ATM, Myrinet, Memory Channel. Case study of various cluster architectures.					
UNIT IV	SETTING UP AND ADMINISTERING A CLUSTER	8			
Setting Up and Administering a Cluster: Setup of simple cluster, setting up nodes, clusters of clusters, System monitoring, Global Clocks Sync. Cluster Technology for High Availability: High availability clusters, high availability parallel computing, types of failures and errors, cluster architectures and configurations for high availability, Failure/Recovery clusters.					
UNIT V	PROCESS SCHEDULING	9			
Process Scheduling: Job management System, Resource management system, policies of resource utilization, Scheduling policies. Load Sharing and Load Balancing: Introduction, Strategies for load balancing, Modelling parameters. Case study of various load balancing and scheduling policies.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Familiarize the technologies and architecture of grid and cluster computing - Illustrate the service architecture and grid and databases - Analyze the resource management and scheduling in clusters - Setting up of simple clusters - Analyze the various load balancing and scheduling policies					

19PCS519	PARALLEL ALGORITHMS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To familiarize the different parallel computing models - To learn parallel algorithms and their performance measures - To apply parallel algorithms in different domain					
UNIT I	INTRODUCTION	8			
Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAMCREW, EREW models, simulation of one model from another one.					
UNIT II	PERFORMANCE MEASURES OF PA	9			
Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Cost optimality, An example of illustrate Cost-optimal algorithms- such as summation, Min/Max on various models.					
UNIT III	PARALLEL SORTING AND MERGING ALGORITHMS	9			
Parallel Sorting Networks, Parallel Merging Algorithms on CREW/EREW/MCC/, Parallel Sorting Networks on CREW/EREW/MCC/, linear array. Case study of parallel sorting networks, which include CREW, EREW and their performance analysis for various problems.					
UNIT IV	PARALLEL SEARCHING ALGORITHMS	10			
Parallel Searching Algorithm, Kth element, Kth element in X+Y on PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector- Matrix Multiplication, Solution of Linear Equation, Root finding.					
UNIT V	GRAPH ALGORITHMS	9			
Graph Algorithms - Connected Graphs, search and traversal, Combinatorial Algorithms- Permutation, Combinations, Derangements.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Infer the various parallel computing models - Analyze the performance of parallel algorithms - Implement the various parallel sorting and merging algorithms - Compare the different parallel searching algorithms - Illustrate the different graph algorithms for parallel computing					

REFERENCES:

1. Designing Efficient Algorithms for Parallel Computer by M.J. Quinn, McGraw Hill.
2. Design and Analysis of Parallel Algorithms by S.G. Akl
3. Parallel Sorting Algorithm” by S.G. Akl, Academic Press
- 4.

19PCS520	WIRELESS ACCESS TECHNOLOGIES	L	T	P	C
		3	0	0	3
OBJECTIVES : • Overview of wireless access technologies, fixed wireless access networks. Terminal mobility issues regarding wireless access to Internet • Introduction to various Network topologies, hotspot networks, Communication links: point-to-point, point-to-multipoint, multipoint-to-multipoint. • To provide an overview of Standards for most frequently used wireless access networks: WPAN, UWB, WLAN, WMAN and WWAN. Network services. Wireless access networks planning, design and installation. • To get and insight of Wireless networking security issues, Wireless access network exploitation and management, software requirements, link quality control.					
UNIT I	INTRODUCTION	9			
Necessity for wireless terminals connectivity and networking. Wireless networking advantages and disadvantages, Overview of wireless access technologies. Narrowband and broadband networks, fixed and nomadic networks. Wireless local loop (WLL), Public Switched Telephone Network (PSTN) interfaces.					
UNIT II	TYPES OF WIRELESS ACESS NETWORKS	9			
Fixed wireless access (FWA) networks, frequency bands for different networks. Criterions for frequency bands allocation, Network topologies, hotspot networks. Communication links: point-to-point (PTP), pointto- multipoint (PMP), multipoint-to-multipoint (MTM).					
UNIT III	STANDARDS FOR WAN	10			
Standards for most frequently used wireless access networks: WPAN (802.15, Bluetooth, DECT, IrDA), UWB (Ultra-Wideband), WLAN (802.11, Wi-Fi, HIPERLAN, IrDA), WMAN (802.16, WiMAX, HIPERMAN, HIPERACCESS), WWAN (802.20), Other technologies for broadband wireless access, Local Multipoint Distribution Service (LMDS), Multichannel Multipoint Distribution Service (MMDS). Ad Hoc networks, Network services. Services types based on carrier frequency and bandwidth.					
UNIT IV	WSN SERVICES AND SECURITY ISSUES	9			
Wireless access networks planning, design and installation. Services provision, legislative and technical aspects, Technical and economic factors for network planning: expenses, coverage, link capacity, network complexity and carrier-to-interference ratio (C/I). Base station or access point allocation. Base station and access point equipment.Terminal mobility issues regarding wireless access to Internet.Wireless networking security issues.					
UNIT V	APPLICATIONS OF WSN	8			
Example of laptop or handheld PC wireless connection in real environment. PC wireless interface equipment. Wireless access network exploitation and management, software requirements, link quality control. Business model, wireless network services market, market research and marketing, service providers, wireless data application service providers (WDASP) and their role on public telecommunication services market, billing systems.					
TOTAL:45 Periods					

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

- Interpret basic terms and characteristics of wireless access networks
- Compare various wireless access technologies
- Analyze measurements of wireless access network parameter
- Assess security issues in wireless networks
- Choose modulation technique for wireless transmission

REFERENCES:

1. M. P. Clark, Wireless Access Networks: Fixed Wireless Access and WLL networks – Design and Operation, John Wiley & Sons, Chichester
2. D. H. Morais, Fixed Broadband Wireless Communications: Principles and Practical Applications, Prentice Hall, Upper Saddle River
3. R. Pandya, Introduction to WLLs: Application and Deployment for Fixed and Broadband Services, IEEE Press, Piscataway

19PCS521	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To familiarize the students the fundamental concepts of big data and analytics - To provide an understanding of various techniques for mining data streams & Event Modeling for different applications - To explain the knowledge of extracting information from surveillance videos.					
UNIT I	INTRODUCTION TO BIG DATA & DATA ANALYSIS	9			
Introduction to Big Data Platform – Challenges of Conventional systems – Web data- Evolution of Analytic scalability- analytic processes and tools- Analysis Vs Reporting- Modern data analytic tools- Data Analysis: Regression Modeling- Bayesian Modeling- Rule induction.					
UNIT II	MINING DATA STREAMS	9			
Introduction to Stream concepts- Stream data model and architecture – Stream Computing-Sampling data in a Stream- Filtering Streams- Counting distinct elements in a Stream- Estimating moments- Counting oneness in a window- Decaying window- Real time Analytics platform(RTAP) applications- case studies.					
UNIT III	VIDEO ANALYTICS	9			
Introduction- Video Basics - Fundamentals for Video Surveillance- Scene Artifacts- Object Detection and Tracking: Adaptive Background Modeling and Subtraction- Pedestrian Detection and Tracking- Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.					
UNIT IV	BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION	9			
Event Modeling- Behavioral Analysis- Human Activity Recognition-Complex Activity Recognition- Activity modeling using 3D shape, Video summarization, shape based activity models- Suspicious Activity Detection.					
UNIT V	HUMAN FACE RECOGNITION & GAIT ANALYSIS	9			
Introduction: Overview of Recognition algorithms – Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Describe big data platform and its analysis techniques. - Identify efficient algorithms for mining the data from large volumes. - Analyze the surveillance videos for analytics. - Build optimization algorithms for better analysis and recognition of objects in a scene. - Infer recognition algorithms, face recognition technologies.					

REFERENCES:

1. Michael Berthold, David J.Hand, Intelligent Data Analysis, Springer, 2007.
2. AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
3. Yunqian Ma, Gang Qian, "Intelligent Video Surveillance: Systems and Technology", CRC Press (Taylor and Francis Group), 2009.
4. Rama Chellappa, AmitK.Roy-Chowdhury, Kevin Zhou.S, "Recognition of Humans and their Activities using Video", Morgan&Claypool Publishers, 2005.

19PCS522	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3
OBJECTIVES : - To familiarize the students the components of the social network - To impart knowledge on the modelling and visualization of social network - To give an idea about mining communities, evolution and opinion mining					
UNIT I	INTRODUCTION	9			
Introduction to Web -Limitations of current Web – Development of Semantic Web -Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis -Development of Social Network Analysis -Key concepts and measures in network analysis -Discussion networks -Blogs and online communities -Web-based networks.					
UNIT II	MODELING AND VISUALIZATION	9			
Visualizing Online Social Networks -A Taxonomy of Visualizations -Graph Representation Centrality-Clustering -Node-Edge Diagrams -Visualizing Social Networks with Matrix Based Representations -Node-Link Diagrams -Hybrid Representations -Modelling and aggregating social network data -Random Walks and their Applications -Use of Hadoop and Map Reduce -Ontological representation of social individuals and relationships.					
UNIT III	MINING COMMUNITIES	9			
Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive -Detecting Communities in Social Networks -Evaluating Communities -Core Methods for Community Detection & Mining Applications of Community Mining Algorithms -Node Classification in Social Networks.					
UNIT IV	EVOLUTION	9			
Evolution in Social Networks -Framework -Tracing Smoothly Evolving Communities -Models and Algorithms for Social Influence Analysis -Influence Related Statistics -Social Similarity and Influence -Influence Maximization in Viral Marketing -Algorithms and Systems for Expert Location in Social Networks -Expert Location without Graph Constraints -with Score Propagation -Expert Team Formation -Link Prediction in Social Networks -Feature based Link Prediction -Bayesian Probabilistic Models -Probabilistic Relational Models.					
UNIT V	TEXT AND OPINION MINING	9			
Text Mining in Social Networks -Opinion extraction -Sentiment classification and clustering Temporal sentiment analysis -Irony detection in opinion mining -Wish analysis -Product review mining -Review Classification – Tracking sentiments towards topics over time.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Describe the fundamentals of social network - Model and visualize the social network - Identify the behaviour of the users in the social network - Discuss the evolution in social networks. - Analyse various text mining and opinion extraction techniques					

REFERENCES:

1. CharuC.Aggarwal, "Social Network Data Analytics", Springer;2011
2. PeterMika, "Social Networks and theSemantic Web", Springer, 1stedition, 2007.
3. BorkoFurht, "Handbook of Social Network Technologies and Applications" ,Springer, 1st edition, 2010.
4. GuandongXu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking - Techniques and applications", Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
6. AjithAbraham,AboulEllaHassanien,VáclavSnášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.
7. TobySegaran, "Programming Collective Intelligence",O'Reilly, 2012

19PCS523	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3
OBJECTIVES : - To introduce software architectural drivers - To make the students understand architectural views and documentation - To familiarize the students with the various styles, design and evaluation of software architectures					
UNIT I	ARCHITECTURAL DRIVERS	9			
Introduction – Standard Definitions of Software Architecture– Architectural structures – Influence of software architecture on organization – Architecture Business Cycle – Functional requirements – Technical constraints – Quality Attributes – Quality Attribute Workshop (QAW) – Documenting Quality Attributes – Six part scenarios.					
UNIT II	ARCHITECTURAL VIEWS AND DOCUMENTATION	9			
Introduction – Standard Definitions for views – Structures and views-Perspectives: Static, dynamic and physical and the accompanying views – Representing views-available notations – Good practices in documentation– Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages -Architectural Description Languages – ACME.					
UNIT III	ARCHITECTURAL STYLES	9			
Introduction – Data flow styles – Call-return styles – Shared Information styles – Event styles – Case studies for each style.					
UNIT IV	ARCHITECTURAL DESIGN	9			
Approaches for architectural design – System decomposition – Attributes driven design – Architecting for specific quality attributes – Performance, Availability – Security – Architectural conformance .					
UNIT V	ARCHITECTURE EVALUATION	9			
Evaluating Software Architecture -The ATAM-A Method for Architecture Evaluation -SAAM to Evaluate an Example Architecture -ARID-An Evaluation Method for Partial Architectures.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to: - Explain key architectural drivers - Demonstrate documentation of architectural views using UML - Illustrate various architectural styles - Analyze the software architecture design of a given problem - Explain the various architecture evaluation methods					

REFERENCES:

1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures in Practice", 2nd Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive Systems: A Practitioner's Guide", Auerbach Publications, 2010.
3. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison-Wesley, 2010.
4. Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Methods and case studies.", Addison-Wesley, 2001.
5. David Garlan and Mary Shaw, "Software architecture: Perspectives on an emerging discipline", Prentice Hall, 1996.

19PCS524	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3
OBJECTIVES : - To learn processors architecture and their instruction set - To understand hardware platform for embedded systems - To learn to design and analyze programs for embedded systems - To study multi-tasking embedded systems with RTOS - To examine distributed and multi-processor embedded system design methodology					
UNIT I	PROCESSOR AND INSTRUCTION SETS	9			
Introduction to embedded computing – overview of embedded system design process – instruction set of processors: ARM, PIC, TI C55x, TI C64x – programming I/O – modes and exceptions – coprocessors – memory system – CPU performance – CPU power consumption					
UNIT II	EMBEDDED COMPUTING PLATFORM	9			
Basic computing platforms – CPU Bus – memory devices and systems – choosing a platform – development environments – debugging –consumer electronics architecture – platform level performance analysis – design example: Audio Player.					
UNIT III	PROGRAM DESIGN AND ANALYSIS	9			
Components for embedded programs – models of programs – Assembly, linking, and loading – compiler optimizations – program level performance analysis – performance optimization – program level energy optimization – optimizing program size – program validation and testing – design example: Digital Still Camera					
UNIT IV	PROCESSES AND OPERATING SYSTEMS	9			
Multiples tasks and multiple processes – multi rate systems – pre-emptive RTOS – priority based scheduling – inter process communication – evaluating OS performance – processes and power optimization – Case study: Real-time and embedded Linux – design example: Telephone answering machine					
UNIT V	SYSTEM DESIGN, NETWORKS, AND MULTIPROCESSORS	9			
System design methodologies – requirements analysis – specifications – architecture design – quality assurance – distributed embedded systems – shared memory multiprocessors – design example: Video accelerator					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Develop assembly code for processors such as ARM, PIC Microcontroller, TI C55x, TI C64x - Choose hardware platform and analyze platform level performance - Develop embedded applications using an RTOS - Analyze OS level performance - Develop distributed embedded systems with shared memory concurrency					

REFERENCES:

1. Marilyn Wolf, "Computers as Components: Principles of Embedded Computing Systems Design", Third Edition, Morgan Kaufmann, 2012.
2. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Prentice Hall, 2010.
3. KarimYaghmour et al., "Building Embedded Linux Systems", O'Reilly, 2008.
4. Arnold S. Berger, "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 2001.
5. David E. Simon, "An embedded Software Primer", Addison-Wesley, 1999.

19PCS525	SMART SENSORS AND INTERNET OF THINGS	L	T	P	C
		3	0	0	3
OBJECTIVES : • Able to understand the application areas of IOT • Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks • Able to understand building blocks of Internet of Things and characteristics					
UNIT I	INTRODUCTION	9			
Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT					
UNIT II	SENSORS	9			
Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.					
UNIT III	IMPORTANT CHARACTERISTICS OF SENSORS	9			
Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors.					
UNIT IV	ARCHITECTURE OF SMART SENSORS	9			
Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing- Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel.					
UNIT V	IEC FOR SMART SENSORS AND CHALLENGES	9			
Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Future scope of research in smart sensor.					
TOTAL:45 Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to • Explain the basic terminology and working of various components constituting the smart sensors (Understand) • Illustrate the efficient methods to enhance the specific functionality of the smart sensors (Apply) • Applying suitable smart sensors for obtaining the solution for the Complex problems (Apply) • Analyze the characteristics of the smart sensors and its various application paradigm. (Analyze) • Discriminate the smart sensors to make it suitable to apply in Industrial and commercial Building Automation. (Evaluate) • Demonstrate the suitable way of identifying the suitable sensors applicable for the given real time problem and responds to the others suggestion. (Affective Domain)					

REFERENCES:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing

2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the basic terminology and working of various components constituting the smart sensors [Understand]		2				
Illustrate the efficient methods to enhance the specific functionality of the smart sensors [Apply]		2				
Applying suitable smart sensors for obtaining the solution for the Complex problems [Apply]		2				
Analyze the characteristics of the smart sensors and its various application paradigm. [Analyze]		3				
Discriminate the smart sensors to make it suitable to apply in Industrial and commercial Building Automation. [Evaluate]		3			3	
Demonstrate the suitable way of identifying the suitable sensors applicable for the given real time problem and responds to the others suggestion [Affective Domain]		3			3	2

OPEN ELECTIVE

19PCD601	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3
OBJECTIVES : - To understand the operational safety - To understand the safety management					
UNIT I	ACCIDENT INVESTIGATION AND ANALYSIS	9			
Concept of an Accident, reportable and non reportable accidents, reporting to statutory authorities. Principles of accident prevention-accident investigation and analysis-Unsafe act and unsafe condition- Domino sequence-cost of accidents-permanent total disabilities, Permanent partial disabilities, Temporary total disabilities-Calculation of frequency rate and severity rate of accidents.					
UNIT II	ERGONOMICS AND HUMAN BEHAVIOUR	9			
Introduction to ergonomics and its area of application in the work system. Anatomy, Posture and body mechanics-low back pain, risk factors for musculoskeletal disorders in the work place-behavioral aspects of posture - effectiveness. Individual differences, Factors contributing to personality, fitting the man to the job. Motivation -job satisfaction - Frustration and conflicts, reaction to frustration, emotion and frustration. Attitudes - determination of attitudes- changing attitudes.					
UNIT III	HAZARDS AND THEIR CONTROL	9			
Physical hazards-Noise, heat, vibration, ionizing and non-ionizing radiations, and effects. Chemical hazards-dusts, fumes, mist, vapor, fog, gases, types, concentration, exposure Vs dose, TLV. Mechanical hazards. Engineering control methods- use of personal protective equipments.					
UNIT IV	FIRE PREVENTION AND PROTECTION	9			
Fire triangle-principles of fire extinguishing- various classes of fires- A, B, C, D types of fire extinguishers- Industrial fire protection systems. Sprinklers- Fire hydrants- Alarm and detection systems- other suppression systems- CO2 system, foam system and DCP system.					
UNIT V	SAFETY MANAGEMENT TECHNIQUES, EDUCATION AND TRAINING	9			
Incident Recall Technique (IRT), disaster control, Job safety Analysis, Safety survey, safety inspection. Safety training programs, seminars, conferences, competitions- method of promoting safe practice- motivation- creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme- domestic safety and training.					
TOTAL:45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
- Evaluate the concept of accident prevention& accident investigation - Identify the human behavior - Demonstrate hazards and their control - Prepare the fire prevention and protection - Summarize the safety management techniques					

TEXT BOOKS:

1. Heinrich.H.W. "Industrial Accident Prevention", McGraw Hill Company, New York, 1980.
2. John V. Grimaldi and Rollin H. Simonds, "Safety Management" , All India Travellers Book Seller, New Delhi, 1989.
3. E.J.McCormick and M.S. Sanders "Human Factors in Engineering and Design", TMH, New Delhi, 1982.
4. Hand Book of "Occupational Safety and Health", National Safety Council, Chicago, 1982.
5. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.

REFERENCES:

1. Krishnan.N.V. "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
2. Lees, F. P. "Loss Prevention in Process Industries", Butter Worth publications, London, 2nd Edition, 1990.
3. Dan Peterson, "Techniques of Safety Management", McGraw Hill Company, Tokyo, 1981.
4. "Accident Prevention Manual for Industrial Operations", N.S.C. Chicago, 1982.
5. Hunter, Gomos, "Engineering Design for Safety", McGraw Hill Inc., 1992.
6. Encyclopedia of "Occupational Health and Safety" Vol I and II, Published by International Labour Office, Geneva, 1985.
7. Gupta. R.S., "Hand Book of Fire Technology", Orient Longman, Bombay, 1977.

19PCS602	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3
OBJECTIVES : - Understand the role of business analytics within an organization. - Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization. - To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making. - Use decision-making tools/Operations research techniques. - Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.					
UNIT I	BUSINESS ANALYTICS	9			
Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.					
UNIT II	TRENDINESS AND REGRESSION ANALYSIS	9			
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.					
UNIT III	ANALYTICS MODELLING AND MINING	9			
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.					
UNIT IV	FORECASTING TECHNIQUES	10			
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.					
UNIT V	DECISION ANALYSIS	8			
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.					
TOTAL:45 Periods					

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

- Demonstrate Different Statistical and Analytical Techniques for Decision-Making Under Uncertainty. (Understand)
- Apply the Knowledge of Statistical and Analytical Techniques to different Modelling for solving various problems in Business Decision Making.(Apply)
- Identify the Appropriate Analytical Tools in the Analysis of Quantitative and Qualitative Data from a Variety of Business Scenarios for Reaching Sustained Conclusions.(Analyze)
- Evaluate the solution of a different Business problems using the fundamental concepts of analytics. (Evaluate)
- Develop a Computer based solution to use suitable recent technology.(Create)
- Present the sustained conclusions for the different business problems with teams or individually. (Affective Domain)

REFERENCES:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Demonstrate Different Statistical and Analytical Techniques for Decision-Making Under Uncertainty. (Understand)						
Apply the Knowledge of Statistical and Analytical Techniques to different Modelling for solving various problems in Business Decision Making.(Apply)	3					
Identify the Appropriate Analytical Tools in the Analysis of Quantitative and Qualitative Data from a Variety of Business Scenarios for Reaching Sustained Conclusions.(Analyze)		3				
Evaluate the solution of a different Business problems using the fundamental concepts of analytics. (Evaluate)		3				
Develop a Computer based solution to use suitable recent technology.(Create)		3		3		3

Present the sustained conclusions for the different business problems with teams or individually. (Affective Domain)			3		3	
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19PCM603	IOT FOR SMART APPLICATIONS	L	T	P	C
		3	0	0	3
OBJECTIVES : - Brief about the interconnection and integration of smart devices with controller/SoC - Learn the architecture of IoT and its standards - Give an basic idea about M2M-IoT					
UNIT I	M2M AND IOT- INTRODUCTION	9			
The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.					
UNIT II	M2M AND IoT TECHNOLOGY FUNDAMENTALS	9			
Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.					
UNIT III	IOT REFERENCE ARCHITECTURE	9			
IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.					
UNIT IV	SENSORS AND SMART SENSORS	10			
Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor, Types- Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors, Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.					
UNIT V	INTERNET OF THINGS –PRIVACY, SECURITY AND GOVERNANCE	8			
Introduction, Overview of Governance, Privacy and Security Issues, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.					
TOTAL:45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to - Understand the concept of web technology for IoT - Understand the concept of IOT and M2M - Differentiate between IOT architecture and Embedded Architecture - Apply IoT technology for smart applications - Study the security and privacy issues in IOT..					

REFERENCES:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, Apress Publications, 2013.
3. CunoPfister, "Getting Started with the Internet of Things", O'Reilly Media, 2011.
4. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
5. Samuel Greenguard, "Internet of things", MIT Press, 2015.
6. <http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things1.html>
7. <https://developer.mbed.org/handbook/AnalogIn>
8. http://www.libelium.com/50_sensor_applications

19PPE604	BIOENERGY FROM WASTE	L	T	P	C
		3	0	0	3
OBJECTIVES : - To provide the details of types of wastes. - To illustrate the concept of waste treatment and disposal. - To outline concepts behind eco-technological alternatives for waste to energy.					
UNIT I	INTRODUCTION TO WASTE & WASTE PROCESSING	9			
Definitions, sources, types and composition of various types of wastes; Characterization of Municipal Solid Waste (MSW) , Industrial waste and Biomedical Waste (BMW), waste collection and transportation; waste processing-size reduction, separation; waste management hierarchy, waste minimization and recycling of MSW; Life Cycle Analysis (LCA), Material Recovery Facilities (MRF), recycling processes of solid waste.					
UNIT II	WASTE TREATMENT AND DISPOSAL	9			
Aerobic composting, incineration, different type of incineration;medical and pharmaceutical waste incinerations- land fill classification, types, methods and sittingconsideration, layout and preliminary design of landfills: composition, characteristics, generation,movement and control of landfill leachate and gases, environmental monitoring system for land fill gases.					
UNIT III	ENERGY FROM WASTE-THERMO CHEMICAL CONVERSION	9			
Sources of energy generation, incineration, pyrolysis,gasification of waste using gasifiers, briquetting, utilization and advantages of briquetting,-environmental and health impacts of incineration; strategies for reducing environmental impacts.					
UNIT IV	ENERGY FROM WASTE- BIO-CHEMICAL CONVERSION	9			
Anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, industrial waste, agro residues, anaerobic digestionbiogas production, land fill gas generation and utilization, present status of technologies for conversion of waste into energy, design of waste to energy plants for cities, small townships and villages.					
UNIT V	ENVIRONMENTAL AND HEALTH IMPACTS-CASE STUDIES	9			
Environmental and health impacts of waste to energy conversion, case studies of commercial waste to energy plants, waste to energy- potential sand constraints in India, eco-technological alternatives for waste to energy conversions – Rules related to the handling, treatment and disposal of MSW and BMW in India.					
TOTAL:45Periods					
COURSE OUTCOMES: On completion of the course the student should be able to - Classify different types of waste. - Implement the waste disposal & energy conversion techniques. - Apply the strategies for reducing environmental impacts. - Design the waste to energy plants					

REFERENCES:

1. Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, by Gary C. Young, ISBN:9780470539675, Publisher: John Wiley & Sons, Publication Date: June 2010.
2. Recovering Energy from Waste Various Aspects Editors: Velma I. Grover and Vaneeta Grover, ISBN 978-1-57808-200-1; 2002
3. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall, 2000.
4. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987.
5. Waste-to-Energy by Marc J. Rogoff, DEC-1987, Elsevier, ISBN-13: 978-0-8155-1132-8, ISBN-10: 0-8155-1132-9.
6. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier AppliedScience, London, 1985.
7. ManojDatta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997.
8. Bhide A. D., Sundaresan B. B., Solid Waste Management in Developing Countries, INSDOC, New Delhi, 1983.
9. Robert Green, From Waste to Energy, Cherry Lake Pub. ISBN: 1602795096, 2009.
10. G. Evans, Biowaste and Biological Waste Treatment, 2005
11. Biogas from waste and renewable resources, by Dieter D. And Angelika S. Wiley-Vch Publication 2010

19PSE605	SMART CITY TECHNOLOGIES	L	T	P	C
		3	0	0	3
OBJECTIVES : - To make the students understand the core challenges relating to the foundation of sustainable smart cities - To impart knowledge on understanding, and critical thinking related to smart, sustainable urban development. - To explore issues relating to the development and deployment of new and emerging technologies, that will create a thorough understanding of smart processes and systems of the present and future					
UNIT I	INTRODUCTION TO SMART CITIES	9			
Introduction, Definition, Drivers, barriers and benefits of smart cities, characteristics and factors of Smart cities, understanding Livability, Affordability and Inequality, Development standards, Fundamentals of smart city rankings, emerging trends and technologies.					
UNIT II	SMART CITIES FRAMEWORK	9			
Smart city responsibilities: Built environment, Energy, Telecommunications, Transportation, Health and human services, Water and wastewater, Smart city enablers: instrumentation and control, connectivity, security, privacy and data management					
UNIT III	SMART AND SUSTAINABLE URBAN DEVELOPMENT	9			
Principles of sustainable development and smart growth, low carbon and renewable energy technologies, pollution prevention, climate adaptation, environmental systems management, smart buildings infrastructure.					
UNIT IV	SMART TECHNOLOGIES	9			
Concepts of Big Data Analytics: big data platforms and cloud computing, urban informatics, GIS and spatial analysis, measuring impact and data visualization Smart Technologies: Internet of things, remote sensing and communication technologies.					
UNIT V	INDIAN INITIATIVES TOWARDS SMART CITIES	9			
ICT initiatives in Indian Cities, Institutional frame work, selection of cities for suitability to become a smart city, e- governance, identification parameters for smart city and allocation, Case studies.					
TOTAL:45Periods					
COURSE OUTCOMES: On completion of the course the student should be able to - Explain the concepts of smart cities. - Describe the framework of smart cities. - Analyse the principles of sustainable development. - Apply Big data analytics and smart technologies in creating smart cities - Evaluate the smart city projects implemented in India					

TEXT BOOKS:

1. AniketBhagwat, SuparnaBhalla, Sanjay PrakashAshishBhalla Destination 100 (The making of Smart Cities in India, Future Institute publishers, 2014.(ISBN 13: 9781 4392 57883).
2. Vinodkumar T. M., Geographic Information Systems for Smart Cities, Copal Publishing, New Delhi, 2014.(ISBN: 9788 1924 73352).

REFERENCES:

1. Jesse Berst, Liz Enbysk and Christopher Williams Smart Cities Readiness Guide – The planning manual for building tomorrow's cities today, Smart Cities Council, 2014.
2. Joy Sen, Sustainable Urban Planning, The Energy and Resources Institute, New Delhi, 2013. (ISBN 978-81-7993-324-4).
3. Anthony M. Townsend, SMART CITIES Big Data, Civic Hackers, and the Quest for a New Utopia, W. W. Norton & Company, Inc., 2013.(ISBN-13: 978-0393082876)

MANDATORY CREDIT COURSE

19PGM701	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3
OBJECTIVES : - To provide an overview on selection of research problem based on the Literature review - To enhance knowledge on the Data collection and Analysis for Research design - To outline the importance of ethical principles to be followed in Research work and IPR					
UNIT I	FORMULATION OF RESEARCH PROBLEM	9			
Meaning of research problem, Sources of research problem, Criteria- good research problem, and selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Necessity of defining the problem – Types of Literature Review- Sources for Literature Review - Identifying gap areas from literature review.					
UNIT II	RESEARCH DESIGN AND ETHICS	9			
Research Design – Different Research designs- Sampling design- Types of sampling, Methods of Data collection- primary data, secondary data Plagiarism, Application of results and ethics - Environmental impacts - Ethical issues - ethical committees					
UNIT III	DATA ANALYSIS AND TESTING OF HYPOTHESES				
Data Processing and Analysis strategies -Types of Analysis- Statistics in Research - Measures of Central Tendency - Measures of Dispersion - Measures of Asymmetry (Skewness) -Measures of Relationship - Simple Regression Analysis - Multiple Correlation and Regression Testing of Hypotheses- Chi-square test, Taguchi and ANOVA					
UNIT IV	REPORT AND RESEARCH PROPOSAL WRITING	9			
Significance of Report Writing - Different Steps in Writing Report - Layout of the Research Report - Types of Reports - Oral Presentation - Mechanics of Writing a Research Report - Bibliography, types of referencing, citations. Format of research proposal -Research Proposal writing - assessment by a review committee.					
UNIT V	INTELLECTUAL PROPERTY AND PATENT RIGHTS	9			
Nature of Intellectual Property – Patents- Designs, Trade and Copyright- Geographical Indications. Process of Patenting and Development – Patent Search- Invention, Innovation-Documents for Patent filing - Examination- Grant of Patent. Scope of Patent Rights - Case Studies Total: 45 Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to - Analyze the literature to identify the research gap in the given area of research. (Analyze/Problem Analysis) - Design suitable research methodology to pursue the research in scientific and systematic procedure with statistical / IT Tools.(Analyze/ Design & development of Solutions) - Analyze and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.(Analyze/Investigation) - Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report (organizing/Affective domain) - Conduct patent database search in various countries for the research problem identified. (Analyze). - Apply ethical principles in research and reporting to promote healthy scientific practice (Apply)					

REFERENCES:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
2. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
3. Wadehra, B.L. 2000. Law relating to patents, Trade Marks, Copy right designs and Geographical indications. Universal Law Publishing.
4. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.

ADDITIONAL READING

1. <https://www.editage.com/insights/how-to-write-the-literature-review-of-your-research-paper>
2. https://www.ee.iitb.ac.in/~apte/CV_PRA_TAGUCHI_INTRO.htm

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain key research/IPR concepts and issues. (Understand)	3					
Implement the concepts and procedures of sampling, data collection, analysis and reporting. (Apply)	3					
Identify the complex issues inherent in selecting a research problem, selecting an appropriate research/Patent design. (Analyze)		3				
Evaluate the collection of data using Statistical Packages. (Evaluate)		3				
Create appropriate research design to implementing a research project. (Create)		3		3		3
Read, comprehend, and write research articles in their academic discipline. (Affective Domain)			3		3	

AUDIT COURSES

19PGM801	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0
OBJECTIVES : - To make the students understand a range of cognitive capacities in human learners - To explain the outcome-based education system - To describe the curriculum design process					
UNIT I	EDUCATIONAL PSYCHOLOGY AND ENGINEERING EDUCATION	8			
Learning process, motivation and engagement, ICT in learning and teaching, Facilitating the learners, Engineering education and recent trends, Research in Engineering education, General maxims of teaching, Teacher-centered, learner-centered and learning-centered approaches, Becoming a reflective teacher, Disruptive Innovation in Education					
UNIT II	OUTCOME BASED EDUCATION	8			
Outcome Based Education: A broad context for quality teaching and learning, planning for quality teaching and learning, Necessity for learning outcomes - Course Outcomes and Program Outcomes, Defining learning outcomes, learning outcomes in the cognitive domain, learning outcomes in the affective domain, learning outcomes in the psychomotor domain, Program Outcomes, Graduate Attributes, Program Educational Objectives, linking learning outcomes to teaching and assessment.					
UNIT III	CURRICULUM DESIGN	7			
Curriculum design cycle, curriculum structure, credit and academic load, need assessment – feedback from stakeholders, concept of “Constructive alignment”, the two loop approach of ABET, tuning approach of curriculum design, CDIO concept of curriculum design and implementation, Industry relevant curriculum design and implementation, concept mapping, Instructional design and delivery.					
UNIT IV	TEACHING AND ASSESSMENT STRATEGIES	7			
Direct instruction teaching strategy, co-operative learning, problem-solving, industry relevant teaching, role-play, case study, technology enabled teaching, research orientation, measurement and evaluation of students’ achievement, assessment of learning outcomes - assessment tools: direct and indirect assessment tools, rubrics for assessment, attainment analysis, corrective action-curriculum updation, improvement in pedagogy, innovative assessment methods					
TOTAL:30Periods					
COURSE OUTCOMES:					
After the successful completion of this course, the student will be able to					
- Develop pedagogical expertise through an introduction to theoretically-based teaching methods and strategies - Write learning outcomes and link learning outcomes to appropriate assessments - Design syllabus and lesson plans that align with learning outcomes - Choose teaching-learning strategies appropriate to the needs of the learners					

REFERENCES:

1. Dr.Sue Duchesne, Anne McMaugh, Sandra Bochner, Kerri-Lee Krause, “Educational Psychology for Learning and Teaching”, Cengage Learning, 4th Edition, 2019.
2. Lisa R. Lattuca, Patrick T. Terenzini, J. Fredericks Volkwein, and George D. Peterson, “The Changing Face of Engineering Education” The Bridge, National Academy of Engineering, Summer 2006.
3. Anderson, L. & Krathwohl, D. A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives . New York: Longman, 2001.
4. Blumberg, P. Developing learner-centred teaching: A practical guide for faculty. San Francisco: Jossey-Bass, 2017.
5. Teaching Support Services. Learning objectives. University of Guelph, Guelph, ntario. Retrieved from <http://www.uoguelph.ca/tss/resources/idres/learningobjectives1.pdf>
6. O.V. Boev, N.Gruenwald and G.Heitmann, “Engineering Curriculum Design aligned with Accrediation Standards”, Hochschule Wismar Publishers, 2013
7. Fink, D. L. Integrated course design. Manhattan, KS: The IDEA Center, 2005. Retrieved from http://www.theideacenter.org/sites/default/files/Idea_Paper_42.pdf

CO / PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Explain the Curriculum Design Process (Understand)		3				
Design syllabus and lesson plans that align with learning outcomes (Apply)		3				
Analyze learning outcomes and link learning outcomes to appropriate assessments (Analyze)		3				
Choose suitable pedagogical techniques to achieve the learning outcomes (Create)		3		2		3
Work individually or in teams to identify the learning outcome for the topic and an appropriate assessment to achieve the outcome. (Affective Domain)		3			2	

19PGM802	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0
OBJECTIVES : - To impart the knowledge of each section of the paper - To give and exposure on writing skills and readability - To enhance the student to write the good quality Research paper					
UNIT I	INTRODUCTION TO RESEARCH	9			
Introduction to Research Paper, Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs, Clarity and Removing Redundancy, Highlighting the Findings, Hedging and Criticising, Paraphrasing and Plagiarism - Useful idioms & phrases.					
UNIT II	STRUCTURE OF RESEARCH PAPER	6			
Types of the Research papers, Regular Research Paper - Review Research Paper – Case Study Research Paper – Research Letters - Sections of a Paper, Title, Author names and affiliations - Corresponding author - Abstracts, Keywords, Highlights, Graphical Abstract - Introduction, Methods, Results, Discussion, Conclusions, Acknowledgment - the First Draft.					
UNIT III	METHODOLOGY, RESULTS & DISCUSSION AND CONCLUSION	9			
Introduction – Writing preview of Research work – Review of literature – assimilating the points – Logical flow – Research gap - Writing the Methodology – Sequence - Specification – Explaining results – Interpretation and plotting – Discussion of the salient findings – Critical analysis – Writing the Conclusion					
UNIT IV	SUBMISSION OF RESEARCH PAPER	6			
Direct instruction as teaching strategy, co-operative learning, problem-solving, industry relevant teaching, role-play, case study, technology enabled teaching, research orientation, measurement and evaluation of students' achievement, assessment of learning outcomes - assessment tools: direct and indirect assessment tools, rubrics for assessment, attainment analysis, corrective action-curriculum updation, improvement in pedagogy, innovative assessment methods					
TOTAL:30Periods					
COURSE OUTCOMES: After the successful completion of this course, the student will be able to - Write research paper effectively with improved standard of language - Explain the different sections of the Research paper - Formulate the Acceptable Research Manuscript					

REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

ADDITIONAL READING

1. MLA Handbook for Writers of Research Papers, The Modern Language Association of America, New York 2009