Francis Xavier Engineering College

(An Autonomous Institution)
Tirunelveli 627 003
Tamil Nadu India

Department of CSE

Curriculum and Syllabi 2021-PG

M.E – Computer Science and Engineering

CHOICE BASED CREDIT SYSTEM AND OBE

Vision of the Department

To become a center of excellence in Computer Science and Engineering and research to create global leaders with holistic growth and ethical values for the industry and academics.

Mission of the Department

- To produce technocrats in the industry and academia by educating computer concepts and techniques.
- To facilitate the students to trigger more creativity and leadership skills by applying modern tools and technologies in the field of computer science and engineering
- To inculcate the spirit of ethical values contributing to the welfare of the society

Table of Content

Programme Educational Objectives (PEOs)

PEO 1	**Core Competence:** Proficient Technocrats, competent to meet the challenges of the industry and the society by applying knowledge in Computer Science and Engineering principles in an efficient manner.
PEO 2	**Professionalism:** Engineering professional engaged in higher education, research and/or career in technology development and deployment in the specializations related to Computer Science and Engineering
PEO 3	**Leadership and Entrepreneurship:** Talented professionals with technical and problem solving skills to function as global leaders of engineering teams, and with eloquent and effective communication skills to pursue business opportunities beyond the control of resources.
PEO 4	**Virtues**: Technocrats who function in their profession with ethics and values with Corporate Social Responsibility.

Programme Specific Outcomes (PSOs)

PSO_1	Apply computer science knowledge and efficient programming to analyze conceptualized problems in Cloud computing, Big Data, Artificial Intelligence and Software Systems to provide novel solutions.
SO_2	Design cost effective hardware or software systems in Computer Networks, Computer Architecture and Cyber Security to apply pertain techniques with emerging technologies to develop engineering products.
PSO_3	Provide modern engineering solutions in Augmented Reality, Virtual Reality and Internet of Things technologies for the revolution in engineering society to create innovative ideas into real time products.

Programme Outcomes(POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

Mapping with PO Vs PEO, PSO

PEO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
PEO1	3	3	3	3	3	3	2	2	1	1	2	2	3	3	2
PEO2	3	3	3	3	3	1	2	1	2	2	2	3	3	3	2
PEO3	3	3	3	3	3	3	3	3	3	3	3	2	1	1	2
PEO4	2	2	2	2	2	3	3	3	3	3	2	2			3

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	PROGRAMME OUTCOMES (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO 1	3	3	3	3	3	3	2	2	1	1	2	2
PEO 2	3	3	3	3	3	1	2	1	2	2	2	3
PEO 3	3	3	3	3	3	3	3	3	3	3	3	2
PEO 4	2	2	2	2	2	3	3	3	3	3	2	2

1→Low 2→Medium 3→High

MAPPING OF PROGRAMME SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Outcomes and the Programme outcomes is given in the following Table

PROGRAMME SPECIFIC OBJECTIVES (PSO)	PROGRAMME OUTCOMES (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO 1	3	3	2	1	1	1	2		1	2		2
PSO 2	3	3	2		1	1				2		2
PSO 3	3	3	2	1	1	1			1	1		2

1→Low 2→Medium 3→High

FRANCIS XAVIER ENGINEERING COLLEGE

M.E – Computer Science and Engineering

Choice Based Credit System and Outcome Based Education

SUMMARY OF CREDIT DISTRIBUTION

S.No	Category	Credits Per Semester				Total Credits	Credits in %
		I	II	III	IV		
1	**FC**	4				**4**	5.714%
2	**PC**	18	14			**32**	45.714%
3	**PE**		6	9		**15**	21.429%
4	**EEC**		1	6	12	**19**	27.143%

Minimum Number of Credits to be Acquired:70

FC - Foundation Course

PC - Professional Core

PE - Professional Elective

EEC - Employability Enhancement Course

FRANCIS XAVIER ENGINEERING COLLEGE
M.E – Computer Science and Engineering
Choice Based Credit System and Outcome Based Education
I-IVSemester Curricula and Syllabi
SEMESTER I

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MA1251	Mathematical Foundation For Engineers	FC	60	3	1	0	4
2	21CP1601	Advanced Data Structures and Algorithms	PC	60	4	0	0	4
3	21CP1602	Software Architectures and Design	PC	45	3	0	0	3
4	21CP1603	Advanced Operating Systems	PC	45	3	0	0	3
5	21CP1604	Machine Learning Techniques	PC	45	3	0	0	3
6	21CP1605	Advanced Software Engineering	PC	45	3	0	0	3
Practical Courses								
1	21CP1611	Data Structures Laboratory	PC	60	0	0	4	2
			Total	**360**	**19**	**1**	**4**	**22**

SEMESTER II

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21CP2601	Network Design and Technologies	PC	45	3	0	0	3
2	21CP2602	Cyber Security	PC	45	3	0	0	3
3	21CP2603	Internet of Things	PC	45	3	0	0	3
4	21CP2604	Cloud Computing and Big Data	PC	45	3	0	0	3
5		Professional Elective –I	PE	45	3	0	0	3
6		Professional Elective –II	PE	45	3	0	0	3
Practical Courses								
1	21CP2611	Data Analytics Laboratory	PC	60	0	0	4	2
2	21CP2912	Term Paper Writing and Seminar	EEC	30	0	0	2	1
			Total	**360**	**18**	**0**	**6**	**21**

SEMESTER III

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1		Professional Elective –III	PE	45	3	0	0	3
2		Professional Elective –IV	PE	45	3	0	0	3
3		Professional Elective –V	PE	45	3	0	0	3
Practical Courses								
1	21CP3911	Project Phase – I	EEC	180	0	0	12	6
			Total	**315**	**9**	**0**	**12**	**15**

SEMESTER IV

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Practical Courses								
1	21CP4911	Project Phase – II	EEC	360	0	0	24	12
			Total	**360**	**0**	**0**	**24**	**12**

Minimum Number of Credits to be Acquired:70

List of Foundation Courses

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21CP1201	Mathematical Foundation for Computer Science	FC	60	4	0	0	4

List of Professional Core Courses

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21CP1601	Advanced Data Structures and Algorithms	PC	60	4	0	0	4
2	21CP1602	Software Architectures and Design	PC	45	3	0	0	3
3	21CP1603	Advanced Operating Systems	PC	45	3	0	0	3

4	21CP1604	Machine Learning Techniques	PC	45	3	0	0	3
5	21CP1605	Advanced Software Engineering	PC	45	3	0	0	3
6	21CP2601	Network Design and Technologies	PC	45	3	0	0	3
7	21CP2602	Cyber Security	PC	45	3	0	0	3
8	21CP2603	Internet of Things	PC	45	3	0	0	3
9	21CP2604	Cloud Computing and Big Data	PC	45	3	0	0	3
Practical Courses								
1	21CP1611	Data Structures Laboratory		60	0	0	4	2
2	21CP2611	Data Analytics Laboratory	PC	60	0	0	4	2

List of Employability Enhancement Course

S. No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Practical Courses								
1	21CP2912	Term Paper Writing and Seminar	EEC	30	0	0	2	1
2	21CP3911	Project Phase – I	EEC	180	0	0	12	6
3	21CP4911	Project Phase – II	EEC	360	0	0	24	12

List of Professional Electives Courses

S.No	Course Code	Course Name	Semester	L	T	P	C	Stream/Domain
Professional Elective I								
1	21CP2701	Advanced Databases	02	3	0	0	3	Database Management Systems
2	21CP2702	Image and Video Processing	02	3	0	0	3	Image Processing
3	21CP2703	Security Practices	02	3	0	0	3	Cryptography
4	21CP2704	Web Engineering	02	3	0	0	3	Web Development
5	21CP2705	Agent Based Intelligent Systems	02	3	0	0	3	Machine Learning
Professional Elective II								
1	21CP2706	Real Time Systems	02	3	0	0	3	Distributed Systems

2	21CP2707	Mobile and Pervasive Computing	02	3	0	0	3	Computing Technologies
3	21CP2708	Parallel Programming Paradigms	02	3	0	0	3	Programming
4	21CP2709	Information Retrieval Techniques	02	3	0	0	3	Machine Learning
5	21CP2710	Data Mining Techniques	02	3	0	0	3	Data mining
Professional Elective III								
1	21CP3701	Performance Analysis of Computer Systems	03	3	0	0	3	Computing
2	21CP3702	Language Technologies	03	3	0	0	3	NLP
3	21CP3703	Computer Vision	03	3	0	0	3	Computer Vision
4	21CP3704	Deep Learning Techniques	03	3	0	0	3	Machine Learning
5	21CP3705	Software Quality Assurance and Testing	03	3	0	0	3	Testing
Professional Elective IV								
1	21CP3706	Formal models of software systems	03	3	0	0	3	Computing
2	21CP3707	Embedded Software Development	03	3	0	0	3	Embedded Systems
3	21CP3708	Social Network Analysis	03	3	0	0	3	Networks
4	21CP3709	Compiler Optimization Techniques	03	3	0	0	3	Compiler Design
5	21CP3710	Bio-Inspired Computing and Bio Informatics	03	3	0	0	3	Computing
Professional Elective V								
1	21CP3711	Data Visualization Techniques	03	3	0	0	3	Big Data
2	21CP3712	Reconfigurable Computing	03	3	0	0	3	Computer Architecture
3	21CP3713	Soft Computing Techniques	03	3	0	0	3	Soft Computing
4	21CP3714	Advanced Communication Systems	03	3	0	0	3	Data Science with biology
5	21CP3715	Information Storage Management	03	3	0	0	3	Information management

Semester I

21MA1251	MATHEMATICAL FOUNDATION FOR ENGINEERS	L	T	P	C
		3	1	0	4

Preamble

An engineering PG student needs to have some basic mathematical tools and techniques to apply in diverse applications in Engineering. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraiseshim of the complete procedure for solving different kinds of problems that occur in engineering. Based on this, the course aims at giving adequate exposure in probability and estimation theory.

Prerequisites for the course

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge.

Objectives

- To introduce the basic concepts of random variables
- To introduce the basic concepts of two dimensional random variables
- To have knowledge in principles of estimation theory
- To acquire the knowledge of testing hypotheses for small and large samples this plays an important role in real life problems
- To introduce the basic concepts of multivariate analysis

UNIT I	PROBABILITY AND RANDOM VARIABLES	9+3

Probability – Axioms of probability – Conditional probability – Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Uniform, and Normal distributions – Function of a random variable.

UNIT II	TWO DIMENSIONAL RANDOM VARIABLES	9+3

Joint distributions two random variables – Marginal distributions and Conditional distributions – Covariance – Correlation coefficients for two dimensional random variables for statistical data.

UNIT III	ESTIMATION THEORY	9+3

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines for two dimensional random variables for statistical data.

UNIT IV	TESTING OF HYPOTHESIS	9+3

Sampling distributions and Standard Error - Small samples and large samples - Test of hypothesis - Type I, Type II Errors - Large sample tests for mean –Small sample tests for mean – t and f test - Chi-Square distribution -Test of independence of attributes.

UNIT V	MULTIVARIATE ANALYSIS	9+3

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables.

Total Periods	**45+15**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
1. Descriptive Questions	1. ASSIGNMENT 2. ONLINE QUIZZES	1. Descriptive Questions

Outcomes

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

1	Apply the fundamental knowledge of moments and distributions (Apply)
2	Apply the basic concept of two dimensional random variable in engineering application. (Apply)
3	Apply Consistency and efficiency of estimator (Apply)
4	Testing of hypothesis for large samples and small samples in real life problems(Analyze)
5	Apply the Multivariate statistical analysis. (Apply)

Reference Books

1. Devore, J. L., ―Probability and Statistics for Engineering and the Sciences‖, 8th Edition, Cengage Learning, 2014
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.

Web Resources

1. Probability and random variables - https://youtu.be/COI0BUmNHT8
2. Two dimensional random variables – https://youtu.be/_WM8vzYSQhs
3. Estimation theory - https://youtu.be/SeT3TbMXQ8A
4. Testing of hypothesis - https://youtu.be/IEP3swFeauE
5. Multivariate analysis - https://youtu.be/n9qpktdFfL

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	1				1	1			1		
2	3	2	1	1				1	1			1		
3	3	2	1	1				1	1			1		
4	3	2	1	1				1	1			1		
5	3	2	1	1				1	1			1		

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME1(CO1): (Apply)

1. Find the M.G.F of binomial distribution and hence find its mean and variance. corresponding to the eigen value λ=7.
2. A random variable X has the following probability function

X	0	1	2	3	4	5	6	7
P(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

i) Find the value of k

ii) Find $P(X<6)$, $P(X \geq 6)$, $P(0< X <5)$

COURSE OUTCOME 2 (CO2): (Apply)

1. If the joint p.d.f of (x, y) is given by p(x, y)=k(2x+3y), x= 0,1,2 &y =1,2,3.Find k and all the marginal and the conditional probability distribution of (x, y)&p(x+ y>3)
2. If the joint PDF of X and Y is given by

$$f(x, y)=\{\frac{1}{8}(6-x-y);0< x <2,\ 2< y <4,\ 0 \text{ else}$$

(a) $P[X<1 \cap Y<3]$ and $P[X<1/\ Y<3]$.

COURSE OUTCOME 3(CO3): (Apply)

1) From the following data, find(a). The two regression equations(b). The coefficient of correlation between the marks(c).The most likely marks in English when marks in Maths is 30

Maths	25	28	35	32	31	36	29	38	34	32
English	43	46	49	41	36	32	31	30	33	39

2

2) In a random sampling from Normal distribution N(μ, σ^2), find MLE estimators Forμwhenσ^2isknown.

COURSE OUTCOME 4(CO4): (Apply)

1) Test if the difference in the means is significant for the following data

Sample I	76	68	70	43	94	68	33	
Sample II	40	48	92	85	70	76	68	22

3) A random sample of 200 tins of coconut oil gave an average weight of 4.95 kg. with a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kg per tin at 5% level?

COURSE OUTCOME 5(CO5): (Apply)

1. Find the Correlation Matrix for the covariance matrix $\sum = \begin{bmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{bmatrix}$.

2. Two batches each of 12 animals are taken for a test of inoculation. One batch was inoculated and the other batch was not inoculated. The numbers of dead and Surviving animals are given in the following table in both cases. Can the inoculation be regarded as effective against the disease?

	Dead	Survived
Inoculated	15	85
Not inoculated	25	75

21CP1601	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		4	0	0	4

Prerequisites for the course

- Data Structures

Objectives

1. To understand the usage of algorithms in computing.
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications.
4. To select and design data structures and algorithms that is appropriate for problems.
5. To study about NP Completeness of problems.

UNIT I	ROLE OF ALGORITHMS IN COMPUTING	12

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method.

UNIT II	HIERARCHICAL DATA STRUCTURES	12

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B- trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III	GRAPHS	12

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – ToPO12ogical Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd- Warshall Algorithm.

UNIT IV	ALGORITHM DESIGN TECHNIQUES	12

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V	NP COMPLETE AND NP HARD	12

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems.

Total Periods	60

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Design data structures and algorithms to solve computing problems
CO2 Design algorithms using graph structure to solve real-life problems.
CO3 Design algorithms using various string matching algorithms to solve real-life problems.
CO4 Apply suitable design strategy for problem solving.
CO5 Analyze NP Complete and NP Hard Problems.

Reference Books

1. Robert Sedgewick and Kevin Wayne, —ALGORITHMS||, Fourth Edition, Pearson Education.
2. S.Sridhar,||Design and Analysis of Algorithms||, First Edition, Oxford University Press. 2014
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, —Introduction to Algorithms||, Third Edition, Prentice-Hall, 2011.
4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, —Data Structures and Algorithms||, Pearson Education, Reprint 2006.

Web Recourses

1. https://www.csc.lsu.edu/~kundu/dstr/1-intr.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2	3	1	1						1	2	2	
2	3		2	3	1	1					2	1	2		
3	3		2	3	1	1					2	1	2		
4	3	2	2	3	1	1						1	2	2	
5	3		2	3	1	1						1	2		

21CP1602	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Distributed Systems

Objectives

1. To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
2. To learn the design principles and to apply for large scale systems
3. To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
4. To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
5. To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT I	INTRODUCTION TO SOFTWARE ARCHITECTURE	9

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II	OBJECT ORIENTED PARADIGM	9
Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).		
UNIT III	**DISTRIBUTED ARCHITECTURE**	**9**
Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes.		
UNIT IV	**USER INTERFACES AND CONTAINERS**	**9**
Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA- Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.		
UNIT V	**ASPECT ORIENTED ARCHITECTURE**	**9**
Aspect Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understand the need of software architecture for sustainable dynamic systems
CO2 Analyze the sound knowledge on design principles and to apply for large scale systems.
CO3 Design architectures for distributed heterogeneous systems
CO4 Analyze service oriented and model driven architectures and the aspect oriented architecture.
CO5 Apply knowledge to develop appropriate architectures through various case studies.

Reference Books

1. Essentials of software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011.
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010.

Web Recourses

1. https://www.castsoftware.com/glossary/Software-Architecture-definition-examples-explanation-tools-principle

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	1		
2	3			2							1	2	1		
3	3		2								1	2	1		
4	3			2							1	2	1		
5	3			2							1	2	1		

21CP1603	ADVANCED OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Operating System

Objectives

1. To be able to read and understand sample open source programs and header files.
2. To learn how the processes are implemented in linux.
3. To understand the implementation of the Linux file system.
4. To study Linux memory management data structures and algorithms.
5. To acquire the knowledge in the implementation of interprocess communication.
6. To understand how program execution happens in Linux.

UNIT I	INTRODUCTION	9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management Memory Management - Device Drivers.

UNIT II	PROCESSES	9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT III	FILE SYSTEM	9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesytem Type Registration - Filesytem Handling - Namespaces – Mounting Unmounting - Implementation of VFS System Calls.

UNIT IV	MEMORY MANAGEMENT	9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V	**PROCESS COMMUNICATION AND PROGRAM EXECUTION**	**9**

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading from and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Understand the functionality of a large software system by reading its source.
CO2 Analyze any algorithm presents in a system.
CO3 Design a new algorithm to replace an existing one.
CO4 Apply appropriate algorithm for memory management.
CO5 Analyze and apply the data structures of the Linux kernel for a different software system.

Reference Books

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, ―Structure and Interpretation of Computer Programs‖, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, ―The Design of the Unix Operating System‖ 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, ―Linux Kernel Internals‖, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, ―Linux Kernel Development‖, 3rd Edition, Addison-Wesley, 2010

Web Recourses

1. https://www.slideshare.net/ayyakathir/cs9222-advanced-operating-system

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2						1	1	2		
2	3	3	3	3	3						1	1	2		
3	3	3	3	3	3	1					1	1	2	2	
4	3	3	3	3	3						1	1	2		
5	3	3	3	3	3						1	1	2		

21CP1604	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Artificial Intelligence

Objectives

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To have a thorough understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To study about dimensionality Reduction and Evolutionary models.
5. To understand graphical models of machine learning algorithms.

UNIT I	INTRODUCTION	9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II	LINEAR MODELS	9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III	TREE AND PROBABILISTIC MODELS	9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT IV	DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS	9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

UNIT V	GRAPHICAL MODELS	9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test	Formative Assessment Test	End Semester Exams

(30 Marks)	(10 Marks)	(60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understand the difference between, supervised, unsupervised and semi-supervised learning
CO2 Analyze the appropriate machine learning strategy for any given problem
CO3 Analyze and Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.
CO4 Design systems that uses the appropriate graph models of machine learning
CO5 Apply existing machine learning algorithms to improve classification efficiency.

Reference Books

1. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014.
2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014.
3. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.

Web Recourses

1. https://www.sas.com/en_in/insights/analytics/machine-learning.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	2		
2	2	3	3	3							1	2	2		
3	2	3	2	3							1	2	2		
4	3	2	3	3	2	1					1	2	2		
5	2	3	3	3							1	2	2		

21CP1605	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Software Engineering

Objectives

1. To understand Software Engineering Lifecycle Models
2. To do project management and cost estimation
3. To gain knowledge of the System Analysis and Design concepts.
4. To understand software testing approaches
5. To be familiar with DevOps practices.

UNIT I	INTRODUCTION	9
Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management Project planning – Estimation – Scheduling – Risk management – Software configuration management.		
UNIT II	**SOFTWARE REQUIREMENT SPECIFICATION**	**9**
Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.		
UNIT III	**ARCHITECTURE AND DESIGN**	**9**
Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client- server - Tiered - Pipe and filter - User interface design.		
UNIT IV	**TESTING**	**9**
Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.		
UNIT V	**DEVOPS**	**9**
DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Micro services.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understand the advantages of various Software Development Lifecycle Models
CO2 Analyze theknowledge on project management approaches as well as cost and schedule estimation strategies
CO3 Perform formal analysis on specifications,Use UML diagrams for analysis and design
CO4 Architect and design using architectural styles and design patterns
CO5 Analyzesoftware testing approaches and the advantages of DevOps practices

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd edition, Pearso Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, ―DevOps: A Software Architect‘s Perspective‖, Pearson Education, 2016
5. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

Web Recourses

1. https://www.tutorialride.com/software-engineering/advanced-software-engineering.htm

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	3	3	3	3						1		
2	3		1	3	3	2	3						1		
3	3		3	2	3	3	3						2		
4	3		3	3	3	3	2						2		
5	3		3	2	3	3	3						2		

21CP1611	**DATA STRUCTURES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisites for the course

- Data Structures

Objectives

1. To acquire the knowledge of using advanced tree structures.
2. To learn the usage of heap structures.
3. To understand the usage of graph structures and spanning trees

S.No	List of Experiments	CO
1	Implementation of Merge Sort and Quick Sort-Analysis	CO1
2	Implementation of a Binary Search Tree	CO1
3	Red-Black Tree Implementation	CO2
4	Heap Implementation	CO2
5	Fibonacci Heap Implementation	CO2
6	Graph Traversals	CO3
7	Spanning Tree Implementation	CO4
8	Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)	CO4
9	Implementation of Matrix Chain Multiplication	CO5
10	Activity Selection and Huffman Coding Implementation.	CO5

Total Periods :60

Suggestive Assessment Methods

Lab Components Assessments (50 Marks)	**End Semester Exams (50 Marks)**
Experiments, Model Lab Exam	End Semester Lab Exam

Outcomes

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

CO1 Design and implement basic data structures extensively
CO2 Design and implement advanced data structures extensively
CO3 Design and implement graph traversals
CO4 Design algorithms using graph structures
CO5 Design and develop efficient algorithms with minimum complexity using design techniques

Laboratory Requirements

- Java or C / C++

Reference Books

1. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education.
2. S.Sridhar,‖Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.
4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006.

Web Recourses

- https://www.oreilly.com/library/view/advanced-data-structures/9781788624213/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3		3							1	2	1	
2	3	2	3		3							1	2	1	
3	3	2	3		3							1		2	
4	3	2	3		3							1		2	
5	3	2	3		3							1		2	

SEMESTER II

21CP2601	NETWORK DESIGN AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Computer Networks

Objectives

1. To understand the principles required for network design
2. To explore various technologies in the wireless domain
3. To study about 3G and 4G cellular networks
4. To study about 4G cellular networks
5. To understand the paradigm of Software defined networks

UNIT I	NETWORK DESIGN	9

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling toPO12ogies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.

UNIT II	WIRELESS NETWORKS	9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security– IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles.

UNIT III	CELLULAR NETWORKS	9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security.

UNIT IV	4G NETWORKS	9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G.

UNIT V	SOFTWARE DEFINED NETWORKS	9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types– Virtualization – Data Plane – I/O – Design of SDN Framework.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understandthe components required for designing a network
CO2 Design a network at a high-level using different networking technologies
CO3 Analyze the various protocols of wireless and cellular networks
CO4 Analyze the features of 4G and 5G networks
CO5 Analyze and Createwith software defined networks

Reference Books

1. Erik Dahlman, Stefan Parkvall, Johan Skold, ―4G: LTE/LTE-Advanced for Mobile Broadband‖, Academic Press, 2013.
2. Jonathan Rodriguez, ―Fundamentals of 5G Mobile Networks‖, Wiley, 2015.
3. Larry Peterson and Bruce Davie, ―Computer Networks: A Systems Approach‖, 5th edition, Morgan Kauffman, 2011
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
5. Martin Sauter, ―Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0‖, Wiley, 2009.
6. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, ―Next-Generation Wireless Technologies‖, Springer, 2013.
7. Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Morgan Kauffman, 2014.
8. Savo G Glisic, ―Advanced Wireless Networks – 4G Technologies‖, John Wiley & Sons, 2007.

Web Recourses

1. http://networkdesigntechnologies.com

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3											2	2		
2	3	3	3		3							2	2		
3	3			2								2	2		
4	3											2	2		
5	3			2								2	2		

21CP2602	CYBER SECURITY	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Network Security

Objectives

1. To introduce the basic concepts and challenges in cyber security
2. To illustrate the use of modern tools to resolve the security issues
3. To implement the cyber security principles and methods in organization

UNIT I	INTRODUCTION TO CYBERCRIME	9

Cybercrime- definition and origins of the world- Cybercrime and information security Classifications of cybercrime- Cybercrime and the Indian ITA 2000 - A Global Perspective oncybercrimes- Cloud Computing-Proliferation of Mobile and Wireless Devices- Trends inMobility, Credit Card Frauds in Mobile and Wireless Computing Era.

UNIT II	**CYBER SECURITY CHALLENGES IN MODERN DEVICES**	**9**

Security Challenges Posed by Mobile Devices- Registry Settings for Mobile Devices Authentication Service Security- Attacks on Mobile/Cell Phones, Mobile Devices, - Security Implications for Organizations- Organizational Measures for Handling Mobile-Devices-Related Security Issues Organizational Security Policies and Measures in Mobile Computing Era,Laptops.

UNIT III	**TOOLS AND METHODS**	**9**

Tools and Methods Used in Cyber line Proxy Servers and Anonymizers- Phishing – PasswordCracking, Key loggers and Spywares, - Virus and Worms, Steganography – DoSDDoS Attacks -SQL Injection, Buffer Over Flow - Attacks on Wireless Networks, Phishing, Identity Theft (IDTheft) - The Legal Perspectives - Cyberlaw: The Indian Context - The Indian IT Act.

UNIT IV	**CYBER FORENSICS**	**9**

Understanding Computer Forensics - Historical Background of Cyber forensics – DigitalForensics Science - The Need for Computer Forensics -Cyber forensics and Digital Evidence -Forensics Analysis of Email - Digital Forensics Lifecycle - Chain of Custody Concept – NetworkForensics - Approaching a Computer Forensics Investigation - Setting of a Computer ForensicsLaboratory: Understanding the Requirements, Computer Forensics and Steganography.

UNIT V	**ORGANIZATIONS IMPLICATIONS**	**9**

Organizational Implications Cost of Cybercrimes and IPR Issues: - Lesson for Organizations Web Treats for Organizations: The Evils and Perils - Security and Privacy Implications fromCloud Computing - Social Media Marketing: Security Risk and Perils for Organization – SocialComputing and the Associated Challenges for Organizations - Protecting People- Privacy in theOrganization, Organizational Guidelines for Internet Usage - Safe Computing Guidelines and Computer Usage Policy.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Implement and Manage the security essentials in IT Sector
CO2 Analyze the concepts of Cyber Security and encryption Concepts
CO3 Analye the knowledge in the area of Privacy and Storage security and related Issues
CO4 Apply the techniques ultimately society from attacks
CO5 Analyze the Safe Computing Guidelines and Computer Usage Policy

Reference Books

1. Nina Godbole, SunitBelapure, Cyber Security, Wiley India, New Delhi 2012.
2. Harish Chander, cyber laws & IT protection, PHI learning pvt.ltd, 2012.
3. Dhiren R Patel, Information security theory &practice,PHI learning pvt ltd,2010
4. MS.M.K.Geetha&Ms.SwapneRaman Cyber Crimes and Fraud Management, MACMILLAN,2012.
5. Pankaj Agarwal : Information Security & Cyber Laws (Acme Learning), Excel, 2013.

6. VivekSood, Cyber Law Simplified, TMH, 2012.

Web Recourses

1. https://www.itgovernance.co.uk/what-is-cybersecurity

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2						1	2	2		
2	3	2	2	2							1	2			
3	3	3	3	3							1	2	2		
4	3	3	3	3							1	2			
5	3	3	3	3							1	2			

21CP2603	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Computer Networks

Objectives

1. To understand the fundamentals of Internet of Things
2. To Learn the Various architecture in IoT
3. To learn about the basics of IOT protocols
4. To build a small low cost embedded system using Raspberry Pi.
5. To apply the concept of Internet of Things in the real world scenario.

UNIT I	INTRODUCTION TO IoT	9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT II	IoT ARCHITECTURE	9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

UNIT III	IoT PROTOCOLS	9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.

UNIT IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	9
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & EndPO9nts - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		
UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.		
	Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Analyze various protocols for IoT
CO2 Develop web services to access/control IoT devices.
CO3 Design a portable IoT using Rasperry Pi
CO4 Deploy an IoT application and connect to the cloud
CO5 Analyze applications of IoT in real time scenario

Reference Books

1. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach||, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things||, Springer, 2011.
3. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective||, CRC Press, 2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols||, Wiley, 2012.

Web Recourses

1. https://www.oracle.com/in/internet-of-things/what-is-iot/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		2		1					1	2	2		
2	3		3			1					1	2	2		
3	3				3	1					1	2	2		
4	3	2		2	2	1					1	2	2	3	
5	3					1					1	2	2	3	

21CP2604	CLOUD COMPUTING AND BIG DATA	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Introduction to Cloud Computing

Objectives

1. To understand the various issues in cloud computing
2. To be able to set up a private cloud
3. To understand the competitive advantages of big data analytics
4. To understand the big data frameworks
5. To learn data analysis methods
6. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT I	CLOUD PLATFORM ARCHITECTURE	9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management.

UNIT II	PROGRAMMING MODEL	9

Introduction to Hadoop Framework – Map Reduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus.

UNIT III	INTRODUCTION TO BIG DATA	9

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT IV	DATA ANALYSIS	9

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT V	BIG DATA FRAMEWORKS	9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – 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 Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Identify the architecture, infrastructure and delivery models of cloud computing
CO2 Develop services using Cloud computing.
CO3 Understand how to leverage the insights from big data analytics
CO4 Analyze data by utilizing various statistical and data mining approaches
CO5 Understand the various NoSql alternative database models

Reference Books

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
2. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner‟s Guide||, McGraw-Hill Osborne Media, 2009.
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
5. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.
6. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics||, Wiley and SAS Business Series, 2012.
7. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
8. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
9. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of PO12yglot Persistence", Addison-Wesley Professional, 2012.
10. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O‘Reilly Media, 2013.

Web Recourses

1. https://www.computer.org/publications/tech-news/trends/big-data-and-cloud-computing

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	2		
2	3		2								1	2	2		
3	3										1	2	2		
4	3	3		2							1	2	2	2	
5	3			2	3						1	2	2	2	

21CP2611	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course

- Big Data

Objectives

1. To implement Map Reduce programs for processing big data
2. To realize storage of big data using H base, Mongo DB
3. To analyze big data using linear models
4. To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering

S.No	List of Experiments	CO
1	Install, configure and run Hadoop and HDFS	CO1
2	Implement word count / frequency programs using MapReduce	CO1
3	Implement an MR program that processes a weather dataset	CO2
4	Implement Linear and logistic Regression	CO2
5	Implement SVM / Decision tree classification techniques	CO3
6	Implement clustering techniques	CO3
7	Visualize data using any plotting framework	CO4
8	Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop/R	CO5

Total Periods :60

Suggestive Assessment Methods

Lab Components Assessments (50 Marks)	**End Semester Exams (50 Marks)**
Experiments, Model Lab Exam	End Semester Lab Exam

Outcomes

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

CO1 Process big data using Hadoop framework
CO2 Build and apply linear and logistic regression models
CO3 Perform data analysis with machine learning methods
CO4 Perform graphical data analysis
CO5 Implement applications that uses Hbase/MongoDB

Laboratory Requirements

- Hadoop, YARN, R Package, Hbase, MongoDB

Reference Books

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

Web Recourses

- https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.htm

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3				2						2	2	2	2	
2	3		2								2	2	2	2	
3	3	3									2	2	2	2	
4	3	3		3	2						2	2	2	2	
5	3			2	3						2	2	2	2	

21CP2612	TERM PAPER WRITING AND SEMINAR	L	T	P	C
		0	0	2	1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out.

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in	3rd week	**3%** (the selected information must be area specific and of international and national standard)

	your area 7. Attach a call for papers (CFP) from your area.		
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective - Search various digital libraries and GoogleScholar • When picking papers to read - tryto: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out ofthem, • Favour papers from well-known journals andconferences, • Favour -first‖or -foundational‖papers in the field (as indicated in other people's surveypaper), • Favour more recentpapers, • Pick a recent survey of the field so you can quickly gain anoverview, • Find relationships with respect to each other and to your topic area (classificationscheme/categorization) • Mark in the hard copy of papers whether	4th week	**6%** (the list of standard papers and reason for selection)

	complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper • What is the main topic of thearticle? • What was/were the main issue(s) the author said they want todiscuss? • Why did the author claim it was important ? • How does the work build on other's work, in the author'sopini on? • What simplifying assumptions does the author claim to bemaking? • What did the authordo? • How did the author claim they were going to evaluate their work and compare it toothers? • What did the author say were the limitations of theirresearc h? • What did the author say were the	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about eachpaper)

	important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft	13th week	**10%** (formatting,

	of your paper		English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th& 15th week	**10%** (based on presentation and Viva-voce)

Total: 30 Periods

21CP2701	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Database Management Systems

Objectives

1. To acquire knowledge on parallel and distributed databases and its applications.
2. To study the usage and applications of Object Oriented and Intelligent databases.
3. To understand the emerging databases like Mobile, XML, Cloud and Big Data
4. To understand the mobile database, transactions and concurrency control
5. To understand the multimedia database – Image, Text/ Document, Video, audio databases.

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	XML DATABASES	9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT IV	MOBILE 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.

UNIT V	MULTIMEDIA DATABASES	9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.	
Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Develop skills on databases to optimize their performance in practice
CO2 Analyze each type of databases and its necessity.
CO3 Design faster algorithms in solving practical database problems
CO4 Analyzethe database connectivity
CO5 Analyze the emerging databases like Mobile, XML, Cloud and Big Data

Reference Books

1. C.J.Date, A.Kannan, S.Swamynathan, —An Introduction to Database Systems||, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, —Advanced Database Systems||, Morgan Kaufmann publishers,2006
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, —Database System Concepts||, Sixth Edition, McGraw Hill, 2011
4. R. Elmasri, S.B. Navathe, —Fundamentals of Database Systems||, Sixth Edition, Pearson Education/Addison Wesley, 2010.
5. Vijay Kumar, —Mobile Database Systems||, John Wiley & Sons, 2006.

Web Recourses

1. https://slideplayer.com/slide/9352779/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2	2							1	2	1		
2	3	3									1	2	1		
3	3		3	2							1	2	1		
4	3	2		2							1	2	1		
5	3	3									1	2	1		

21CP2702	IMAGE AND VIDEO PROCESSING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Digital Image Processing

Objectives

1. To understand the image processing concepts and analysis
2. To understand the image processing techniques
3. To familiarize the image processing environment and their applications,
4. To appreciate the use of image processing in various applications
5. To understand the video processing concepts

UNIT I	IMAGE PROCESSING FUNDAMENTALS	9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT II	IMAGE ENHANCEMENT AND RESTORATION	9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III	IMAGE SEGMENTATION AND MORPHOLOGY	9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic Morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labelling – Regional descriptors and Feature Selection Techniques.

UNIT IV	IMAGE ANALYSIS AND CLASSIFICATION	9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V	BASIC STEPS OF VIDEO PROCESSING	9

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
CO2 Apply MATLAB and its equivalent open source tools.
CO3 Critically analyze different approaches to image processing applications
CO4 Analyze andExplore the possibility of applying Image processing concepts in various applications
CO5 Critically analyze different approaches to video processing applications

Reference Books

1. Alasdair McAndrew, —Introduction to Digital Image Processing with Matlab||, Cengage Learning 2011,India.
2. Anil J Jain, —Fundamentals of Digital Image Processing||, PHI, 2006.
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, "Video processing and communication ",1st edition , PHI.
4. Kavyan Najarian and RobertSplerstor,|| Biomedical signalsand Image processing||,CRC – Taylor and Francis, New York, 2006
5. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processing||, Third Edition, Pearson Education, 2008, New Delhi.
6. S.Sridhar, —Digital Image Processing||, Oxford University Press, 2011.

Web Recourses

1. https://www.slideserve.com/darius-padilla/image-and-video-processing-an-introduction

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3								1	2	1		
2	3				2						1	2	1		
3	3	2									1	2	1		
4	3			2							1	2	1		
5	3	2									1	2	1		

21CP2703	SECURITY PRACTICES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Cryptography and Network Security

Objectives

1. To learn the core fundamentals of system and web security concepts
2. To have through understanding in the security concepts related to networks
3. To deploy the security essentials in IT Sector
4. To be exposed to the concepts of Cyber Security and encryption Concepts
5. To perform a detailed study of Privacy and Storage security and related Issues.

UNIT I	**SYSTEM SECURITY**	**9**
Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.		
UNIT II	**NETWORK SECURITY**	**9**
Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security- Optical Network Security- Optical wireless Security.		
UNIT III	**SECURITY MANEGEMENT**	**9**
Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.		
UNIT IV	**CYBER SECURITY AND CRYPTOGRAPHY**	**9**
Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.		
UNIT V	**PRIVACY AND STORAGE SECURITY**	**9**
Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security Policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Understand the core fundamentals of system security
CO2 Apply the security concepts related to networks in wired and wireless scenario.
CO3 Implement and Manage the security essentials in IT Sector
CO4 Analyze and Apply he concepts of Cyber Security and encryption Concepts
CO5 Analyze theknowledge in the area of Privacy and Storage security and related Issues

Reference Books

1. John R.Vacca, Computer and Information Security Handbook, Second Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, Fourth Edition, Cengage Learning, 2012.
3. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016

Web Recourses

1. https://us.norton.com/internetsecurity-how-to-cyber-security-best-practices-for-employees.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	3	2	2					3					2		
2	3					2	2	3					2		
3	3	2	2			2					1		2		
4	3			2				2			1		2		
5	3	2				2		2			1		2		

21CP2704	WEB ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Software Engineering

Objectives

1. Understand the characteristics of web applications
2. Learn to Model web applications
3. Be aware of Systematic design methods
4. Be familiar with the testing techniques for web applications

UNIT I	INTRODUCTION TO WEB ENGINEERING	9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II	WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS	9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures-Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages- Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

UNIT III	WEB APPLICATION DESIGN	9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV	TESTING WEB APPLICATIONS	9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches- Conventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing- Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-

Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

UNIT V	**PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT**	**9**

Introduction-challenges in launching the web Application-Promoting Web Application- Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Understand syntax and semantics of programming languages.
CO2 Analyz**e** data, data types, and basic statements of programming languages.
CO3 Design and implement subprogram constructs, Apply object - oriented, concurrency, pro and event handling programming constructs
CO4 Develop programs in LISP, ML, and Prolog
CO5 Analyze the challenges in launching web applications

Reference Books

1. Chris Bates, ―Web Programming: Building Internet Applications‖, Third Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, ―Web Engineering‖, John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, ―Web Programming‖, Cengage Learning, 2008.
4. John Paul Mueller, ―Web Development with Microsoft Visual Studio 2005‖, Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, ―Web Engineering‖, Tata McGraw Hill Publication, 2007.

Web Recourses

1. https://www.slideshare.net/hello_hi90/web-engineering

CO Vs PO Mapping and CO Vs PSO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	2	2	1	2						3	1		
2	3	3		2		2						3	1		
3			2		1							3	1		
4	2	1	3	2	2							2	1		
5	3	3		2		2						3	1		

21CP2705	AGENT BASED INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Artificial Intelligence

Objectives

1. To learn the basic concepts of agent design
2. To understand about the agents learning and intelligent assistance
3. To explore agent communication and cooperation
4. To study multi agent communication and cooperation
5. To understand multi agent decision making concepts

UNIT I	INTRODUCTION	9

Introduction - Interaction with agent - Direct manipulation to Delegation - Interface agents - Designing agents - Direct manipulation versus agents: Paths to predictable, Controllable and Comprehensible interfaces.

UNIT II	AGENTS FOR LEARNING AND INTELLIGENT ASSISTANCE	9

Agents for information sharing and coordination - Agents that reduce work and information overload - Programming agent - Life like computer characteristics - Software agents for cooperative learning.

UNIT III	AGENT COMMUNICATION AND COLLABORATION	9

Agent based framework for interoperability - Agent for information gathering - Industrial strength open agent architecture - Communicative actions - Mobile agents.

UNIT IV	MULTIAGENT COMMUNICATION AND COOPERATION	9

Ontology fundamentals – Ontology languages - RDF – Construction an Ontology –Software Tools for Ontology- Communication: Speech acts – Agent communication languages - Working together: Cooperative Distributed Problem Solving - Task Sharing - Result Sharing - Handling inconsistency - Coordination - Multi agent planning and synchronization.

UNIT V	MULTI AGENT DECISION MAKING	9

Multi agent interactions – Utilities and Preferences- Solution Concepts-Competitive and Zero-sum Interactions-The Prisoner's Dilemma-Making group decisions – Social welfare Functions-Voting Procedures-Properties-Strategic Manipulation.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understand and Formulate a problem and propose an agent framework.
CO2 Analyze the agents for learning and intelligent assistance.
CO3 Construct interface for agent communication and cooperation
CO4 Analyzemulti agent systems
CO5 Construct decision framework for multi agent systems

Reference Books

1. Jeffrey M Bradshaw, "Software Agents", The MIT Press, 2010
2. Michael Wooldridge, "An Introduction to Multi Agent Systems", second edition John Wiley and Sons ltd., 2009.
3. Yoav Shoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game theoretic and Logical foundations", Cambridge, 2008
4. Tomas Salamon, 'design of Agent Based Models: Developing Computer Simulations for a better understanding of social Processes", Academic series, 2011
5. John Fulcher, L.C.Jain, "Computational Intelligence : A Compendium, Studies in Computational Intelligence", Vol.115, Springer,2008.

Web Recourses

1. https://datascience.foundation/sciencewhitepaper/an-overview-of-agent-based-intelligent-systems-and-its-tools

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	2	2					3	3	1		
2	2	3	3			2					2	3	1		
3	3										2	3	1		
4	2	3	3			2					2	3	1		
5		3	2	2							3	2	1		

21CP2706	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Operating systems

Objectives

1. To learn real time operating system concepts, the associated issues & Techniques.
2. To understand design and synchronization problems in Real Time System.
3. To explore the concepts of real time databases.
4. To understand the evaluation techniques present in Real Time System

UNIT I	REAL TIME SYSTEM AND SCHEDULING	9

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II	SOFTWARE REQUIREMENTS ENGINEERING	9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

UNIT III	INTERTASK COMMUNICATION AND MEMORY MANAGEMENT	9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

UNIT IV	REAL TIME DATABASES	9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V	EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION	9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault– Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Apply principles of real time system design techniques to develop real time applications.
CO2 Analyze the database in real time applications.
CO3 Analyze architectures and behaviour of real time operating systems
CO4 Analyze the issues in real time databases
CO5 Apply evaluation techniques in any application

Reference Books

1. C.M. Krishna, Kang G. Shin, —Real-Time Systems||, McGraw-Hill International Editions, 1997.
2. Philip.A.Laplante, —Real Time System Design and Analysis||, Prentice Hall of India, 3rd Edition, 2004.
3. Rajib Mall, —Real-time systems: theory and practice||, Pearson Education, 2009.

4. R.J.A Buhur, D.L Bailey, —An Introduction to Real-Time Systems||, Prentice Hall International, 1999.
5. Stuart Bennett, —Real Time Computer Control-An Introduction||, Prentice Hall of India, 1998.
6. Allen Burns, Andy Wellings, —Real Time Systems and Programming Languages||, Pearson Education, 2003.

Web Recourses

1. https://www.geeksforgeeks.org/real-time-systems/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	2	2	2					3	3	2		
2	2	3	3			2					2	3	2		
3	3										2	3	2		
4	2	3	3			2					2	3	2		
5		3	2	2							3	2	2		

21CP2707	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Mobile Computing

Objectives

1. To learn the basic architecture and concepts till Third Generation Communication systems.
2. To understand the latest 4G Telecommunication System Principles.
3. To introduce the broad perspective of pervasive concepts and management
4. To explore the HCI in Pervasive environment
5. To apply the pervasive concepts in mobile environment

UNIT I	INTRODUCTION	9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II	OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM	9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

UNIT III	PERVASIVE CONCEPTS AND ELEMENTS	9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management - Service Management - Data Management - Security Management – Pervasive Computing

Environments - Smart Car Space - Intelligent Campus.

UNIT IV	HCI IN PERVASIVE COMPUTING	9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context- Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

UNIT V	PERVASIVE MOBILE TRANSACTIONS	9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Understand the basic architecture and concepts of till Third Generation Communication systems.
CO2 Analyze the latest 4G Telecommunication System Principles.
CO3 Apply pervasive concepts
CO4 Implement the HCI in Pervasive environment
CO5 Apply the pervasive concepts in mobile environment

Reference Books

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
2. J.Schiller, ―Mobile Communication‖, Addison Wesley, 2000.
3. Juha Korhonen, ―Introduction to 4G Mobile Communications‖ , Artech House Publishers, 2014.
4. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, ―Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks‖, CRC 2016.
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, ― Pervasive Computing: Concepts, Technologies and Applications ‖ CRC Press, 2016.

Web Recourses

1. https://slideplayer.com/slide/6643042/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2							2	2	2		
2	2	2		2	2						2	2	2		
3	2	2	2	2							2	2	2		
4	3		3	2							2	2	2		
5	3										2	2	2		

21CP2708	PARALLEL PROGRAMMING PARADIGMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Programming Paradigm

Objectives

1. To familiarize the issues in parallel computing.
2. To describe distributed memory programming using MPI.
3. To understand shared memory paradigm with Pthreads and with OpenMP.
4. To learn the GPU based parallel programming using OpenCL

UNIT I	FOUNDATIONS OF PARALLEL PROGRAMMING	9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs-– parallel program design.

UNIT II	DISTRIBUTED MEMORY PROGRAMMING WITH MPI	9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD- programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm.

UNIT III	SHARED MEMORY PARADIGM WITH PTHREADS	9

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

UNIT IV	SHARED MEMORY PARADIGM: OPENMP	9
Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search.		
UNIT V	**GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA**	**9**
Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.		
	Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/Written	**MCQ/Assignment**	**MCQ/Written**

Outcomes

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

CO1 Understand and Identify issues in parallel programming.
CO2 Develop distributed memory programs using MPI framework.
CO3 Design and develop shared memory parallel programs using Pthreads
CO4 Design and develop shared memory parallel programs using OpenMP
CO5 Create and Implement Graphical Processing OpenCL programs

Reference Books

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, ―OpenCL programming guide‖, Addison Wesley, 2011.
2. M. J. Quinn, ―Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill, 2003.
3. Peter S. Pacheco, ―An introduction to parallel programming‖, Morgan Kaufmann, 2011.
4. Rob Farber, ―CUDA application design and development‖, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, ―Using MPI: Portable parallel programming with the message passing interface‖, Second Edition, MIT Press, 1999.

Web Recourses

1. https://www.cse.iitd.ac.in/~dheerajb/parallel_paradigms.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		2		1					1	2	1		
2	3		3		2	1					1	2	1		
3	3		3		2	2					1	2	1		
4													1		
5	3				2	3					1	2	1	2	

21CP2709	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Machine Learning

Objectives

1. To understand the basics of information retrieval, open source IR systems, search engines.
2. To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
3. To get an understanding of machine learning techniques for text classification and clustering.
4. To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
5. To understand the concepts of digital libraries

UNIT I	INTRODUCTION: MOTIVATION	9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR ––IR Versus Web Search–Components of a Search engine.

UNIT II	MODELING	9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT III	INDEXING	9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

UNIT IV	CLASSIFICATION AND CLUSTERING	9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning.

UNIT V	SEARCHING THE WEB	9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Build an Information Retrieval system using the available tools.
CO2 Design the various components of an Information Retrieval system.
CO3 Analyze the Information Retrieval with regard to indexing
CO4 Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO5 Design an efficient search engine and analyze the Web content structure

Reference Books

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.
2. Implementing and Evaluating Search Engines‖, The MI Cambridge, Massachusetts London, England, 2010.
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval.

Web Recourses

1. https://www.ijcncs.org/published/volume3/issue9/p3_3-9.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2		2	2					1	2			
2	3		3			1					1	2	1		
3	3		2			1					1	2			
4	3		2			1					1	2			
5	3		3			1					1	2			

21CP2710	DATA MINING TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Database Management Systems

Objectives

1. To impart knowledge on
2. To study data mining and its issues
3. To learn to mine the data using Frequent Patterns
4. To learn the various classification methods
5. To study the role of clustering on large data
6. To learn how to apply data mining techniques in real time applications

UNIT I	INTRODUCTION TO DATA MINING	9

Introduction to Data Mining – Types of Data Mining – Major Issues in Data Mining – Data sets – Models and Patterns – Data Objects and Attributes – Measurement and Data – Data Pre-processing – R as a Language for data mining – Data exploration and visualization.

UNIT II	FREQUENT PATTERN MINING	9

Frequent Itemset – Frequent Itemset Mining Methods – Evaluation of Interestingness – Pattern Mining in Multilevel, Multidimensional Space – Mining High dimensional Data – Applications of Pattern Mining.

UNIT III	CLASSIFICATION	9

Classifications – Decision Tree induction – Bayes Classification Methods – Model Evaluation and Selection – Techniques to improve Classification Accuracy – Advanced concepts: Bayesian Belief Networks – Classification by Back Propagation – Support Vector Machine – Classification using frequent patterns – k-Nearest-Neighbour Classifiers – Genetic Algorithms – Rough Set Approach – Fuzzy Set Approach – Introduction to active learning and transfer learning.

UNIT IV	CLUSTER ANALYSIS	9

Cluster Analysis: Partitioning methods – Hierarchical methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering – Advanced Cluster Analysis: Probabilistic model based clustering – Clustering High Dimensional Data – Clustering Graph and Network Data – Clustering with Constraints.

UNIT V	APPLICATIONS AND CASE STUDIES	9

Mining complex data types – Statistical data mining – Visual and audio data mining – Data mining Applications: Financial data analysis – Retail and telecommunication industries – Intrusion detection and prevention – Recommender systems. Case Studies: Social Network Analysis, Text Mining.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/Written	MCQ/Assignment	MCQ/Written

Outcomes

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

CO1 Identify the data mining tasks and the issues in data mining applications.
CO2 Createrules using association rule mining.
CO3 Develop solutions using classification algorithms
CO4 Develop solutions using clustering techniques
CO5 Apply data mining techniques to real time applications

Reference Books

1. Jiawei Han, Micheline Kamber ,Jian Pei, "Data Mining: Concepts and Techniques", Third Edition (The Morgan Kaufmann Series in Data Management Systems), 2012.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education, New Delhi, 2013
3. David J. Hand, Heikki Mannila and Padhraic Smyth "Principles of Data Mining" (Adaptive Computation and Machine Learning), 2005.
4. Margaret H Dunham, "Data Mining: Introductory and Advanced Topics", 2003.
5. Soman, K. P., DiwakarShyam and Ajay V. "Insight into Data Mining: Theory and Practice", PHI, 2009.
6. I. H. Witten and E. Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Morgan Kaufmann. 2005

Web Recourses

1. https://www.talend.com/resources/data-mining-techniques/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	1		
2	3			2							1	2			
3	3		2								1	2			
4	3			2							1	2			
5	3			2							1	2			

Semester III

Elective III

21CP3701	Performance Analysis of Computer Systems	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Networks

Objectives

1. To understand the mathematical foundations needed for performance evaluation of computer systems
2. To understand the metrics used for performance evaluation
3. To understand the analytical modeling of computer systems
4. To enable the students to develop new queuing analysis for both simple and complex systems
5. To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling topologies

UNIT I	OVERVIEW OF PERFORMANCE EVALUATION	9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems

UNIT II	MARKOV CHAINS AND SIMPLE QUEUES	9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III	MULTI-SERVER AND MULTI-QUEUE SYSTEMS	9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV	REAL-WORLD WORKLOADS	9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment topologies for Server Farms.

UNIT V	SMART SCHEDULING IN THE M/G/1	9

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based topologies - Scheduling Non-Preemptive and Preemptive Size-Based topologies – Scheduling - SRPT and Fairness

Total Periods	45

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1 Identify the need for performance evaluation and the metrics used for it
CO2 Analyze and Distinguish open and closed queuing networks
CO3 Apply Little's law and other operational laws
CO4 Apply discrete-time and continuous-time Markov chains to model real world systems
CO5 Design analytical techniques for evaluating scheduling topologies.

Reference Books

1. K. S. Trivedi, ―Probability and Statistics with Reliability, Queueing and Computer Science Applications‖, John Wiley and Sons, 2001.
2. Krishna Kant, ―Introduction to Computer System Performance Evaluation‖, McGraw-Hill, 1992.
3. Lieven Eeckhout, ―Computer Architecture Performance Evaluation Methods‖, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, ―Performance Modeling and Design of Computer Systems – Queueing Theory in Action‖, Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, ―Computer Systems Performance Evaluation and Prediction‖, Elsevier, 2003.
6. Raj Jain, ―The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling‖, Wiley-Interscience, 1991.

Web Recourses

1. https://nptel.ac.in/courses/106/106/106106048/
2. https://opencourses.emu.edu.tr/course/view.php?id=16
3. https://en.wikipedia.org/wiki/Computer_performance

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		2							1	1			
2	3			2							1	1	3		
3	3										1	1			
4	3										1	1	2		
5	3		3		1						1	1			

21CP3702	LANGUAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Programming Languages

Objectives

1. To learn the fundamentals of natural language processing
2. To learn automatic speech recognition technologies
3. To appreciate the use of CFG and PCFG in NLP
4. To understand the role of semantics and pragmatics
5. To develop an application based on languages technologies for translation

UNIT I	INTRODUCTION	9

Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of- Speech – Tagging - Hidden Markov and Maximum Entropy Models.

UNIT II	SPEECH	9

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.

UNIT III	SYNTAX	9

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.

UNIT IV	SEMANTICS AND PRAGMATICS	9

The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse

UNIT V	APPLICATIONS	9

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1 Understandgiven text with basic Language features
CO2 Design an innovative application using NLP components
CO3 Analyze and implement a rule based system to tackle morphology/syntax of a language
CO4 Design a tag set to be used for statistical processing for real-time applications

CO5 Analyze and apply different statistical approaches for different types of NLP applications.

Reference Books

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
2. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
4. Richard M Reese, "Natural Language Processing with Java", O_Reilly Media, 2015.
5. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python", First Edition, O_Reilly Media, 2009.

Web Recourses

1. https://en.wikipedia.org/wiki/Language_technology

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2			
2	3		3								1	2	3		
3	3										1	2			
4	3		3								1	2	2		
5	3			2							1	2			

21CP3703	COMPUTER VISSION	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Image Processing

Objectives

1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand Hough Transform and its applications to detect lines, circles, ellipses.
4. To understand three-dimensional image analysis techniques.
5. To understand motion analysis.
6. To study some applications of computer vision algorithms

UNIT I	IMAGE PROCESSING FOUNDATIONS	9

Review of image processing techniques – classical filtering operations – thresholding techniques edge detection techniques – corner and interest Point detection – mathematical morphology – texture

UNIT II	SHAPES AND REGIONS	9
Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.		
UNIT III	**HOUGH TRANSFORM**	**9**
Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection accurate center location – speed problem – ellipse detection – Case study: Human Iris location hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.		
UNIT IV	**3D VISION AND MOTION**	**9**
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – PO9nt-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.		
UNIT V	**APPLICATIONS**	**9**
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1 Understand and Implement fundamental image processing techniques required for computer vision.
CO 2 Analyze shape and implement boundary tracking techniques
CO3 Apply Hough Transform for line, circle, and ellipse detections
CO4 Apply 3D vision techniques
CO5 Develop applications using computer vision techniques

Reference Books

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.
2. E. R. Davies, ―Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, ―Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, ―Feature Extraction & Image Processing for Computer

Vision‖, Third Edition, Academic Press, 2012.
5. R. Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011.
6. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

Web Recourses

1. https://en.wikipedia.org/wiki/Computer_vision
2. http://szeliski.org/Book/
3. https://www.cs.ryerson.ca/~kosta/CPS843-W2020/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2								1	2			
2	3	3		3							1	2	3		
3	3										1	2			
4	3										1	2	2		
5	3		2								1	2			

21CP3704	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Machine Learning

Objectives

1. To learn feed forward deep networks
2. To understand convolution networks and sequence modelling
3. To study probabilistic models and auto encoders
4. To acquire knowledge on various deep generative models
5. To get exposure on various applications of deep learning

UNIT I	DEEP NETWORKS	9

Machine Learning Basics: Learning Algorithms – Supervised and Unsupervised learning – Feed forward Deep networks – Regularization: Regularization and Under-Constrained Problems - Dataset Augmentation – Early stopping. Optimization for training Deep models: Learning vs Optimization – Challenges – Basic Algorithms: Stochastic Gradient Descent, Adam, Conjugate Gradient method.

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 – introduction to Long term dependencies and Temporal dependencies.

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 – Deep learning approach – Monte carlo models – Linear Factor models and Auto encoders.

UNIT IV	DEEP GENERATIVE MODELS	9

Restricted Boltzmann Machines – Deep Belief networks – Deep Boltzmann machine – Convolutional Boltzmann machine.

UNIT V	APPLICATIONS	9

Speech, Audio and Music processing – Language modelling and Natural language processing – Information Retrieval – Object Recognition and Computer Vision – Multi modal and multi task learning

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1 Understand feed forward deep networks
CO2 Apply convolutional networks and sequence modelling for problem solving
CO3 Analyze and Work with probabilistic models and auto encoders
CO4 Analyze the functionalities using deep generative models
CO5 Apply the deep learning techniques in various real time applications.

Reference Books

1. Yoshua Bengio 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, issue. 5, 2010

Web Recourses

1. https://en.wikipedia.org/wiki/Deep_learning
2. https://www.upgrad.com/blog/top-deep-learning-techniques-you-should-know-about/
3. https://nptel.ac.in/courses/106/105/106105215/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3									1	2	1		
2	3										1	2			
3	3	3									1	2			
4	3	3									1	2			
5	3										1	2			

21CP3705	SOFTWARE QUALITY ASSURANCE AND TESTING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Software Testing

Objectives

1. To understand the basics of testing, test planning &design and test team organization
2. To study the various types of test in the life cycle of the software product.
3. To build design concepts for system testing and execution
4. To learn the software quality assurance, metrics, defect prevention techniques
5. To learn the techniques for quality assurance and applying for applications

UNIT I	SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES	9

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation

. Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Team Building.

UNIT II	SYSTEM TESTING MODELLING	9

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. Functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models.

UNIT III	SYSTEM TEST CATEGORIES	9

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote. system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness..

UNIT IV	SOFTWARE QUALITY	9

Software quality - People 's Quality Expectations**,** Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models**-** Test Process Improvement, Testing Maturity Model.

UNIT V	SOFTWARE QUALITY ASSURANCE	9

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1	Perform functional and non-functional tests in the life cycle of the software product.
CO2	Understand system testing and test execution process.
CO3	Analyze defect prevention techniques and software quality assurance metrics.
CO4	Analyze the software quality assurance metrics and defect prevention techniques
CO5	Apply techniques of quality assurance for typical applications

Reference Books

1. Software Testing and Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008.
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
3. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004.
4. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011.

Web Recourses

1. https://www.tutorialspoint.com/software_testing/software_testing_qa_qc_testing.htm
2. https://www.javatpoint.com/quality-assurance
3. https://en.wikipedia.org/wiki/Software_quality_assurance

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3					1				2	1	2	2		
2	3	2								1	1	2	2		
3	3	2				1					1	2	2		
4	3	2				1					1	2	2		
5	3		3	2		1					1	2	1		

Semester III
Elective IV

21CP3706	FORMAL MODELS OF SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Artificial Intelligence

Objectives

1. To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
2. To understand the fundamentals of abstraction and formal systems
3. To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
4. To understand formal specification models based on set theory, calculus and algebra and apply to a case study
5. To learn Z, Object Z and B Specification languages with case studies

UNIT I	SPECIFICATION FUNDAMENTALS	9

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, how to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities-Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II	FORMAL METHODS	9

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

UNIT III	LOGIC	9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic

(FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT IV	SPECIFICATION MODELS	9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labelled Transition Systems.

UNIT V	FORMAL LANGUAGES	9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System.TheObject-Z SpecificationLanguage-BasicStructureofan Object-Z,Specification. Parameterized Class, Object-Orientation, and composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

Total Periods	**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity

CO2 Understand and Gain knowledge on fundamentals of abstraction and formal systems

CO3 Analyze the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems

CO4 Design formal specification models based on set theory, calculus and algebra and apply to a typical case study

CO5 Apply the knowledge on Z, Object Z and B Specification languages with case studies.

Reference Books

1. Mathematical Logic for computer science,second edition, M.Ben-Ari ,Springer,2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.
3. Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011.
4. The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.
5. Using Z-Specification Refinement and Proof,Jim Woodcock and Jim Devies Prentice Hall, 1996.
6. Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994.

Web Recourses

1. https://en.wikipedia.org/wiki/Formal_methods

2. https://study.com/academy/lesson/formal-methods-model-definition-application.html
3. https://www.cse.iitb.ac.in/~supratik/courses/cs615/index.htm

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3				2						1	2			
2	3				2						1	2	3		
3	3				2						1	2			
4	3		3	2							1	2	2		
5	3				2						1	2			

21CP3707	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Embedded System

Objectives

1. To understand the architecture of embedded processor, microcontroller and peripheral devices.
2. To interface memory and peripherals with embedded systems.
3. To study the embedded network environment.
4. To understand challenges in Real time operating systems.
5. To study, analyze and design applications on embedded systems

UNIT I	EMBEDDED PROCESSORS	9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.

UNIT II	EMBEDDED COMPUTING PLATFORM	9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III	EMBEDDED NETWORK ENIVIRONMENT	9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV	REAL-TIME CHARACTERISTICS	9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V	**SYSTEM DESIGN TECHNIQUES**	**9**

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes..

Total Periods	**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand different architectures of embedded processor, microcontroller and peripheral \ devices.
CO2 Analyze Interface memory and peripherals with embedded systems.
CO3 Analyze and work with embedded network environment.
CO4 Analyze the challenges in Real time operating systems.
CO5 Design and analyze applications on embedded systems.

Reference Books

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, || Arm system developers guide||, Morgan Kauffman/Elsevier, 2006.
3. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014
4. C. M. Krishna and K. G. Shin, ―Real-Time Systems|| , McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, ―Embedded System Design: A Unified Hardware/Software Introduction||, John Wiley & Sons.
6. Jane.W.S. Liu, ―Real-Time systems||, Pearson Education Asia.
7. Michael J. Pont, ―Embedded C||, Pearson Education , 2007.
8. Steve Heath, ―Embedded SystemDesign|| , Elsevier, 2005
9. Wayne Wolf, ―Computers as Components:Principles of Embedded Computer System Design||, Elsevier, 2006.

Web Recourses

1. https://en.wikipedia.org/wiki/Embedded_software
2. https://www.coursera.org/lecture/introduction-embedded-systems/3-embedded-software-engineering-IGCwA
3. https://onlinecourses.nptel.ac.in/noc20_cs14/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1		1		1					2	3			
2	2	1		1		1					2	3	3		
3	2	2		1		1					2	2			
4	3	2		1		1					1	2	2		
5	2	1	3	2		1					2	2			

21CP3708	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Web Technology

Objectives

1. To understand the components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems

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	**APPLICATIONS**	**9**
A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.		
Total Periods		**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understandthe internals components of the social network.
CO2 Model and visualize the social network
CO3 Analyze the behavior of the users in the social network
CO4 Analyze and Predict the possible next outcome of the social network
CO5 Apply social network in real time applications.

Reference Books

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, ―Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012.
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖,Springer, 1st edition, 2011.
3. Charu C. Aggarwal, ―Social Network Data Analytics‖, Springer; 2014.
4. Giles, Mark Smith, John Yen, ―Advances in Social Network Mining and Analysis‖, Springer, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, Springer, 1st edition, 2012.
6. Peter Mika, ―Social Networks and the Semantic Web‖, Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla,‖Applications of Social Media and Social Network Analysis‖, Springer,2015.

Web Recourses

1. https://en.wikipedia.org/wiki/Social_network_analysis
2. ttps://nptel.ac.in/noc/courses/noc17/SEM2/noc17-cs41/
3. ttps://nptel.ac.in/courses/106/106/106106169/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		3								2	2			
2	2		3		1						2	2	3		
3	1										2	2			
4	2										2	2	2		
5	2		2	2							3	1			

21CP3709	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Compiler Design

Objectives

1. To be aware of different forms of intermediate languages and analyzing programs.
2. To understand optimizations techniques for simple program blocks.
3. To apply optimizations on procedures, control flow and parallelism.
4. To learn the inter procedural analysis and optimizations.
5. To explore the knowledge about resource utilization

UNIT I	INTERMEDIATE REPRESENTATIONS AND ANALYSIS	9

Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common – Sub expression Elimination - Loop-Invariant Code Motion - Partial- Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT II	EARLY AND LOOP OPTIMIZATIONS	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	PROCEDURE OPTIMIZATION AND SCHEDULING	9

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

UNIT IV	INTER PROCEDURAL OPTIMIZATION	9

Symbol table – Runtime Support – Interprocedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph – Interprocedural Data-Flow Analysis Interprocedural Constant Propagation – Interprocedural Alias Analysis – Interprocedural Optimizations -

Interprocedural Register Allocation - Aggregation of Global References.

UNIT V	REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY	9

Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

Total Periods	**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand the different optimization techniques for simple program blocks.
CO2 Design performance enhancing optimization techniques
CO3 Analyze the optimization on procedures
CO4 Analyze the inter procedural analysis and optimizations
CO5 Analyze and Ensure better utilization of resources

Reference Books

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
3. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach||, Morgan Kaufman, 2001.
4. Robert Morgan ,||Building an Optimizing Compiler||, Digital Press, 1998
5. Steven Muchnick, —Advanced Compiler Design and Implementation||, Morgan Kaufman Publishers, 1997.

Web Recourses

1. https://www.ibm.com/docs/en/aix/7.1?topic=tuning-compiler-optimization-techniques
2. https://www.embedded.com/advanced-compiler-optimization-techniques/
3. ttps://www.iith.ac.in/~ramakrishna/fc5264/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PS O2	PS O3
1	2	2		1								2	2		
2	2		2								1	1			
3	2		1									1			
4	2		1									1			
5	3	2		2								2			

21CP3710	BIO-INSPIRED COMPUTING AND BIO INFORMATICS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Image Processing,Linear algebra and computer programming

Objectives

1. To Learn bio-inspired theorem and algorithms
2. To understand open problems and issues in replication and selection
3. To Learn genetic algorithm and swarm optimization.
4. To get exposed to the fundamentals of bioinformatics.
5. To study and exposed to the domain of human genomics.

UNIT I	INTRODUCTION	9

Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms -Nature Inspires Algorithms - Parameter tuning and parameter control.

UNIT II	RANDOM WALK AND ANEALING	9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunnelling.

UNIT III	GENETIC ALGORITHMS AND DIFFERENTIAL EVOLUTION	9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

UNIT IV	SWARM OPTIMIZATION AND FIREFLY ALGORITHM	9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients- Ant colonyoptimizationtowardfeature selection.

UNIT V	APPLICATION IN IMAGE PROCESSING	9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using

Total Periods	45

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand and apply bio-inspired algorithms.
CO2 Analyze random walk and simulated annealing
CO3Analyze swarm intelligence and ant colony for feature selection
CO4 Analyze and Work on assemble genomes and sequences
CO5Apply the Microarray technologies for genome expression.

Reference Books

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
3. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
4. IstvanMiklos,RenyiInstitutue, —Introduction to algorithms in bioinformatics||,Springer 2016.
5. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

Web Recourses

1. https://en.wikipedia.org/wiki/Bio-inspired_computing
2. https://tutorials.one/bio-inspired-computing-approach-in-artificial-intelligence/
3. https://www.uio.no/studier/emner/matnat/ifi/INF3490/
4. https://en.wikipedia.org/wiki/Bioinformatics
5. https://onlinecourses.nptel.ac.in/noc21_bt06/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		3	3	3	2							2	3	2	1
2		3	3	2	2							2	3	2	1
3	3	2	2	2	2							3	3	2	1
4	3	3	2	2	2							2	3	2	1
5	3	3	2	2	2							1	3	2	1

Elective V

21CP3711	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Cloud Computing

Objectives

1. To develop skills to both design and critique visualizations.
2. To introduce visual perception and core skills for visual analysis.
3. To understand visualization for time-series analysis.
4. To understand visualization for ranking analysis.
5. To understand visualization for deviation analysis.
6. To understand visualization for distribution analysis.
7. To understand visualization for correlation analysis.
8. To understand visualization for multivariate analysis.
9. To understand issues and best practices in information dashboard design.

UNIT I	CORE SKILLS FOR VISUAL ANALYSIS	9

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT II	TIME-SERIES, RANKING, AND DEVIATION ANALYSIS	9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT III	DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS	9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT IV	INFORMATION DASHBOARD DESIGN	9

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT V	INFORMATION DASHBOARD DESIGN	9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Spark lines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

Total Periods	45

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1Understand the principles of visual perception
CO2 Apply core skills for visual analysis
CO3Apply visualization techniques for various data analysis tasks
CO4Design information dashboard
CO5Analyze the Information Dashboard Display Media.

Reference Books

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data PO9nts: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

Web Recourses

1. https://www.mygreatlearning.com/blog/understanding-data-visualization-techniques/
2. https://www.simplilearn.com/data-visualization-article
3. https://nptel.ac.in/courses/110/107/110107092/ (lecture 11)

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2											1	2		
2	2			2							2	1			
3	3			2							2	1			
4	2		3	2	2							1			
5	2		3	2	2							1			

21CP3712	RECONFIGURABLE COMPUTING	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Computer architecture and organization

Objectives

1. To understand the need for reconfigurable computing
2. To expose the students to various device architectures
3. To examine the various reconfigurable computing systems
4. To understand the different types of compute models for programming reconfigurable architectures
5. To expose the students to HDL programming and familiarize with the development environment
6. To expose the students to the various placement and routing protocols
7. To develop applications with FPGAs

UNIT I	DEVICE ARCHITECTURE	9

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

UNIT II	RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS	9

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III	PROGRAMMING RECONFIGURABLE SYSTEMS	9

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing Operating System Support for Reconfigurable Computing.

UNIT IV	MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS	9

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

UNIT V	APPLICATION DEVELOPMENT WITH FPGAS	9

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

Total Periods	45

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
MCQ/WRITTEN	MCQ/SEMINAR/ASSIGNMENTS	MCQ/WRITTEN

Outcomes

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

CO1UnderstandandIdentify the need for reconfigurable architectures
CO2 Analyze the architecture of FPGAs.
CO3 Understand the salient features of different reconfigurable architectures
CO4 Build basic modules using any HDL
CO5 Develop applications using any HDL and appropriate tools.
CO6 Design and build an SoPC for a particular application

Reference Books

1. Christophe Bobda, —Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications||, Springer, 2010.
2. Maya B. Gokhale and Paul S. Graham, —Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays||, Springer, 2005.
3. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform**.**
4. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer
5. Scott Hauck and Andre Dehon (Eds.), —Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation||, Elsevier / Morgan Kaufmann, 2008.

Web Recourses

1. https://en.wikipedia.org/wiki/Reconfigurable_computing
2. https://www.cdac.in/index.aspx?id=hpc_cc_recounfigurable_computing
3. https://nptel.ac.in/courses/106/106/106106088/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		3	3						2	2		2		
2	1	2	2		3	3					2	2	2		
3	2	3	2			3					1	2	2	2	
4	2	3	2		2						1	2		2	
5	2	3	3			2					1	2			

21CP3713	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Artificial Intelligence and Machine Learning

Objectives

1. To acquire basic knowledge on soft computing techniques
2. To learn supervised and unsupervised neural network architecture
3. To understand the concept of fuzzy logic
4. To explore the concept of genetic algorithm
5. To study applications of soft computing in real world domains

UNIT I	INTRODUCTION TO SOFT COMPUTING	9
Introduction - Soft computing vs. hard computing – Neural Networks – Fuzzy Logic – Genetic Algorithm – Advantages and Limitations - Hybrid systems.		
UNIT II	**NEURAL NETWORKS**	**9**
Basics – Supervised Learning Network: Perceptron – Adaline – Madaline – Back Propagation Network – Radial Basis Function Network - Unsupervised Learning Network: Kohonen Self Organizing feature Maps – Counterpropagation Networks – Adaptive Resonance Theory Network.		
UNIT III	**FUZZY LOGIC**	**9**
Introduction – Classical Sets – Fuzzy Sets – Classical relation and fuzzy relation – Membership functions – Defuzzification – Fuzzy Rule Base and Approximate Reasoning – Fuzzy Inference System – Mamdani FIS – Takagi Sugeno Fuzzy Model.		
UNIT IV	**GENETIC ALGORITHM**	**9**
Introduction – Biological Background – Traditional Optimization - GA Vs Traditional Algorithms – Operators: Encoding – Selection – Crossover – Mutation – Stopping Condition – Constraints – Problems.		
UNIT V	**APPLICATIONS OF SOFT COMPUTING**	**9**
A Fusion approach of Multispectral images with SAR - Travelling Salesman Problem using GA – Hybrid fuzzy Controllers – Internet Search Technique.		
Total Periods		**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand the basics of soft computing techniques
CO2 Construct neural network for real world problem.
CO3 Apply fuzzy logic for problems with uncertainty
CO4 Analyze and work with the genetic algorithms for optimization problems
CO5 Apply suitable soft computing techniques for real world problems.

Reference Books

1. Sivanandam S.N., Deepa S.N., "Principles of Soft Computing", Wiley India Pvt. Ltd, 2nd Edition,2013
2. J.S.R.Jang,C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing",PHI,Pearson Education,2004
3. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications",Prentice Hall of India,2006
4. George J.Klir,Ute St.Clair,Bo Yuan, "Fuzzy Set Theory: Foundations and Applications",Prentice Hall, 1997
5. David E.Goldberg, "Genetic Algorithm In Search Optimization and Machine Learning",Pearson Education India, 2013

6. James A.Freeman,David M.Skapura, "Neural Networks Algorithms, Applications and Programming Techniques", Pearson Education India, 1991
7. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Pearson Education,Second Edition,2005

Web Recourses

1. https://en.wikipedia.org/wiki/Soft_computing
2. https://nptel.ac.in/courses/106/105/106105173/
3. https://onlinecourses.nptel.ac.in/noc20_cs17/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2								2		2		
2	3	2										2			
3	3		2								2	3			
4	3		3		2						2	2			
5	3		3		2						2	3	1		

21CP3714	ADVANCED COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Signals and Systems, Communication Theory

Objectives

1. To introduce advanced topics in digital communications
2. To understand fundamentals of microwave communication
3. To understand principles of Radar.
4. To study about satellite services.
5. To understand optical communication system, fiber nodes, configurations and losses

UNIT I	WAVE GUIDE AND COMPONENT	9

Introduction to the basics of microwave transmission- Microwave spectrum and band designations-Comparison of the waveguide with the transmission line-Propagation of waves through rectangular waveguide – Rectangular waveguides, Basic behavior, dominant mode at the conducting surface, parallel and normal wavelength, Reflection of waves, plane waves at conducting surface. Simple numerical The parallel plane waveguide cut off frequency, cut off wavelength, group and phase velocity.TEm,omodes,TEm,n modes, TE1,0,TE2,0,TE1,1 modes-Rectangular waveguide modes-Circular waveguide-Waveguide components.

UNIT II	MICROWAVE DEVICES	9

Microwave vacuum tube devices-Construction, working, specifications and applications - Microwave semiconductor devices -Construction, working and applications of Gunn diode, IMPATT diode, PINdiode, Tunnel diode.

UNIT III	MICROWAVE DEVICES RADAR SYSTEM	9

Basic block diagram of the radar system-Radar range equation- Radar performance factors - factors influencing max-Range -the effect of noise. Basic pulse Radar system: Block diagram & description-Antenna Tracking and scanning-Antenna tracking: Sequential, conical and monopulse-Display Methods: A-Scope, PPI, Automatic target detection-CW Doppler radar, Block diagram, operation and application of pulsed radar system and MTI and-Radar Beacons.

UNIT IV	**SATELLITE COMMUNICATION SYSTEM**	**9**

Introduction to satellite communication system-Importance of the satellite communication system-Concept of orbit & its types-Communication link : uplink & downlink frequency-elevation angle, look angle altitude, Azimuth angle station and keeping-function of satellite earth station and Block diagram-Subsystems of the satellite: Power subsystem-Communication channel subsystem-Attitude control subsystem-Thermal control subsystem-Telemetry tracking and command subsystem-Main & auxiliary propulsion subsystem-Antenna subsystem.

UNIT V	**OPTICAL COMMUNICATION SYSTEMS**	**9**

Types of fiber optics cable and its losses: Optical fiber types and Characteristics-Optical fiber Losses: Absorption loss, Dispersion loss, scattering loss, Radiation loss, Coupling loss. Optical sources and detectors: Edge emitter and Surface emitter LED, Laser construction & working – Optical sources and Photo Detector-Splicers and connectors. Properties of splicing, fusion splice, V-groove splice and elastic tube splice- Splicing techniques. Fusion splice and V-groove splice. Fiber connector-properties of connector, ferrule connector.OTDRworking principle, and OTDR trace – Attenuation measurements.

Total Periods	**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Understand the advanced topics ofdigital communications.
CO2 Analyze the detailed view of microwave communication
CO3 Analyzeabout microwave radar system
CO4 Analyze the detailed view of satellite communication systems.
CO5 Analyze the basics of optical communication systems**.**

Reference Books

1. Wireless Communication Systems – RF IC Design and Advances in Analog by imusti Information Systems: The e-Business Challenge by Roland Traunmüller.
2. Testing of Communicating Systems: Tools and Techniques by RoThierryGayraud and Michel Mazella Bert L Probert and Gregor von Bochmann
3. Satellite Communication Systems Broadband and the Mobility Challenges by Michel Mazella and Thierry Gayraud.
4. Optical fiber communication – Gerd Keiser – Third Edition – McGraw Hill – 2000
5. Satellite communication – Dr. D.C. Agarwal – Third Edition – Khanna publishers – 1995
6. Electronic Communications systems – Fundamentals through Advanced – Wayne Tomasi – Fifth Edition – Pearson Education – 2005.
7. 7. Electronic communication systems – Kennedy – Davis -Fourth Edition -Tata McGraw Hill .

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	1	2	3	2					2	3	3	1
2	2	3	3	2	2	2	3					2	3	3	2
3	3	3	3	2	2	3	2					3	3	3	2
4	3	3	2	3	2	2	2					2	3	2	2
5	3	3	2	2	2	3	2					1	3	2	1

21CP3715	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Cloud Computing

Objectives

1. To understand the storage technologies
2. To understand the storage architecture and available technologies.
3. To learn to establish & manage datacenter.
4. To learn security aspects of storage & data center
5. To understand the concept of storage virtualization

UNIT I	STORAGE TECHNOLOGY	9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data centre infrastructure, role of each element in supporting business activities.

UNIT II	STORAGE SYSTEMS ARCHITECTURE	9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system.

UNIT III	INTRODUCTION TO NETWORKED STORAGE	9

Evolution of networked storage, Architecture, components, and toPO12ogies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT IV	INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS	9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities.

Identify key areas to monitor in a data centre, Industry standards for data centre monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data centre.

UNIT V	**SECURING STORAGE AND STORAGE VIRTUALIZATION**	**9**

Information security, Critical security attributes for information systems, Storage security domains,List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

Total Periods	**45**

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
MCQ/WRITTEN	**MCQ/SEMINAR/ASSIGNMENTS**	**MCQ/WRITTEN**

Outcomes

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

CO1 Select from various storage technologies to suit for required application
CO2 Apply security measures to safeguard storage & farm.
CO3 Analyze QoS on Storage
CO4 Analyze Key metrics to monitor for different components in a storage infrastructure
CO5 Analyze the Virtualization technologies.

Reference Books

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley, —Building Storage Networks||, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill , Osborne, 2003.

Web Recourses

1. http://www.ictacademy.in/pages/Information-Storage-and-Management.aspx#
2. https://www.coursera.org/specializations/bioinformatics
3. https://nptel.ac.in/courses/106/108/106108058/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			2									1		
2	3	2	3		3							3			
3	3		1	2		1						1			
4	2			2							2	2			
5	2	3	3	2	2						2	2			