M.E. COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND SYLLABI

(For the Students admitted in the Academic Year 2019-2020 onwards)

FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
19PMT101	Applied Probability and Statistics	FC	3	1	0	4	40	60	100
19PCT101	Advanced Data Structures and Algorithms	PC	3	1	0	4	40	60	100
19PCT102	Advanced Computer Architecture	PC	3	0	0	3	40	60	100
19PCT103	Operating System Internals	PC	3	0	0	3	40	60	100
19PCT104	Advanced Software Engineering	PC	3	0	0	3	40	60	100
19PCT105	Machine Learning Techniques	PC	3	0	0	3	40	60	100
PRACTICALS									
19PCL101	Data Structures Laboratory	PC	0	0	4	2	40	60	100
TOTAL CREDITS IN SEMESTER- I			**22**						

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
19PCT201	Network Design and Technologies	PC	3	0	0	3	40	60	100
19PCT202	Security Practices	PC	3	0	0	3	40	60	100
19PCT203	Internet of Things	PC	3	0	0	3	40	60	100
19PCT204	Big Data Analytics	PC	3	0	0	3	40	60	100
	Professional Elective –I	PE	3	0	0	3	40	60	100
	Professional Elective–II	PE	3	0	0	3	40	60	100
PRACTICALS									
19PCL201	Data Analytics Laboratory	PC	0	0	4	2	40	60	100
EMPLOYABILITY ENHANCEMENT COURSE									
19PCS201	Term Paper Writing and Seminar	EEC	0	0	2	1	100	-	100
TOTAL CREDITS IN SEMESTER- II			**21**						

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
	Professional Elective –III	PE	3	0	0	3	40	60	100
	Professional Elective –IV	PE	3	0	0	3	40	60	100
	Professional Elective –V	PE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSE									
19PCJ301	Project Work Phase – I	EEC	0	0	12	6	40	60	100
TOTAL CREDITS IN SEMESTER- III			**15**						

FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSE									
19PCJ401	Project Work Phase – II	EEC	0	0	24	12	40	60	100
TOTAL CREDITS IN SEMESTER -IV			**12**						

TOTAL NO. OF CREDITS: 70

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

FOUNDATION COURSES (FC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PMT101	Applied Probability and Statistics	FC	3	1	0	4	40	60	100

PROFESSIONAL CORE (PC)

Course Code	Course Title	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCT101	Advanced Data Structures and Algorithms	PC	3	1	0	4	40	60	100
19PCT102	Advanced Computer Architecture	PC	3	0	0	3	40	60	100
19PCT103	Operating System Internals	PC	3	0	0	3	40	60	100
19PCT104	Advanced Software Engineering	PC	3	0	0	3	40	60	100
19PCT105	Machine Learning Techniques	PC	3	0	0	3	40	60	100
19PCL101	Data Structures Laboratory	PC	0	0	4	2	40	60	100
19PCT201	Network Design and Technologies	PC	3	0	0	3	40	60	100
19PCT202	Security Practices	PC	3	0	0	3	40	60	100
19PCT203	Internet of Things	PC	3	0	0	3	40	60	100
19PCT204	Big Data Analytics	PC	3	0	0	3	40	60	100
19PCL201	Data Analytics Laboratory	PC	0	0	4	2	40	60	100

LIST OF ELECTIVES

II SEMESTER

ELECTIVE-I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCP201	Advanced Databases	PE	3	0	0	3	40	60	100
19PCP202	Principles of Programming Languages	PE	3	0	0	3	40	60	100
19PCP203	Image Processing and Analysis	PE	3	0	0	3	40	60	100
19PCP204	Web Engineering	PE	3	0	0	3	40	60	100
19PCP205	Cloud Computing Technologies	PE	3	0	0	3	40	60	100

II SEMESTER

ELECTIVE-II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCP206	Real Time Systems	PE	3	0	0	3	40	60	100
19PCP207	Mobile and Pervasive Computing	PE	3	0	0	3	40	60	100
19PCP208	Parallel Programming Paradigms	PE	3	0	0	3	40	60	100
19PCP209	Information Retrieval Techniques	PE	3	0	0	3	40	60	100
19PCP210	Software Architectures and Design	PE	3	0	0	3	40	60	100

III SEMESTER

ELECTIVE-III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCP301	Performance Analysis of Computer Systems	PE	3	0	0	3	40	60	100
19PCP302	Language Technologies	PE	3	0	0	3	40	60	100
19PCP303	Computer Vision	PE	3	0	0	3	40	60	100
19PCP304	Speech Processing and Synthesis	PE	3	0	0	3	40	60	100
19PCP305	Software Quality Assurance and Testing	PE	3	0	0	3	40	60	100

III SEMESTER

ELECTIVE-IV

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCP306	Formal models of software systems	PE	3	0	0	3	40	60	100
19PCP307	Embedded Software Development	PE	3	0	0	3	40	60	100
19PCP308	Social Network Analysis	PE	3	0	0	3	40	60	100
19PCP309	Bio-inspired Computing	PE	3	0	0	3	40	60	100
19PCP310	Compiler Optimization Techniques	PE	3	0	0	3	40	60	100

III SEMESTER

ELECTIVE-V

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCP311	Data Visualization Techniques	PE	3	0	0	3	40	60	100
19PCP312	Reconfigurable Computing	PE	3	0	0	3	40	60	100
19PCP313	Mobile Application Development	PE	3	0	0	3	40	60	100
19PCP314	Bio Informatics	PE	3	0	0	3	40	60	100
19PCP315	Information Storage Management	PE	3	0	0	3	40	60	100

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PCS201	Term Paper and Seminar	EEC	0	0	2	1	40	60	100
19PCJ301	Project Work Phase – I	EEC	0	0	12	6	40	60	100
19PCJ401	Project Work Phase – II	EEC	0	0	24	12	40	60	100

SUMMARY OF CREDIT DISTRIBUTION

Category	Sem 1	Sem 2	Sem 3	Sem 4	Total
FC	**4**	**-**	**-**	**-**	**4**
PC	**18**	**14**	**-**	**-**	**32**
PE	**-**	**6**	**9**	**-**	**15**
EEC	**-**	**1**	**6**	**12**	**19**
Total	**22**	**21**	**15**	**12**	**70**

FC: FOUNDATION COURSES, PC: PROFESSIONAL CORE
PE: PROFESSIONAL ELECTIVES,,EEC: EMPLOYABILITY ENHANCEMENT COURSES

SEMESTER I

19PMT101 APPLIED PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES:

- This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.
- It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

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

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

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: 60 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and un biasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

TEXT BOOKS:

1. Devore, J. L., -Probability and Statistics for Engineering and the Sciences‖,8th Edition, Cengage Learning,2014.
2. Dallas E. Johnson, -Applied Multivariate Methods for Data Analysis‖, Thomson and Duxbury press,1998.

REFERENCES:

1. Gupta S.C. and Kapoor V.K.,‖ Fundamentals of Mathematical Statistics‖, Sultan and Sons, New Delhi,2001.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition,2015.

E-RESOURCES:

1. http://webbuild.knu.ac.kr/~mhs/classes/2015/spring/prob/notes.pdf
2. https://me2013regulation.wordpress.com/2014/10/07/ma7155-applied-probability-and-statistics-notes/comment-page-1/

19PCT101 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C
3 1 0 4

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for 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 DATASTRUCTURES 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 – Topological 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: 60 PERIODS

OUTCOMES:

- Upon the completion of the course the students should be able to:
- Design data structures and algorithms to solve computing problems
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems

TEXT BOOKS:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education.

REFERENCES:

1. S.Sridhar,‖Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms, Third Edition, Prentice-Hall, 2011.

E-RESOURCES:

1. http://lalitsrm.weebly.com/me-cse-notes.html
2. https://lecturenotes.in/materials/16161-anna-university-chennai-syllabus-for-me-computer-science-engineering/9

19PCT102 ADVANCED COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction–Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study-Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Discuss the various techniques used for optimising the cache performance
- Design hierarchal memory system

TEXT BOOKS:

1. Darryl Gove, —Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, —Programming Massively Parallel Processors‖, Morgan Kauffman, 2010

REFERENCES:

1. David E. Culler, Jaswinder Pal Singh, —Parallel computing architecture : A
2. hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999
3. John L. Hennessey and David A. Patterson, —Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.

E-RESOURCES:

1. https://lecturenotes.in/notes/3153-notes-for-advanced-computer-architecture-aca-by-bipasa-das
2. https://easyengineering.net/ec6009-advanced-computer-architecture/

19PCT103 OPERATING SYSTEM INTERNALS L T P C
3 0 0 3

OBJECTIVES:

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in Linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of inter process communication.
- 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 – File system Types - Special File systems – File system Type Registration – File system 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: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system.

TEXT 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.

REFERENCES:

1. Maurice J. Bach, —The Design of the Unix Operating System‖ 1st Edition Pearson Education, 2003.
2. Michael Beck, Harald Bohme, MirkoDziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner,Linux Kernel Internals‖, 2nd Edition, Addison-Wesley, 1998.

E-RESOURCES:

1. http://williamstallings.com/OperatingSystems/
2. http://dinus.ac.id/repository/docs/ajar/Operating_System.pdf

19PCT104 ADVANCED SOFTWARE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches

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 REQUIREMENTSPECIFICATION 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 Microservices.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches

TEXT BOOKS:

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.

REFERENCES:

1. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
2. Len Bass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect's Perspectivell, Pearson Education, 2016.

E-RESOURCES:

1. http://www.vssut.ac.in/lecture_notes/lecture1428551142.pdf
2. http://www.cse.msu.edu/~cse870/Lectures/Notes/01-SE-Intro-notes.pdf

19PCT105 MACHINE LEARNING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- 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 Neighbor 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 GRAPHICALMODELS **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

TEXT 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.

REFERENCES:

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

E-RESOURCES:

1. http://faculty.ucmerced.edu/mcarreira-perpinan/teaching/CSE176/lecturenotes.pdf
2. http://www.cs.cmu.edu/~yandongl/mlnotes.html

19PCL101 **DATA STRUCTURES LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

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

EXPERIMENTS:

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

SEMESTER II

19PCT201 NETWORK DESIGN AND TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks
- 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 topologies – 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 Modeling 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 : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students should be able to:
- Identify the components required for designing a network
- Design a network at a high-level using different networking technologies
- Analyze the various protocols of wireless and cellular networks
- Discuss the features of 4G and 5G networks
- Experiment with software defined networks

TEXT BOOKS:

1. ErikDahlman, Stefan Parkvall,Johan Skold,-4G:LTE/LTE-Advancedfor Mobile Broadband‖, Academic Press,2013.
2. Jonathan Rodriguez,-Fundamentalsof5GMobileNetworks‖,Wiley,2015.

REFERENCES:

1. LarryPeterson andBruce Davie,-ComputerNetworks:A SystemsApproach‖,5th edition, Morgan Kauffman,2011
2. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks andMobile Broadband", Wiley,2014.

E-RESOURCES:

1. https://csenotescorner.blogspot.com/2018/01/cp5201-network-design-and-technologies.html
2. https://nasrinword.wordpress.com/cp5201-network-design-and-technologies/

19PCT202 SECURITY PRACTICES L T P C
3 0 0 3

OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts
- 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 : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand the core fundamentals of system security
- Apply the security concepts related to networks in wired and wireless scenario
- Implement and Manage the security essentials in IT Sector
- Able to explain the concepts of Cyber Security and encryption Concepts
- Able to attain a through knowledge in the area of Privacy and Storage security and related Issues.

TEXT 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.

REFERENCES:

1. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016
2. Julia H Allen, The CERT Guide to System and Network Security Practices, First Edition, Addison Wesley,2001

E-RESOURCES:

1. https://csenotescorner.blogspot.com/2018/01/cp5291-security-practices.html
2. https://ishareyoublog.files.wordpress.com/2018/04/cp5291-security-practices-unit-2-docx

19PCT203 INTERNET OF THINGS L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- 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 & Endpoints - 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 : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

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

TEXT 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.

REFERENCES:

1. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
2. 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.

E-RESOURCES:

1. https://csenotescorner.blogspot.com/2018/01/cp5292-internet-of-things.html

2. https://lecturenotes.in/subject/370/internet-of-things-iot

19PCT204 BIG DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT I INTRODUCTION TO BIG DATA 7

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 II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III DATA ANALYSIS 13

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 IV MINING DATA STREAMS 7

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

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 : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

TEXT BOOKS:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.

REFERENCES:

1. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
2. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

E-RESOURCES:

1. https://lecturenotes.in/notes/6099-notes-for-data-analytics-da-by-prasanta-bal

2. http://raiith.iith.ac.in/477/1/477_raiith.pdf

19PCL201 **DATA ANALYTICS LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

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

EXPERIMENTS:

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset
4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop /R.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Process big data using Hadoop framework
- Build and apply linear and logistic regression models
- Perform data analysis with machine learning methods
- Perform graphical data analysis

19PCS201 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	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
Stating an Objective			

Activity	Instructions	Submission week	Evaluation
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 your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
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 Google Scholar • When picking papers to read - try to: • 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 of them, • Favour papers from well-known journals and conferences, • Favour -first‖ or -foundational‖ papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)

Activity	Instructions	Submission week	Evaluation
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th 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 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 of your paper	13th week	**10%** (formatting, 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

19PCP201 ADVANCED DATABASES L T P C
3 0 0 3

OBJECTIVES:

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML, Cloud and Big Data

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

UNIT II INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy-Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases-Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods-Spatial DB Implementation.

UNIT III 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 : 45 PERIODS

OUTCOMES:

Upon completion of course, students will be able to

- To develop skills on databases to optimize their performance in practice.
- To analyze each type of databases and its necessity
- To design faster algorithms in solving practical database problems

TEXT 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, MorganKaufmannpublishers,2006.

REFERENCES:

1. Henry FKorth,AbrahamSilberschatz,S.Sudharshan,-Database SystemConcepts‖, Sixth Edition, McGraw Hill, 2011.
2. R. Elmasri, S.B. Navathe, -Fundamentals of Database Systems‖, Sixth Edition, Pearson Education/Addison Wesley, 2010.

E-RESOURCES:

1. https://lecturenotes.in/subject/823/advanced-database-techniques-adt
2. http://www.inf.ed.ac.uk/teaching/courses/adbs/slides/adbs.pdf

19PCP202 PRINCIPLES OF PROGRAMMING LANGUAGES L T P C
3 0 0 3

OBJECTIVES:

- To understand and describe syntax and semantics of programming languages
- To understand Data, Data types, and Bindings.
- To learn the concepts of functional and logical programming
- To explore the knowledge about concurrent Programming paradigms.

UNIT I ELEMENTS OF PROGRAMMING LANGUAGES 9

Reasons for studying, concepts of programming languages, Language Evaluation Criteria, influences on Language design, Language categories. Programming Language Implementation – Compilation, Hybrid Implementation, Pure Interpretation and Virtual Machines. Describing Syntax and Semantics -Introduction - The General Problem of Describing Syntax-Formal Methods of Describing Syntax - Attribute Grammars – Describing the Meanings of Programs: Dynamic Semantics.

UNIT II DATA TYPES-ABSTRACTION 9

Introduction - Primitive Data Types- Character String Types- User-Defined Ordinal Types- Array types- Associative Arrays-Record Types- Tuple Types-List Types -Union Types - Pointer and Reference Types -Type Checking- Strong Typing -Type Equivalence - Theory and Data Types-Variables-The Concept of Binding -Scope - Scope and Lifetime - Referencing Environments - Named Constants- The Concept of Abstraction- Parameterized Abstract Data Types-Encapsulation Constructs- Naming Encapsulations

UNIT III FUNCTIONAL PROGRAMMING 9

Introduction- Mathematical Functions- Fundamentals of Functional Programming Languages-TheFirst Functional Programming Language: LISP- An Introduction to Scheme- Common LISP-Haskell-F# - ML : Implicit Types- Data Types- Exception Handling in ML. Functional Programming with Lists**-** Scheme, a Dialect of Lisp- The Structure of Lists- List Manipulation- A Motivating Example: Differentiation- Simplification of Expressions- Storage Allocation for Lists.

UNIT IV LOGIC PROGRAMMING 9

Relational Logic Programming- Syntax- Basics- Facts- Rules- Syntax- Operational Semantics-Relational logic programs and SQL operations- Logic Programming- Syntax- Operational semantics- Data Structures-Meta-tools: Backtracking optimization (cuts); Unify; Meta-circular interpreters- The Origins of Prolog- Elements- of Prolog-Deficiencies of Prolog- Applications of Logic Programming.

UNIT V CONCURRENT PROGRAMMING **9**

Parallelism in Hardware- Streams: Implicit Synchronization-Concurrency as Interleaving-Liveness Properties- Safe Access to Shared Data- Concurrency in Ada- Synchronized Access to Shared Variables- Synthesized Attributes- Attribute Grammars- Natural Semantics-Denotational Semantics -A Calculator in Scheme-Lexically Scoped Lambda Expressions- An Interpreter-Recursive Functions**.**

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of course, students will be able to

- Describe syntax and semantics of programming languages
- Explain data, data types, and basic statements of programming languages
- Design and implement subprogram constructs, Apply object - oriented, concurrency, pro and event handling programming constructs
- Develop programs in LISP, ML, and Prolog.

TEXT BOOKS:

1. Ghezzi,-Programming Languages‖, 3rdEdition,JohnWiley, 2008
2. John C. Mitchell, -Concepts in Programming Languages‖, Cambridge University Press, 2004.

REFERENCES:

1. Louden,-Programming Languages‖, 3rdEdition,2012.
2. Ravi Sethi, -Programming Languages: Concepts and Constructs‖, 2nd Edition, Addison Wesley, 1996.

E-RESOURCES:

1. https://examupdates.in/principles-of-programming-languages
2. https://www.gnits.ac.in/sites/default/files/ONLINERESOURCES/IT/ppl.pdf

19PCP203 IMAGE PROCESSING AND ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

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 – Homomorphism 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 IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of course, students will be able to

- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing.
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

TEXT 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.

REFERENCES:

1. Kavyan Najarian and Robert Splerstor, Biomedical signals andImage processing,CRC – Taylor and Francis, New York,2006
2. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processing‖, Third Edition, Pearson Education, 2008, New Delhi

E-RESOURCES:

1. https://www.vidyarthiplus.com/vp/Thread-CP7004-Image-Processing-And-Analysis-Lecture-Notes-All-Units
2. https://csenotescorner.blogspot.com/2018/02/image-processing-and-analysis.html

19PCP204 **WEB ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- 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: 45 PERIODS

OUTCOMES:

Upon completion of course, students will be able to

- Explain the characteristics of web applications.
- Model web applications.
- Design web applications.
- Test web applications.

TEXT 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.

REFERENCES:

1. Guy W. Lecky-Thompson, -Web Programming‖, Cengage Learning, 2008.
2. John Paul Mueller, -Web Development with Microsoft Visual Studio 2005‖, Wiley Dream tech, 2006.

E-RESOURCES:

1. https://be.rgpvnotes.in/2018/07/web-engineering-cs-7003.html

2. https://lecturenotes.in/subject/218/web-engineering-we

19PCP205 CLOUD COMPUTING TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing.
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION 9

Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization —- Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data centre automation

UNIT III 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 IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, 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 V CLOUD SECURITY **9**

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of course, students will be able to

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

TEXT BOOKS:

1. Danielle Ruest, Nelson Ruest, -Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005

REFERENCES:

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

E-RESOURCES:

1. https://nasrinword.wordpress.com/cp5092-cloud-computing-technologies/
2. http://www.sridevengg.com/documents/cse/cloud%20computing.pdf

19PCP206 REAL TIME SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To learn real time operating system concepts, the associated issues & Techniques.
- To understand design and synchronization problems in Real Time System.
- To explore the concepts of real time databases.
- 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 : 45 PERIODS

OUTCOMES:

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

- Apply principles of real time system design techniques to develop real time applications.
- Make use of database in real time applications.
- Make use of architectures and behaviour of real time operating systems.
- Apply evaluation techniques in application.

TEXT 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

REFERENCES:

1. Rajib Mall, "Real-time systems: theory and practice", Pearson Education, 2009
2. R.J.A Buhur, D.L Bailey, "An Introduction to Real-Time Systems", Prentice Hall International, 1999

E-RESOURCES:

1. https://lecturenotes.in/notes/73-notes-for-real-time-systems-rts-by-lopamudra-mishra
2. https://lecturenotes.in/subject/63/real-time-systems-rts

19PCP207 MOBILE AND PERVASIVE COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems.
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management
- To explore the HCI in Pervasive environment
- 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: 45 PERIODS

OUTCOMES:

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

- Obtain a through understanding of Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Incorporate the pervasive concepts.
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment.

TEXT 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.

REFERENCES:

1. Juha Korhonen, -Introduction to 4G Mobile Communications‖ , Artech House Publishers, 2014
2. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.

E-RESOURCES:

1. https://issuu.com/brainkart.com/docs/mobile_and_pervasive_computing
2. https://www.academia.edu/9806565/pervasive_computing_lecture_notes

19PCP208 PARALLEL PROGRAMMING PARADIGMS L T P C
3 0 0 3

OBJECTIVES:

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and with OpenMP.
- 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 : 45 PERIODS

OUTCOMES:

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

- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and using OpenMP.
- Implement Graphical Processing OpenCL programs.

TEXT 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.

REFERENCES:

1. Peter S. Pacheco, -An introduction to parallel programming‖, Morgan Kaufmann, 2011.
2. Rob Farber, -CUDA application design and development‖, Morgan Haufmann, 2011.

E-RESOURCES:

1. https://apps.dtic.mil/dtic/tr/fulltext/u2/a196931.pdf
2. http://www.cse.iitd.ernet.in/~dheerajb/parallel_paradigms.pdf

19PCP209 INFORMATION RETRIEVAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- 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: 45 PERIODS

OUTCOMES:

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

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
- Design an efficient search engine and analyze the Web content structure.

TEXT BOOKS:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, —Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008**.**

REFERENCES:

1. Implementing and Evaluating Search Engines‖, The MIT Press, Cambridge, Massachusetts London, England, 2010
2. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, —Modern Information Retrieval: The
concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.

E-RESOURCES:

1. https://csenotescorner.blogspot.com/2018/02/information-retrieval-techniques.html
2. http://www.dce.edu.in/question-bank/cs6007-ir-cse-viis-au.pdf

19PCP210 SOFTWARE ARCHITECTURES AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I **10**

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 **8**

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 **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 **9**

Architecture of User Interfaces containers, case stu-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 **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 : 45 PERIODS

OUTCOMES:

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

- Understand the need of software architecture for sustainable dynamic systems.
- Have a sound knowledge on design principles and to apply for large scale systems
- Design architectures for distributed heterogeneous systems
- Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Have a working knowledge to develop appropriate architectures through various case studies.

TEXT 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

REFERENCES:

1. Jan Bosch, Software Architecture System Design, Development and Maintenance ,Springer,2002
2. Qian Kai, Software Architecture and Design Illuminated, Jones and Bartlett India Private Limited,2010

E-RESOURCES

1. http://dl.icdst.org/pdfs/files2/c9847dbf21cc065c0bad9a28e22a2875.pdf
2. https://www.cs.colorado.edu/~kena/classes/5828/s10/ presentations/ softwarearchitecture.pdf

SEMESTER III

19PCP301 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems

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 ANDSIMPLE 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 Policies for Server Farms.

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

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the need for performance evaluation and the metrics used for it
- Distinguish between open and closed queuing networks
- Use Little'e law and other operational laws
- Apply the operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies

TEXT BOOKS:

1. LievenEeckhout,-ComputerArchitecturePerformanceEvaluationMethods‖,Morganand Claypool Publishers, 2010.
2. MorHarchol -Balter,-Performance Modeling and Design of Computer Systems–Queueing Theory in Action ‖,Cambridge University Press,2013.

REFERENCES:

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.

E-RESOURCES:

1. https://nptel.ac.in/courses/106/106/106106048/
2. https://www.coursebuffet.com/course/820/nptel/performance-evaluation-of-computer-systems-iit-madras.

19PCP302 LANGUAGE TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To learn the fundamentals of natural language processing
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics

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: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast use of different statistical approaches for different types of NLP applications.

TEXT 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.

REFERENCES:-

1.. NitinIndurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
2.. Richard MReese,"Natural LanguageProcessing with Java", O_ReillyMedia,2015.

E-RESOURCES:

1. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf
2. http://ebooks.iospress.nl/volume/human-language-technologies-the-baltic-perspective-proceedings-of-the-seventh-international-conference-baltic-hlt-2016

19PCP303 **COMPUTER VISION** **L T P C**
3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- 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 SHAPESAND REGION **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 Irislocation– 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 – point-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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Implement fundamental image processing techniques required for computer vision.
- Perform shape analysis.
- Implement boundary tracking techniques.
- Apply chain codes and other region descriptors.
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques.

TEXT BOOKS:

1. D.L.Baggioetal.,-MasteringOpenCVwithPracticalComputerVisionProjects‖,Packt Publishing,2012.
2. E.R.Davies,-Computer & Machine Vision‖, Fourth Edition,AcademicPress,2012.

REFERENCES:

1. Jan Erik Solem, -Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media,2012.

2.MarkNixon and AlbertoS.Aquado,-Feature Extraction& Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.

E-RESOURCES:

1.http://szeliski.org/Book/drafts/SzeliskiBook_20100903_draft.pdf

2.https://machinelearningmastery.com/computer-vision-books/

19PCP304 SPEECH PROCESSING AND SYNTHESIS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

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

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

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

UNIT III SPEECH RECOGNITION 9

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

UNIT IV TEXT ANALYSIS 9

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

UNITV SPEECH SYNTHESIS 9

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL :45 PERIODS

OUTCOMES:

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

- Identify the various temporal, spectral and cepstral features required foridentifying speech units – phoneme, syllable and word
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals

- Justify the use of formant and concatenative approaches to speechsynthesis
- Identify the apt approach of speech synthesis depending on the language tobe processed
- Determine the various encoding techniques for representingspeech.

TEXT BOOKS:

1.-Joseph Mariani,-Languageand SpeechProcessing‖,Wiley,2009.--
2.-Lawrence Rabiner and Biing-Hwang Juang, -Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.

REFERENCES:

1.-Sadaoki Furui,-DigitalSpeech Processing:Synthesis,and Recognition, Second Edition,(Signal Processing and Communications)‖,Marcel Dekker, 2000.
2.-Thomas F.Quatieri,-Discrete-Time SpeechSignalProcessing‖,PearsonEducation, 2002.
3.-XuedongHuang,AlexAcero,Hsiao-Wuen Hon,-SpokenLanguage Processing– A guidetoTheory,AlgorithmandSystemDevelopment‖, Prentice Hall PTR,2001.

E-RESOURCES:

1.https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/digital%20speech%20processing%20course/final_speech_paper_1_2008.pdf

2.https://web.ece.ucsb.edu/Faculty/Rabiner/ece259/digital%20speech%20processing%20course/lectures_new/basic%20course%20material_winter_2014.pdf

19PCP305 SOFTWARE QUALITY ASSURANCE ANDTEST L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of testing, test planning &design and test team organization
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution
- To learn the software quality assurance ,metrics, defect prevention techniques
- 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 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 SYSTEMTESTCATEGORIES 10

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, RegulatoryTests.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 8

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 QUALITYASSURANCE **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: 45 PERIODS

OUTCOMES:

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

- Perform functional and nonfunctional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques and software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

TEXT 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

REFERENCES:

1.Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
2.Software Quality Assurance, MilindLimaye, TMH ,New Delhi, 2011

E-RESOURCES:

1.https://www.kobo.com/us/en/ebook/software-quality-assurance-3

2. https://nptel.ac.in/content/storage2/courses/106105087/pdf/m13L33.pdf

ELECTIVE IV

19PCP306 FORMAL MODELS OF SOFTWARE SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I SPECIFICATION FUNDAMENTALS 10

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 8

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, Labeled 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. The Object-Z Specification Language- Basic Structure Object-Z, Specification. Parameterized Class, Object-Orientation, 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 :45 PERIODS

OUTCOMES:

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

- Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
- Gain knowledge on fundamentals of abstraction and formal systems
- Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
- Have working knowledge on Z, Object Z and B Specification languages with case studies.

TEXT 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.

REFERENCES:

1. Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011
2. The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.

E-RESOURCES:

1.https://nptel.ac.in/courses/106/105/106105087/
2.https://www.cse.iitb.ac.in/~supratik/courses/cs615/index.html

19PCP307 EMBEDDED SOFTWARE DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- 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 - Behavioral 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: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

- Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
- Work with embedded network environment.
- Understand challenges in Real time operating systems.
- Design and analyze applications on embedded systems.

TEXT 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, MorganKauffman/Elsevier, 2006.

REFERENCES:

1. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach**"** VPT First Edition,2014
2. C.M.Krishna andK.G. Shin,-Real-TimeSystems‖,McGraw-Hill,1997.

E-RESOURCES:

1.https://nptel.ac.in/courses/108/105/108105057/
2.https://onlinecourses.nptel.ac.in/noc20_cs14/preview

19PCP308 SOCIAL NETWORK ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- 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 :45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to

- Work on the internals components of the social network
- Model and visualize the social network
- Mine the behavior of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time applications

TEXT BOOKS:

1.-Ajith Abraham, AboulElla Hassanien, VáclavSnášel, -Computational Social NetworkAnalysis:Trends,ToolsandResearchAdvances‖,Springer,2012

2.-Borko Furht, -Handbook of Social Network Technologies and Applications‖, Springer, 1st edition, 2011

REFERENCES:

1. CharuC.Aggarwal,-SocialNetworkDataAnalytics‖, Springer;2014
2. Giles, Mark Smith, John Yen, -Advances in Social Network Mining and Analysis‖, Springer, 2010.

E-RESOURCES:

1.https://nptel.ac.in/courses/108/105/108105057/
2.http://www.mjdenny.com/workshops/SN_Theory_I.pdf

19PCP309 BIO-INSPIRED COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I INTRODUCTION 9

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -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 Tunneling.

UNIT III GENETIC ALOGORITHMS AND DIFFERENTIALEVOLUTION 9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differentialevolution - 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 colony optimization toward feature 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 ThresholdedHistogramEqualizationAlgorithmforDigitalImageContrastEnhancement
Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students should be able to

- Implement and apply bio-inspiredalgorithms
- Explain random walk and simulatedannealing
- Implement and apply geneticalgorithms
- Explain swarm intelligence and ant colony for featureselection
- Apply bio-inspired techniques in imageprocessing.

TEXT 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

REFERENCES:

1.Xin-She Yang ,Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016
2.Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
3.Yang ,Cui,Xlao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

E-RESOURCES:

1.https://www.researchgate.net/publication/301344546_Bio_Inspired_Computing_-_A_Review_of_Algorithms_and_Scope_of_Applications

2.https://pdfs.semanticscholar.org/4603/33a3ceee8543998a60655b541d0e764aefba.pdf

19PCP310 COMPILER OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTERMEDIATE REPRESENTATIONS AND ANALYSIS 9

Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis.

UNIT II EARLY AND LOOP OPTIMIZATIONS 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 Re association - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination

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: 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to:

- Identify the different optimization techniques for simple program blocks.
- Design performance enhancing optimization techniques.
- Perform the optimization on procedures.
- Ensure better utilization of resources.

TEXT BOOKS:

1. 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.

REFERENCES:

1. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition,2011. 5.RandyAllen and Ken Kennedy,-Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.

2. RobertMorgan,‖BuildinganOptimizingCompiler‖,DigitalPress,1998

E-RESOURCES:

1.https://www.researchgate.net/publication/316791432_The_New_Trends_in_Compiler_Analysis_and_Optimizations
2.https://core.ac.uk/download/pdf/82104391.pdf

19PCP311 DATA VISUALIZATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.
- To understand visualization for distribution analysis.
- To understand visualization for correlation analysis.
- To understand visualization for multivariate analysis.
- 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: 45 PERIODS

OUTCOMES:

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

- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard

TEXT BOOKS:

1. V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition,2007.

2. AndrewW. Appel, Jens Palsberg, "Modern Compiler Implementation inJava", Cambridge University Press, Second Edition,2002.

REFERENCES:

1. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011.

2. RandyAllen and Ken Kennedy,-Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.

E-RESOURCES:

1.https://www.researchgate.net/publication/316791432_The_New_Trends_in_Compiler_Analysis_and_Optimizations

2.https://core.ac.uk/download/pdf/82104391.pdf

19PCP312 RECONFIGURABLE COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable
- architectures
- To expose the students to HDL programming and familiarize with the development
- environment
- To expose the students to the various placement and routing protocols
- To develop applications with FPGAs

UNIT I DEVICE ARCHITECTUR 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 Bit stream Generation – Case Studies with Appropriate Tools.

UNITV APPLICATION DEVELOPMENT WITH FPGAS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Identify the need for reconfigurable architectures.
- Discuss the architecture of FPGAs.
- Point out the salient features of different reconfigurable architectures.
- Build basic modules using any HDL.
- Develop applications using any HDL and appropriate tools.
- Design and build an SoPC for a particular application

TEXT 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.

REFERENCES:

1. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform**.**

2. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer

E-RESOURCES:

1. https://www.youtube.com/watch?v=5_H_j72Ftq8
2. https://nptel.ac.in/courses/106/106/106106088/

19PCP313 MOBILE APPLICATION DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION **5**

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN **8**

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN **8**

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID **12**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IOS **12**

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the requirements for mobile applications.
- Explain the challenges in mobile application design and development.
- Develop design for mobile applications for specific requirements.
- Implement the design using Android SDK.
- Implement the design using Objective C and iOS.
- Deploy mobile applications in Android and iPhone marketplace for distribution.

TEXT BOOKS:

1.Charlie Collins, Michael Galpin and Matthias Kappler, —Android in Practicell, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, —Beginning iOS 6 Development: Exploring the iOS SDKll, Apress, 2013.

REFERENCES:

1.Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,2012.
2. Reto Meier, PProfessional android Developmentll, Wiley-India Edition, 2012.

E-RESOURCES:

1. https://developer.android.com/develop/index.html.
2. https://www.lynda.com/Mobile-Apps-training-tutorials/55-0.html

19PCP314 BIO INFORMATICS L T P C
3 0 0 3

OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks.
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of humangenomics.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of genes , genomics , molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrival systems – genome browsers.

UNIT II BIOINFORMATICS ALGORITHM AND ANALYSIS 9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT III DNA REPLICATION AND MOLECULAR CLOCKS 9

Beginning of DNA replication – open problems – multiple replication and finding replication– computing probabilities of patterns in a string-the frequency array-converting patterns- solving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.

UNIT IV ASSEMBLE GENOMES AND SEQUENCES 9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler's theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences-Case Study –Manhattan tourist Problem.

UNIT V HUMAN GENOME 9

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graps- synteny block construction -open problem sand technologies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Deploy the genomics technologies in Bioinformatics.
- Able to distinct efficient algorithm and issues.
- Deploy the replication and molecular clocks in bioinformatics.
- Work on assemble genomes and sequences.
- Use the Microarray technologies for genome expression.

TEXT BOOKS:

1. Ion Mandoiu and Alexander Zelikovsky **,** "Computational Methods for Next Generation Sequencing Data Analysis — Wiley series 2016.
2. Istvan Miklos,Renyi Institutue, —Introduction to algorithms in bioinformatics‖,Springer 2016

REFERENCES:

1. Philip Compeau and Pavel pevzner, —Bioinformatics Algorithms: An Active Learning Approach‖ Second edition volume I , Cousera, 2015.

2. Supratim Choudhuri, —Bioinformatics For Beginners‖, Elsevier, 2014.

E-RESOURCES:

1. https://www.nihlibrary.nih.gov/services/bioinformatics-support/online-ioinformatics-tutorials
2. https://digitalworldbiology.com/bioinformatics-tutorials

19PCP315 INFORMATION STORAGE MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To understand the storage architecture and available technologies.
- To learn to establish & manage data center.
- To learn security aspects of storage & data center.

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 center 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:RAID0, RAID1, RAID3, RAID4, RAID5, RAID0+1, RAID1+0, RAID6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage, Architecture, components, and topologies 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 center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V SECURING STORAGE AND STORAGEVIRTUALIZATION **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: 45 PERIODS

OUTCOMES:

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

- Select from various storage technologies to suit for required application.
- Apply security measures to safeguard storage &farm.
- Analyse QoS on Storage.

TEXT BOOKS:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.

REFERENCES:

1. Marc Farley, —Building Storage Networksǁ, Tata McGraw Hill ,Osborne, 2001.
2. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill , Osborne, 2003.

E-RESOURCES:

1.http://amzn.to/2yU13u7
2. https://csenotescorner.blogspot.com/2016/08/information-storage-management.html

M.E. STRUCTURAL ENGINEERING

CURRICULUM AND SYLLABI

(For the Students admitted in the Academic Year 2019-2020 onwards)

FIRST SEMESTER

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
19PMT103	Advanced Mathematical Methods	FC	3	1	0	4	40	60	100
19PST101	Advanced Concrete Structures	PC	3	0	0	3	40	60	100
19PST102	Dynamics of Structures	PC	3	0	0	3	40	60	100
19PST103	Theory of Elasticity and Plasticity	PC	3	0	0	3	40	60	100
	Professional Elective - I	PE	3	0	0	3	40	60	100
	Professional Elective - II	PE	3	0	0	3	40	60	100
TOTAL CREDITS IN SEMESTER - I			**19**						

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

SECOND SEMESTER

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
19PST201	Advanced Steel Structures	PC	3	0	0	3	40	60	100
19PST202	Stability of Structures	PC	3	0	0	3	40	60	100
19PST203	Experimental Techniques	PC	3	0	0	3	40	60	100
19PST204	Finite Element Analysis of Structures	PC	3	0	0	3	40	60	100
	Professional Elective - III	PE	3	0	0	3	40	60	100
	Professional Elective - IV	PE	3	0	0	3	40	60	100
PRACTICALS									
19PSL201	Advanced Structural Engineering Laboratory	PC	0	0	4	2	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES									
19PSE201	Practical Training - I (2 Weeks)	EEC	0	0	0	1	100	0	100
TOTAL CREDITS IN SEMESTER - II			**21**						

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

THIRD SEMESTER

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
19PST301	Earthquake Analysis and Design of Structures	PC	3	0	0	3	40	60	100
	Professional Elective - V	PE	3	0	0	3	40	60	100
	Professional Elective - VI	PE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES									
19PSE301	Practical Training - II (2 Weeks)	EEC	0	0	0	1	100	0	100
19PSE302	Seminar	EEC	0	0	2	1	100	0	100
19PSJ301	Project Work - (Phase - I)	EEC	0	0	12	6	40	60	100
TOTAL CREDITS IN SEMESTER - III			**17**						

FOURTH SEMESTER

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSES									
19PSE401	Practical Training - III (2 Weeks)	EEC	0	0	0	1	100	0	100
19PSJ401	Project Work (Phase - II)	EEC	0	0	24	12	40	60	100
TOTAL CREDITS IN SEMESTER IV			**13**						

TOTAL NO. OF CREDITS: 70

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

FOUNDATION COURSES (FC)

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PMT103	Advanced Mathematical Methods	FC	3	1	0	4	40	60	100

PROFESSIONAL CORE (PC)

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PST101	Advanced Concrete Structures	PC	3	0	0	3	40	60	100
19PST102	Dynamics of Structures	PC	3	0	0	3	40	60	100
19PST103	Theory of Elasticity and Plasticity	PC	3	0	0	3	40	60	100
19PST201	Advanced Steel Structures	PC	3	0	0	3	40	60	100
19PST202	Stability of Structures	PC	3	0	0	3	40	60	100
19PST203	Experimental Techniques	PC	3	0	0	3	40	60	100
19PST204	Finite Element Analysis of Structures	PC	3	0	0	3	40	60	100
19PSL201	Advanced Structural Engineering Laboratory	PC	0	0	4	2	40	60	100
19PST301	Earthquake Analysis and Design of Structures	PC	3	0	0	3	40	60	100

SEMESTER I

PROFESSIONAL ELECTIVE - I & II

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PSP101	Maintenance and Rehabilitation of Structures	PE	3	0	0	3	40	60	100
19PSP102	Prefabricated Structures	PE	3	0	0	3	40	60	100
19PSP103	Offshore Structures	PE	3	0	0	3	40	60	100
19PSP104	Matrix methods for Structural Analysis	PE	3	0	0	3	40	60	100

SEMESTER II

PROFESSIONAL ELECTIVE- III & IV

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PSP201	Theory of Plates	PE	3	0	0	3	40	60	100
19PSP202	Mechanics of Composite Materials	PE	3	0	0	3	40	60	100
19PSP203	Analysis and Design of Tall Buildings	PE	3	0	0	3	40	60	100
19PSP204	Industrial Structures	PE	3	0	0	3	40	60	100
19PSP205	Pre-stressed Concrete	PE	3	0	0	3	40	60	100
19PSP206	Wind and Cyclone Effects on Structures	PE	3	0	0	3	40	60	100

SEMESTER III

PROFESSIONAL ELECTIVE - V & VI

Course Code	Name of the Subject	Category	Hours / Week				Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PSP301	Nonlinear Analysis of Structures	PE	3	0	0	3	40	60	100
19PSP302	Design of Sub Structures	PE	3	0	0	3	40	60	100
19PSP303	Optimization of Structures	PE	3	0	0	3	40	60	100
19PSP304	Design of Steel Concrete Composite Structures	PE	3	0	0	3	40	60	100
19PSP305	Design of Bridges	PE	3	0	0	3	40	60	100
19PSP306	Design of Shell and Spatial Structures	PE	3	0	0	3	40	60	100
19PSP307	Computer Aided Analysis and Design	PE	2	0	2	3	40	60	100

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PSE201	Practical Training - I	EEC	0	0	0	1	100	0	100
19PSE301	Practical Training - II	EEC	0	0	0	1	100	0	100
19PSE302	Seminar	EEC	0	0	2	1	100	0	100
19PSE401	Practical Training - III	EEC	0	0	0	1	100	0	100
19PSJ301	Project Work (Phase - I)	EEC	0	0	12	6	40	60	100
19PSJ401	Project Work (Phase - II)	EEC	0	0	24	12	40	60	100

SUMMARY OF CREDIT DISTRIBUTION

Category	Sem 1	Sem 2	Sem 3	Sem 4	Total
FC	4	-	-	-	4
PC	9	14	3	-	26
PE	6	6	6	-	18
EEC	-	1	8	13	22
Total	19	21	17	13	70

FC: FOUNDATION COURSES, PC: PROFESSIONAL CORE
PE: PROFESSIONAL ELECTIVES, EEC: EMPLOYABILITY ENHANCEMENT COURSES

SEMESTER – I

19PMT103	ADVANCED MATHEMATICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Laplace transform : Definitions – Properties – Transform error function – Bessel's function - Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform : Complex inversion formula – Solutions to partial differential equations : Heat equation – Wave equation.

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transform: Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT III CALCULUS OF VARIATIONS 12

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS 12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient - Divergence and curl.

TOTAL: 60 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

- Application of Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
- Maximizing and minimizing the functional that occur in various branches of Engineering Disciplines.
- Construct conformal mappings between various domains and use of conformal mapping in studying problems in physics and engineering particularly to fluid flow and heat flow problems.
- Understand tensor algebra and its applications in applied sciences and engineering and develops ability to solve mathematical problems involving tensors.
- Competently use tensor analysis as a tool in the field of applied sciences and related fields.

TEXT BOOKS:

1. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
2. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.

REFERENCES:

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Saff, E.B and Snider, A.D, "Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics", 3rd Edition, Pearson Education, New Delhi, 2014.

E - RESOURCES:

1. www.cambridge.org/9780521289641
2. home.iitk.ac.in/~dasgupta/teaching/math/

19PST101	ADVANCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students be familiar with the limit state design of RCC beams and columns
- To design special structures such as Deep beams, Corbels, Deep beams, and Grid floors
- To make the students confident to design the flat slab as per Indian standard, yield line theory and strip method.
- To design the beams based on limit analysis and detail the beams, columns and joints for ductility.

UNIT I DESIGN PHILOSOPHY 9

Limit state design - beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Code. Interaction curve generation for axial force and bending

UNIT II DESIGN OF SPECIAL RC ELEMENTS 9

Design of slender columns - Design of RC walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors.

UNIT III FLAT SLABS AND YIELD LINE BASED DESIGN 9

Design of flat slabs and flat plates according to IS method – Check for shear - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs.

UNIT IV INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS 9

Inelastic behavior of concrete beams and Baker's method, moment - rotation curves, ductility definitions, evaluation

UNIT V DUCTILE DETAILING 9

Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of this course the students will have the confidence to design various concrete structures and structural elements by limit state design and detail the same for ductility as per codal requirements.

TEXT BOOKS:

1. Gambhir.M. L., "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
2. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 1986

REFERENCES:

1. Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.
2. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.

E - RESOURCES:

1. https://study.unisa.edu.au › Study › Advanced Concrete Structures
2. https://engineering.leeds.ac.uk/courses/PG/D885/advanced-concrete-technology

19PST102	DYNAMICS OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.

UNIT I PRINCIPLES OF VIBRATION ANALYSIS 9

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility, applications-examples related to structural engineering

UNIT II TWO DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of two degree of freedom systems, free and forced vibrations of two degree of freedom systems, normal modes of vibration, applications.

UNIT III DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of Multi-degree of freedom systems, orthogonality of normal modes, free and forced vibrations of multi degree of freedom systems, Mode superposition technique, response spectrum method, Applications.

UNIT IV DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 9

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work, Applications.

UNIT V DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 9

Damping in MDOF systems, Nonlinear MDOF systems, step-by-step numerical integration algorithms, substructure technique, Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- After completion of the course the students will have the knowledge of vibration analysis of systems/structures with different degrees of freedom and they know the method of damping the systems.

TEXT BOOKS:

1. Anil K.Chopra, Dynamics of Structures, Pearson Education, 2007.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.

REFERENCES:

1. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, 2004.
2. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.

E - RESOURCES:

1. https://www.pearsoned.co.in/prc/book/anil-k...dynamics-structures.../9788131713297
2. https://www.pearson.com/us/higher...Dynamics-of-Structures.../PGM1101746.html

19PST103	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of 3D stress, strain analysis and its applications.

UNIT I ELASTICITY **9**

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law.

UNIT II 2D STRESS STRAIN PROBLEMS **9**

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Co-ordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION **9**

St.Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled-Open and Closed sections-Design approach to open web section subjected to torsion

UNIT IV BEAMS ON ELASTIC FOUNDATIONS **9**

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi infinite and finite beams – Rigid and flexible – Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT V PLASTICITY **9**

Physical Assumptions – Yield Criteria – Failure Theories – Applications of Thick Cylinder – Plastic Stress Strain Relationship. Elasto-Plastic Problems in Bending and Torsion.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course the students will be familiar to the concept of elastic analysis of plane stress and plane strain problems, beams on elastic foundation and torsion on non- circular section.
- They will also have sufficient knowledge in various theories of failure and plasticity.

TEXT BOOKS:

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2007.

REFERENCES:

1. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
2. Timoshenko, S. and Goodier J.N."Theory of Elasticity", McGraw Hill Book Co., New York, 2010.

E - RESOURCES:

1. https://www.amazon.in/Theory-Elasticity-Chandramouli/dp/9380381638
2. https://www.amazon.in/Theory-Elasticity-Plasticity-Jane-Helena/dp/8120352831

SEMESTER – II

		L	T	P	C
19PST201	**ADVANCED STEEL STRUCTURES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To study the behaviour of members and connections, analysis and design of Industrial buildings and roofs, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

UNIT I GENERAL **9**

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting Base Plates.

UNIT II DESIGN OF CONNECTIONS **9**

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections HSFG bolted connections.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS **9**

Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non sway frames – Aseismic design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES **9**

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections – Requirement - Moment resisting connections. Design of Straight Corner Connections – Haunched Connections - Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES **9**

Introduction to Direct Strength Method - Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be in a position to design bolted and welded connections in industrial structures.
- They also know the plastic analysis and design of light gauge steel structures.

TEXT BOOKS:

1. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
2. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
2. Subramanian.N, Design of Steel Structures, Oxford University Press, 2014.

E - RESOURCES:

1. https://engineering.purdue.edu/ProEd/courses/advanced-steel-design
2. https://www.qut.edu.au/study/unit?unitCode=EGB476

19PST202	STABILITY OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the concept of buckling and analysis of structural elements.

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT III TORSIONAL AND LATERAL BUCKLING 9

Torsional buckling – Combined Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9

Governing differential equation - Buckling of thin plates, various edge conditions -Analysis by equilibrium and energy approach – Finite difference method.

UNIT V INELASTIC BUCKLING 9

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course student will know the phenomenon of buckling and they are in a position to calculate the buckling load on column, beam – column, frames and plates using classical and approximate methods.

TEXT BOOKS:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.

REFERENCES:

1. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
2. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.

E - RESOURCES:

1. edu.epfl.ch/coursebook/en/structural-stability-CIVIL-369
2. www.unipune.ac.in/Syllabi_PDF/.../ME%20Civil%20(Structures%20Engg.).pdf

19PST203	EXPERIMENTAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.

UNIT I FORCES AND STRAIN MEASUREMENT **9**

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long- term monitoring – vibrating wire sensors– Fibre optic sensors.

UNIT II MEASUREMENT OF VIBRATION AND WIND FLOW **9**

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – wind tunnels – Flow meters – Venturimeter – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND CONTROL **9**

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

UNIT IV NON DESTRUCTIVE TESTING METHODS **9**

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission - ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR , Ground penetrating radar (GPR).

UNIT V MODEL ANALYSIS **9**

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems – Usage of influence lines in model studies.

TOTAL : 45 PERIODS

OUTCOMES:

1. At the end of this course students will know about measurement of strain, vibrations and wind blow.
2. They will be able to analyze the structure by non-destructive testing methods and model analysis.

TEXT BOOKS:

1. Dalley .J. W and Riley. W. F, "Experimental Stress Analysis", McGraw Hill Book Company, N.Y. 1991
2. Ravisankar.K.and Chellappan.A., "Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures", SERC, Chennai, 2007.

REFERENCES:

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2006.
2. Sirohi.R.S., Radhakrishna.H.C, "Mechanical Measurements", New Age International (P) Ltd. 1997.

E - RESOURCES:

1. www.iitk.ac.in/civil/geotech/course_structure.pdf
2. skct.edu.in/SKCT-CIVIL/pdf/PG%20R-17.pdf

19PST204 FINITE ELEMENT ANALYSIS OF STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems.

UNIT I INTRODUCTION **9**

Approximate solutions of boundary value problems - Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments-continuity, compatibility, convergence aspects.
Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method.

UNIT II APPLICATION: AXIAL DEFORMATION OF BARS, AXIAL SPRING ELEMENT. 9

Natural Coordinates - Triangular Elements -Rectangular Elements - Lagrange and Serendipity Elements -Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements - Numerical Integration: One, Two and Three Dimensional - Examples.

UNIT III ANALYSIS OF FRAMED STRUCTURES **9**

Stiffness of Truss Member - Analysis of Truss -Stiffness of Beam Member-Finite Element Analysis of Continuous Beam -Plane Frame Analysis -Analysis of Grid and Space Frame – Two Dimensional Solids - Constant Strain Triangle -Linear Strain Triangle -Rectangular Elements - Numerical Evaluation of Element Stiffness -Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element -Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements – Solution for simple frames.

UNIT IV PLATES AND SHELLS **9**

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate -Finite Element Analysis of Thick Plate -Finite Element Analysis of Skew Plate - Introduction to Finite Strip Method - Finite Element Analysis of Shell.

UNIT V APPLICATIONS **9**

Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear, Vibration and Thermal Problems - Meshing and Solution Problems - Modelling and analysis using recent softwares.

TOTAL : 45 PERIODS

OUTCOMES:

- On completion of this course, the students will know the concept of finite element analysis and enable to analyze framed structure, Plate and Shells and modify using recent software's.

TEXT BOOKS:

1. Bhavikatti.S.S, "Finite Element Analysis", New Age International Publishers, 2007.
2. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007.

REFERENCES:

1. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons.
2. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

E - RESOURCES:

1. https://www.nafems.org/e-learning/all-courses/basic-finite-element-analysis-fea/
2. www.stressebook.com/finite-element-analysis-course/

19PSL201	ADVANCED STRUCTURAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic Response of cantilever steel beam
    a. To determine the damping coefficients from free vibrations.
    b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
    a. Drift of the frame.
    b. Stiffness of the frame.
    c. Energy dissipation capacity of the frame.
6. Non-Destructive Test on concrete
    i. Rebound hammer and
    ii. Ultrasonic Pulse Velocity Tester.

LIST OF EQUIPMENTS

1. Strong Floor
2. Loading Frame
3. Hydraulic Jack
4. Load Cell
5. Proving Ring
6. Demec Gauge
7. Electrical Strain Gauge with indicator
8. Rebound Hammer
9. Ultrasonic Pulse Velocity Tester
10. Dial Gauges
11. Clinometer
12. Vibration Exciter
13. Vibration Meter
14. FFT Analyzer

TOTAL: 60 PERIODS

OUTCOMES:

- On completion of this laboratory course students will be able to cast and test RC beams for strength and deformation behaviour.
- They will be able to test dynamic testing on steel beams, static cyclic load testing of RC frames and non-destruction testing on concrete.

REFERENCES:

1. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill Inc. New York, 1991.

19PSE202	PRACTICAL TRAINING – I (2 Weeks)	L	T	P	C
		0	0	0	1

OBJECTIVES:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

The students individually undertake training in reputed Industries during the summer vacation for a specified period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOMES:

They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

SEMESTER – III

19SET301	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the effect of earthquakes, analysis and design of earthquake resistant Structures.

UNIT I EARTHQUAKE GROUND MOTION **9**

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation.

UNIT II EFFECTS OF EARTHQUAKE ON STRUCTURES **9**

Dynamics of Structures SDOFS MDOFS - Response Spectra - Evaluation of Earthquake Forces as per codal provisions - Effect of Earthquake on Different Types of Structures - Lessons Learnt From Past Earthquakes

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES **9**

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES **9**

Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis – Capacity based Design and detailing – Rigid Frames – Shear walls.

UNIT V VIBRATION CONTROL TECHNIQUES **9**

Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems- Case Studies, Important structures.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course the students will be able to understand the causes and effect of earthquake.
- They will be able to design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice.

TEXT BOOKS:

1. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2009.
2. Paulay,T and Priestley, M.J.N., "Seismic Design of Reinforced Concrete and Masonry buildings", John Wiley and Sons, 1992.

REFERENCES:

1. Brebbia C. A.,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
2. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York, 2004.

E - RESOURCES:

1. vnit.ac.in/academic/.../M.-Tech.-in-Structural-Dynamics-Earthquake-Engineering.pdf
2. www.iitk.ac.in/nicee/IITK-GSDMA/EBB_001_30May2013.pdf

		L	T	P	C
19PSL301	**PRACTICAL TRAINING - II (2 Weeks)**	**0**	**0**	**0**	**1**

OBJECTIVES:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

- The students individually undertake training in reputed Industries during the summer vacation for a specified period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

19PSE302	SEMINAR	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To work on a specific technical topic in Structural Engineering and acquire the skills of written and oral presentation.
- To acquire writing abilities for seminars and conferences.

SYLLABUS:

- The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Structural Engineering and to engage in discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic.

- They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar.

TOTAL: 30 PERIODS

OUTCOMES:

The students will be trained to face an audience and to tackle any problem during group discussion in the Interviews.

19PSJ301	PROJECT WORK (PHASE - I)	L	T	P	C
		0	0	12	6

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

- The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programmed. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOMES:

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

SEMESTER – IV

		L	T	P	C
19PSE401	**PRACTICAL TRAINING - III (2 Weeks)**	**0**	**0**	**0**	**1**

OBJECTIVES:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

- The students individually undertake training in reputed Industries during the summer vacation for a specified period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

19PSJ401	PROJECT WORK (PHASE - II)	L	T	P	C
		0	0	24	12

OBJECTIVES:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

- The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department.

- The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOMES:

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

19PSP101	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

To study the damages, repair and rehabilitation of structures

UNIT I INTRODUCTION 9

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.

UNIT II BUILDING CRACKS 9

Causes – diagnosis – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Remedial measures - Techniques for repair – Epoxy injection.

UNIT III MOISTURE PENETRATION 9

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Membrane treated roofs - Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay – Chemical coatings – Flexible and rigid coatings.

UNIT IV DISTRESSES AND REMEDIES 9

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – Materials and methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements. Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against corrosion – Design and fabrication errors – Distress during erection.Masonry Structures: Discoloration and weakening of stones – Biotical treatments – Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures.

UNIT V STRENGTHENING OF EXISTING STRUCTURES 9

General principle – relieving loads – Strengthening super structures – plating – Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening substructures – under pinning – Enhancing the load capacity of footing – Design for rehabilitation.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be in a position to point out the causes of distress in concrete, masonry and steel structures and also they will be able to suggest the remedial measures.

- **TEXT BOOKS:**

1. Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987
2. Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, 1997

REFERENCES:

1. Brebbia C. A.,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
2. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York, 2004.

E - RESOURCES:

1. www.sasurieengg.com/e-course-material/CIVIL/IV.../CE2071%20RRS.pdf
2. Fmcet.in/civil/ce2071 uw.pdf

19PSP102	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the damages, repair and rehabilitation of structures.

UNIT I INTRODUCTION 9

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal

UNIT II BUILDING CRACKS 9

Causes – diagnosis – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Remedial measures - Techniques for repair – Epoxy injection.

UNIT III MOISTURE PENETRATION 9

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Membrane treated roofs - Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay – Chemical coatings – Flexible and rigid coatings.

UNIT IV DISTRESSES AND REMEDIES 9

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – Materials and methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements.

Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against corrosion – Design and fabrication errors – Distress during erection. Masonry Structures: Discoloration and weakening of stones – Biotical treatments – Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures.

UNIT V STRENGTHENING OF EXISTING STRUCTURES 9

General principle – relieving loads – Strengthening super structures – plating – Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening substructures – under pinning – Enhancing the load capacity of footing – Design for rehabilitation

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be in a position to point out the causes of distress in concrete, masonry and steel structures and also they will be able to suggest the remedial measures

TEXT BOOKS:

1. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH, 1971.
2. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, Akademiai Kiado, Budapest, 2007.

REFERENCES:

1. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
2. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 2009

E – RESOURCES

1. www.nscet.org/civil/MAT/4th%20Yr/.../CE6016_Prefabricated%20Structures(CP).pdf
2. https://civildigital.com/prefabricated-structures-prefabrication-concept-components-ad...

19PSP103	OFFSHORE STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the concept of wave theories, forces and design of jacket towers, pipes and cables**.**

UNIT I WAVE THEORIES 9

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9

Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9

Static method of analysis, foundation analysis and dynamics of offshore structures

UNIT V DESIGN OF OFFSHORE STRUCTURES 9

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to determine the forces due to ocean waves and analyze and design offshore structures like platform, helipads, jackets, towers etc.,

TEXT BOOKS:

1. API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design - API Publishing Services, 2005
2. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.

REFERENCES:

1. Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983.
2. James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003

E – RESOURCES

1. https://www.abdn.ac.uk/study/online/...courses/offshore-structures-and-subsea-systems.p.
2. https://nptel.ac.in/books_on_nptel.php

19PSP104	MATRIX METHODS FOR STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the concepts, characteristics and transformation of structures using matrix approach

UNIT I ENERGY CONCEPTS IN STRUCTURES 9

Introduction – Strain Energy – Symmetry of The Stiffness And Flexibility Matrices – Strain Energy in Terms of Stiffness And Flexibility Matrices – Stiffness And Flexibility Coefficients in Terms of Strain Energy – Additional properties of [a] and [k] – another Interpretation of coefficients a_{ij} and k_{ij} Betti's law – Applications of Betti's law: Forces not at the coordinates – Strain energy in systems and in Elements

UNIT II CHARACTERSTICS OF STRUCTURES – STIFFNESS AND FLEXIBILITY 9

Introduction – Structure with Single Coordinate- Two Coordinates-Flexibility and Stiffness Matrices in Coordinates- Examples-Symmetric Nature of Matrices- Stiffness and Flexibility Matrices in Constrained Measurements- Stiffness and Flexibility of Systems and Elements-Computing Displacements and Forces form Virtual Work-Computing Stiffness and Flexibility Coefficients.

UNIT III TRANSFORMATION OF INFORMATION IN STRUTURES 9

Determinate- Indeterminate Structures-Transformation of System Forces to Element Forces- Element Flexibility to System Flexibility - System Displacement to Element Displacement-Element Stiffness to System Stiffness- Transformation of Forces and Displacements in General –Stiffness and Flexibility in General –Normal Coordinates and Orthogonal Transformation-Principle of Contregradience

UNIT IV THE FLEXIBILITY METHOD 9

Statically Determinate Structures –Indeterminate Structures-Choice of Redundant Leading to Ill and Well Conditioned Matrices-Transformation to One Set of Redundant to Another-Internal Forces due to Thermal Expansion and Lack of Fit-Reducing the Size of Flexibility Matrix- Application to Pin-Jointed Plane Truss-Continuous Beams-Frames-Grids.

UNIT V THE STIFFNESS METHOD 9

Introduction-Development of Stiffness Method- Stiffness Matrix for Structures with zero Force at some Coordinates-Analogy between Flexibility and Stiffness-Lack of Fit-Stiffness Matrix with Rigid Motions-Application of Stiffness Approach to Pin Jointed Plane Trusses-Continuous Beams- Frames-Grids-Space Trusses and Frames-Introduction Only-Static Condensation Technique- Choice of Method-Stiffness or Flexibility

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to use matrix approach for solving structural engineering problems
- Students will have a thorough understanding of both flexibility and stiffness approach of Analysis.

TEXT BOOKS:

1. Natarajan C and Revathi P., "Matrix Methods of Structural Analysis", PHI Learning Private Limited, New Delhi, 2014
2. Devdas Menon., "Advanced Structural Analysis", Narosa Publishing House, New Delhi, 2009

REFERENCES:

1. Pandit G.S. and Gupta S.P., "Structural Analysis-A Matrix Approach", Tata McGraw-Hill PublishingCompany Limited, New Delhi, 1997.
2. Moshe F. Rubinstein – Matrix Computer Analysis of Structures- Prentice Hall,1969

E – RESOURCES

1. https://nptel.ac.in/noc/individual_course.php?id=noc19-ce33
2. https://searchworks.stanford.edu/view/11604362

19PSP201	THEORY OF PLATES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the behavior and analysis of thin plates and the behavior of anisotropic and thick plates.

UNIT I INTRODUCTION TO PLATES THEORY 9

Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT II RECTANGULAR PLATES 9

Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions, plates on elastic foundation. Moody's chart (for analysis of plates with various boundary conditions/loading)

UNIT III CIRCULAR PLATES 9

Symmetrical bending of circular plates.

UNIT IV SPECIAL AND APPROXIMATE METHODS. 9

Energy methods, Finite difference and Finite element methods.

UNIT V ANISOTROPIC PLATES AND THICK PLATES 9

Orthotropic plates and grids, moderately thick plates.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be able to analyze different types of plates (rectangular and circular) under different boundary connections by various classical methods and approximate methods.
- They will also know behavior of orthotropic and thick plates and grids.

TEXT BOOKS:

1. Ansel C.Ugural, "Stresses in plate and shells", McGraw Hill International Edition, 1999.
2. Bairagi, "Plate Analysis", Khanna Publishers, 1996

REFERENCES:

1. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.
2. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006

E – RESOURCES

1. ymcaust.ac.in/index.php/the-resources/e-resources
2. skct.edu.in/SKCT-CIVIL/pdf/PG%20R-17.pdf

19PSP202	MECHANICS OF COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the behavior of composite materials and to investigate the failure and fracture characteristics.

UNIT I INTRODUCTION **9**

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites

UNIT II STRESS STRAIN RELATIONS **9**

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III ANALYSIS OF LAMINATED COMPOSITES **9**

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Interlaminar stresses.

UNIT IV FAILURE AND FRACTURE OF COMPOSITES **9**

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V APPLICATIONS AND DESIGN **9**

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will have sufficient knowledge on behavior of various composite materials and will have an idea of failure and fracture mechanisms.

TEXT BOOKS:

1. Agarwal.B.D., Broutman.L.J., and Chandrashekara.K. "Analysis and Performance of Fiber Composites", John-Wiley and Sons, 2006.
2. Daniel.I.M., and Ishai.O, "Engineering Mechanics of Composite Materials", Oxford University Press, 2005.

REFERENCES:

1. Jones R.M., "Mechanics of Composite Materials", Taylor and Francis Group 1999.
2. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press, India, 2005.

E – RESOURCES

1. https://sarrami.iut.ac.ir/...course/01-mechanics_of_composite_materials_sbookfi.org_.pd...
2. https://www.engineering.unsw.edu.au/mechanical.../Course.../MECH9420_Course-Out...

19PSP203	ANALYSIS AND DESIGN OF TALL BUILDINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the behavior, analysis and design of tall structures

UNIT I LOADING AND DESIGN PRINCIPLES 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 9

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT IV STRUCTURAL ELEMENTS 9

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance

UNIT V STABILITY ISSUES 9

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to know the behavior of tall buildings due to various types of loads.
- They will be able to analyze and design such buildings by approximate, accurate and simplified methods.

TEXT BOOKS:

1. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 2005.

REFERENCES:

1. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
2. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988

E – RESOURCES

1. https://www.istructe.org/events/hq/tall-buildings-design-analysis-november/
2. https://www.udemy.com/modeling-analysis-of-high-rise-building-using-etabs-2016/

19PSP204	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the requirements, planning and design of Industrial structures**.**

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.

UNIT II INDUSTRIAL BUILDINGS 9

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

UNIT III POWER PLANT STRUCTURES 9

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of s elf supporting and guyed chimney, Design of Chimney bases.

UNIT V FOUNDATION 9

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course student will be able to plan industrial structures for functional requirements.
- They will be able to design various structures such as Bunkers, Silos, Cooling Towers, Chimneys, and Transmission Towers with required foundations.

TEXT BOOKS:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Manohar S.N, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985

REFERENCES:

1. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
2. Srinivasulu P and Vaidyanathan.C, Handbook of Machine Foundations, Tata McGraw Hill, 1976.

E – RESOURCES

1. https://www.un-ihe.org/online-course-industrial-resource-management-and-cleaner-pr.
2. https://www.udemy.com/structural-steel-design/

19PSP205	PRESTRESSED CONCRETE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Principle of prestressing, analysis and design of prestressed concrete structures**.**
-

UNIT I PRINCIPLES OF PRESTRESSING 9

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strength materials, Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress Box girders.

UNIT III DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and gap cables – Analysis and design of cantilever beams.

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flag masts and similar structures

UNIT V DESIGN OF COMPOSITE MEMBERS 9

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing its advantages and applications

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will have sufficient knowledge on various methods of prestressing and the concepts of partial pre-stressing.
- They will be in a position to design beams, pipes, water tanks, posts and similar structures.

TEXT BOOKS:

1. Arthur H. Nilson, "Design of Prestressed Concrete", John Wiley and Sons Inc, New York, 2004
2. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publishing Co., New Delhi, 2008.

REFERENCES:

1. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2008.
2. Sinha.N.C.and.Roy.S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co., 1998.

E – RESOURCES

1. https://study.unisa.edu.au › Study › Prestressed Concrete Design
2. https://precast.org/education/classes/

19PSP206	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the concept of wind and cyclone effects for the analysis and design of structures.

UNIT I INTRODUCTION 9

Introduction, Types of wind – Characteristics of wind – Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - Dynamic nature of wind – Pressure and suctions - Spectral studies, Gust factor.

UNIT II WIND TUNNEL STUDIES 9

Wind Tunnel Studies, Types of tunnels, - Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design - Modeling requirements, Aero dynamic and Aero-elastic models.

UNIT III EFFECT OF WIND ON STRUCTURES 9

Classification of structures – Rigid and Flexible – Effect of wind on structures - Static and dynamic effects on Tall buildings – Chimneys.

UNIT IV DESIGN OF SPECIAL STRUCTURES 9

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – design of Tall Buildings – Chimneys – Transmission towers and steel monopoles– Industrial sheds.

UNIT V CYCLONE EFFECTS 9

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course, students will be able to design high rise structures subjected wind load, even structures exposed to cyclone.
- Students will be conversant with various code provisions for the design of structures for wind load.

TEXT BOOKS:

1. Cook.N.J., "The Designer's Guide to Wind Loading of Building Structures", Butterworths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, "Wind Effects on Civil Engineering Structures", Elsevier Publications, 1984

REFERENCES:

1. Lawson T.V., "Wind Effects on Building Vol. I and II", Applied Science Publishers, London, 1980.

2. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York, 1978.

E – RESOURCES:

1. www.iitk.ac.in/nicee/IITK-GSDMA/W03.pdf
2. https://nidm.gov.in/PDF/safety/flood/link2.pdf

19PSP301	NONLINEAR ANALYSIS OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To study the concept of nonlinear behaviour and analysis of elements and simple structures.

UNIT I INTRODUCTION TO NONLINEAR ANALYSIS 9

Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial restraints

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course student will have enough knowledge on inelastic and vibration analysis of Flexural members.
- Also they will know the difference between elastic and inelastic analysis of plates and Instabilities of elastically supported beams.

TEXT BOOKS :

1. Fertis, D.G, Non-linear Mechanics, CRC Press, 1999.
2. Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008.

REFERENCES:

1. Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010.

E – RESOURCES

1. https://www.nafems.org/e-learning/all_courses/non-linear-finite-element-analysis-fea/
2. https://ocw.mit.edu/resources/res-2-002-finite...structures.../nonlinear/l

19PSP302	DESIGN OF SUB STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain familiarity with different types of foundation.
- To expose the students to the design of shallow foundations and deep foundations.
- To understand the concepts of designing well, machine and special foundations.

UNIT I SHALLOW FOUNDATIONS 9

Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation

UNIT II PILE FOUNDATIONS 9

Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles –configuration of piles- different shapes of piles cap – structural design of pile cap.

UNIT III WELL FOUNDATIONS 9

Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability.

UNIT IV MACHINE FOUNDATIONS 9

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.

UNIT V SPECIAL FOUNDATIONS 9

Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Design of anchors- Reinforced earth retailing walls.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to select appropriate foundation type based on available soil conditions.
- They will be in a position to determine the load carrying capacity of each type of foundation.
- They will gain thorough knowledge about the design of reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations.

TEXT BOOKS:

1. Bowles .J.E., "Foundation Analysis and Design", McGraw Hill Publishing co., New York, 1997.
2. Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.

REFERENCES:

1. Tomlinson.M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995.
2. Varghese.P.C, "Design of Reinforced Concrete Foundations" – PHI learning private limited, New Delhi – 2009.

E – RESOURCES

1. https://pdfs.semanticscholar.org/bf55/16914e710ee50238cda79b54d18cb18d0bd2.pdf
2. cac.annauniv.edu/PhpProject1/aidetails/afpg_2017_fu/02.M.E.Struc.pdf

19PSP303	OPTIMIZATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the optimization methodologies applied to structural engineering

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space - Feasible and infeasible Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints(Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).

UNIT II LINEAR AND NON-LINEAR PROGRAMMING 9

LINEAR PROGRAMMING: Formulation of problems - Graphical solution - Analytical methods - Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm.

NON LINEAR PROGRAMMING: One Dimensional minimization methods: Unidimensional Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques

UNIT III GEOMETRIC PROGRAMMING 9

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty.

UNIT IV DYNAMIC PROGRAMMING 9

Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods.

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multistorey buildings, water tanks and bridges.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will have sufficient knowledge on various optimization techniques like linear programming, non-linear programming, geometric and dynamic programming and they will also in a position to design various structural elements for minimum weight.

TEXT BOOKS:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997
2. Rao,S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984

REFERENCES:

1. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
2. Uri Krish, "Optimum Structural Design", McGraw Hill Book Co. 1981

E – RESOURCES

1. https://searchworks.stanford.edu/view/12158506
2. www.it-weise.de/projects/book.pdf

19PSP304 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To develop an understanding of the behaviour and design concrete composite elements and structures

UNIT I INTRODUCTION 9

Introduction to steel - concrete composite construction – Codes – Composite action – Serviceability and Construction issues in design.

UNIT II DESIGN OF COMPOSITE MEMBERS 9

Design of composite beams, slabs, columns, beam – columns - Design of composite trusses.

UNIT III DESIGN OF CONNECTIONS 9

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

UNIT IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction - behavior of box girder bridges - design concepts.

UNIT V CASE STUDIES 9

Case studies on steel - concrete composite construction in buildings - seismic behaviour of composite structures.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be in a position to design composite beams, columns, trusses and box-girder bridges including the related connections.
- They will get exposure on case studies related to steel-concrete constructions of buildings.

TEXT BOOKS:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995

REFERENCES:

1. Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

E – RESOURCES

1. www.iosrjournals.org/iosr-jmce/papers/Conf15010/Vol-1/2.%2008-15.pdf
2. https://www.researchgate.net/.../34305603_Analysis_and_design_of_steel_deck-concret...

19PSP305 DESIGN OF BRIDGES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the loads, forces on bridges and design of several types of bridges.

UNIT I GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGES 9

Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts , Tee beam and slab bridges.

UNIT II LONG SPAN RC BRIDGES 9

Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges.

UNIT III PRESTRESSED CONCRETE BRIDGES 9

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

UNIT IV STEEL BRIDGES 9

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

UNIT V BEARINGS AND SUBSTRUCTURES 9

Different types of bearings – Design of bearings – Design of piers and abutments of different types Types of bridge foundations – Design of foundations.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be able to design different types of RCC bridges, Steel bridges and pre-stressed concrete bridges with the bearings and substructures.

TEXT BOOKS:

1. Jagadeesh.T.R. and Jayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd. 2004.
2. Johnson Victor, D. "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. New Delhi, 2001.

REFERENCES:

1. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
2. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.

E – RESOURCES

1. https://sites.northwestern.edu/neweresources/.../bridge-structures-assessment-design-and-...
2. https://www.usbr.gov/.../designstandards.../designdatacollectionguides.../Chap3_Sec17.

19PSP306	DESIGN OF SHELL AND SPATIAL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNIT I CLASSIFICATION OF SHELLS **9**

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31. application to design of shell roofs of water tanks(membrane analyses)

UNIT II FOLDED PLATES **9**

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof.

UNIT III INTRODUCTION TO SPACE FRAME **9**

Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

UNIT IV ANALYSIS AND DESIGN **9**

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to Computer Aided Design.

UNIT V SPECIAL METHODS **9**

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to analyze and design various types of shells, folded plates and space frames manually and also using computer Aided design and software packages.

TEXT BOOKS :

1. ASCE Manual No.31, Design of Cylindrical Shells.
2. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982.

REFERENCES:

1. Subramanian.N ,"Principles of Space Structures", Wheeler Publishing Co. 1999.
2. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.

E – RESOURCES

1. https://www.iass-structures.org/
2. *https://www.sciencedirect.com/science/article/pii/S0143974X97000059*

19PSP307 COMPUTER AIDED ANALYSIS AND DESIGN

L	T	P	C
2	0	2	3

OBJECTIVES:

- To learn the principles of computer graphics, structural analysis, structural design, finite element analysis, optimization and artificial intelligence supported by software tools.

UNIT I COMPUTER GRAPHICS 6+6

Graphic primitives – Transformations – Basics of 2D drafting – Modelling of curves and surfaces – Wire frame modelling – Solid Modelling - Graphic standards - Drafting Software packages.

UNIT II STRUCTURAL ANALYSIS 6+6

Computer method of structural analysis – Simulation and Analysis of steel sections I, channel and Angle –PEB Elements – RCC and Composite members - Nonlinear Analysis through software packages

UNIT III STRUCTURAL DESIGN 6+6

Computer Aided Design of Steel and RC structural elements – Detailing of reinforcement – Detailed Drawing

UNIT IV OPTIMIZATION 6+6

Introduction to Optimization – Applications of Linear programming – Simplex Algorithm – Post Optimality Analysis – Project scheduling – CPM and PERT Applications.

UNIT V ARTIFICIAL INTELLIGENCE 6+6

Introduction – Heuristic Research – Knowledge based Expert Systems – Architecture and Applications – Rules and Decision tables – Inference Mechanisms – Simple Applications – Genetic Algorithm and Applications – Principles of Neural Network – Expert system shells.

PRACTICAL

LIST OF EXERCISES

1. 2-D Frame Modelling and Analysis.
2. 3 – D Frame Modelling and Analysis.
3. Non Linear Analysis using Design software.
4. Design and Detailing of Structural Elements.
5. Simulation and Analysis of steel beam using FEA software.
6. Simulation and Analysis of R.C.Beam using FEA software.
7. Simulation and Analysis of Composite element s using FEA software.

8. Eigen Value Buckling analysis using FEA software.

TOTAL (L: 30 P :30): 60 PERIODS

OUTCOMES:

- On completion of this course students will be familiar and will have sufficient knowledge on the concepts and working principle of various structural engineering softwares

REFERENCES:

1. Shah V.L. "Computer Aided Design in Reinforced Concrete" Structural Publishers, 2014.
2. Harrison H.B., "Structural Analysis and Design Vol.I and II", Pergamon Press, 1991
3. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI

FOR M.E. VLSI DESIGN

(For the Students Admitted in the Academic Year 2019-2020 onwards)

FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY COURSES									
19PMT102	Applied Mathematics for Electronics Engineers	FC	3	1	0	4	40	60	100
19PVT101	Advanced Digital System Design	PC	3	0	0	3	40	60	100
19PVT102	CMOS Digital VLSI Design	PC	3	0	0	3	40	60	100
19PVT103	DSP Integrated Circuits	PC	3	0	0	3	40	60	100
19PVT104	CAD for VLSI Circuits	PC	3	0	0	3	40	60	100
19PVT105	Analog IC Design	PC	3	1	0	4	40	60	100
LABORATORY COURSES									
19PVL101	VLSI Design Laboratory - I	PC	0	0	4	2	40	60	100
TOTAL CREDITS IN SEMESTER - I			22						

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY COURSES									
19PVT201	Testing of VLSI Circuits	PC	3	0	0	3	40	60	100
19PVT202	VLSI Signal Processing	PC	3	0	0	3	40	60	100
19PVT203	Low Power VLSI Design	PC	3	0	0	3	40	60	100
	Professional Elective - I	PE	3	0	0	3	40	60	100
	Professional Elective - II	PE	3	0	0	3	40	60	100
	Professional Elective - III	PE	3	0	0	3	40	60	100
LABORATORY COURSES									
19PVL201	VLSI Design Laboratory - II	PC	0	0	4	2	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES									
19PVE201	Term Paper Writing and Seminar	EEC	0	0	2	1	40	60	100
TOTAL CREDITS IN SEMESTER - II			21						

PC: Professional Core, PE: Professional Elective, EEC: Employability Enhancement Courses, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY COURSES									
19PVT301	Analog to Digital Interfaces	PC	3	0	0	3	40	60	100
	Professional Elective - IV	PE	3	0	0	3	40	60	100
	Professional Elective - V	PE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES									
19PVJ301	Project Work Phase - I	EEC	0	0	12	6	40	60	100
TOTAL CREDITS IN SEMESTER - III			15						

FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSES									
19PVJ401	Project Work Phase - II	EEC	0	0	24	12	40	60	100
TOTAL CREDITS IN SEMESTER - IV			12						

TOTAL NUMBER OF CREDITS: 70

PC: Professional Core, PE: Professional Elective, EEC: Employability Enhancement Courses, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

FOUNDATION COURSES (FC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PMT102	Applied Mathematics for Electronics Engineers	FC	3	1	0	4	40	60	100

PROFESSIONAL CORE (PC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVT101	Advanced Digital System Design	PC	3	0	0	3	40	60	100
19PVT102	CMOS Digital VLSI Design	PC	3	0	0	3	40	60	100
19PVT103	DSP Integrated Circuits	PC	3	0	0	3	40	60	100
19PVT104	CAD for VLSI Circuits	PC	3	0	0	3	40	60	100
19PVT105	Analog IC Design	PC	3	1	0	4	40	60	100
19PVL101	VLSI Design Laboratory - I	PC	0	0	4	2	40	60	100
19PVT201	Testing of VLSI Circuits	PC	3	0	0	3	40	60	100
19PVT202	VLSI Signal Processing	PC	3	0	0	3	40	60	100
19PVT203	Low Power VLSI Design	PC	3	0	0	3	40	60	100
19PVL201	VLSI Design Laboratory - II	PC	0	0	4	2	40	60	100
19PVT301	Analog to Digital Interfaces	PC	3	0	0	3	40	60	100

FC: Foundation Courses, PC: Professional Core, L: Lecture, T: Tutorial, P: Practical, C: Credit Point,
CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVE201	Term Paper Writing and Seminar	EEC	0	0	2	1	40	60	100
19PVJ301	Project Work Phase - I	EEC	0	0	12	6	40	60	100
19PVJ401	Project Work Phase - II	EEC	0	0	24	12	40	60	100

PROFESSIONAL ELECTIVES (PE)

SEMESTER - II

ELECTIVE - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVPX01	Device Modeling - I	PE	3	0	0	3	40	60	100
19PVPX02	RF IC Design	PE	3	0	0	3	40	60	100
19PVPX03	Design of Analog Filters and Signal Conditioning Circuits	PE	3	0	0	3	40	60	100
19PVPX04	Nano Scale Devices	PE	3	0	0	3	40	60	100

PE: Professional Elective, EEC: Employability Enhancement Courses, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

SEMESTER - II
ELECTIVE - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVPX05	DSP Processor Architecture and Programming	PE	3	0	0	3	40	60	100
19PVPX06	Networks on Chip	PE	3	0	0	3	40	60	100
19PVPX07	Signal Integrity for High Speed Design	PE	3	0	0	3	40	60	100
19PVPX08	Digital Control Engineering	PE	3	0	0	3	40	60	100

SEMESTER - II
ELECTIVE - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVPX09	Embedded System Design	PE	3	0	0	3	40	60	100
19PVPX10	Soft Computing and Optimization Techniques	PE	3	0	0	3	40	60	100
19PVPX11	Reconfigurable Architectures	PE	3	0	0	3	40	60	100
19PVPX12	Advanced Microprocessors and Architectures	PE	3	0	0	3	40	60	100

PE: Professional Elective, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

SEMESTER - III
ELECTIVE - IV

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVPX13	Selected Topics in ASIC Design	PE	3	0	0	3	40	60	100
19PVPX14	Design and Analysis of Computer Algorithms	PE	3	0	0	3	40	60	100
19PVPX15	Device Modeling- II	PE	3	0	0	3	40	60	100
19PVPX16	Digital Image Processing	PE	3	0	0	3	40	60	100

SEMESTER - III
ELECTIVE - V

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
19PVPX17	MEMS and NEMS	PE	3	0	0	3	40	60	100
19PVPX18	Scripting Languages for VLSI	PE	3	0	0	3	40	60	100
19PVPX19	Hardware – Software Co-Design	PE	3	0	0	3	40	60	100
19PVPX20	Selected Topics in IC Design	PE	3	0	0	3	40	60	100

PE: Professional Elective, L: Lecture, T: Tutorial, P: Practical, C: Credit Point, CIA: Continuous Internal Assessment, ESE: End Semester Examination, TOT: Total

CREDIT SUMMARY

Category	Sem 1	Sem 2	Sem 3	Sem 4	Total
FC	4	-	-	-	4
PC	18	11	3	-	32
PE	-	9	6	-	15
EEC	-	1	6	12	19
Total	22	21	15	12	70

FC: Foundation Courses

PC: Professional Core

PE: Professional Elective

EEC: Employability Enhancement Courses

SEMESTER I

19PMT102	**APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS**	**L T P C** **3 1 0 4**

OBJECTIVES:

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

UNIT I FUZZY LOGIC **9+3**

Classical logic - Multivalued logics - Fuzzy propositions - Fuzzy quantifiers.

UNIT II MATRIX THEORY **9+3**

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT III PROBABILITY AND RANDOM VARIABLES **9+3**

Probability - Axioms of probability - Conditional probability - Baye's theorem - Random variables - Probability function - Moments - Moment generating functions and their properties - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions - Function of a Random variable.

UNIT IV DYNAMIC PROGRAMMING **9+3**

Dynamic programming - Principle of optimality - Forward and backward recursion - Applications of dynamic programming - Problem of dimensionality.

UNIT V QUEUEING MODELS **9+3**

Poisson Process - Markovian queues - Single and multi server models - Little's formula - Machine interference model - Steady state analysis - Self service queue.

TOTAL: 45+15 PERIODS

OUTCOMES: After completing this course, students should demonstrate competency in the following skills:

- Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and applications of fuzzy logic.
- Apply various methods in matrix theory to solve system of linear equations.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational

procedure of dynamic programming

- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
- Using discrete time Markov chains to model computer systems.

TEXT BOOKS:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw Hill, 2011.
2. George, J. Klir. and Yuan, B., "Fuzzy sets and Fuzzy logic, Theory and Applications", Prentice Hall of India Pvt. Ltd., 1997.

REFERENCES:

1. Gross, D., Shortle J. F., Thompson, J.M., and Harris, C. M., "Fundamentals of Queueing Theory", 4th Edition, John Wiley, 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.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in/nd1_noc19_ma22/preview

19PVT101 ADVANCED DIGITAL SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To introduce methods to analyze and design synchronous and asynchronous sequential circuits
- To introduce the architectures of programmable devices
- To introduce design and implementation of digital circuits using programming tools

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of clocked synchronous sequential circuits and modeling- State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuits design of iterative circuits-ASM chart and realization using ASM

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of asynchronous sequential circuit - flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards - data synchronizers - mixed operating mode asynchronous circuits - designing vending machine controller

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

Fault table method-path sensitization method - Boolean difference method-D algorithm - Tolerance techniques - The compact algorithm - Fault in PLA - Test generation-DFT schemes - Built in self test

UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 9

Programming logic device families - Designing a synchronous sequential circuit using PLA/PAL - Realization of finite state machine using PLD - FPGA - Xilinx FPGA-Xilinx 4000

UNIT V SYSTEM DESIGN USING VERILOG 9

Hardware Modelling with Verilog HDL - Logic System, Data Types and Operators For Modelling in Verilog HDL - Behavioural Descriptions in Verilog HDL - HDL Based Synthesis - Synthesis of Finite State Machines- structural modeling - compilation and simulation of Verilog code -Test bench - Realization of combinational and sequential circuits using Verilog - Registers - counters - sequential machine - serial adder - Multiplier- Divider - Design of simple microprocessor

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- Analyze and design sequential digital circuits
- Identify the requirements and specifications of the system required for a given application
- Design and use programming tools for implementing digital circuits of industry standards

TEXT BOOKS:

1. Charles H.Roth Jr "Fundamentals of Logic Design" Thomson Learning 2004
2. Parag K.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications,2002.

REFERENCES:

1. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999
2. M.G.Arnold, Verilog Digital - Computer Design, Prentice Hall (PTR), 1999.
3. Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001
4. S. Palnitkar , Verilog HDL - A Guide to Digital Design and Synthesis, Pearson , 2003.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT102 **CMOS DIGITAL VLSI DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- This course deals comprehensively with all aspects of transistor level design of all the digital building blocks common to all CMOS microprocessors, DPSs, network processors, digital backend of all wireless systems etc.
- The focus will be on the transistor level design and will address all important issues related to size, speed and power consumption. The units are classified according to the important building and will introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures.

UNIT I MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER 12

MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, Process Variations, Technology Scaling, Internet Parameter and electrical wise models CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore"s constant, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static Latches and Registers, Dynamic Latches and Registers, Timing Issues, Pipelines, Pulse and sense amplifier based Registers, Nonbistable Sequential Circuits.

UNIT IV ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES 9

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Speed and Area Tradeoffs, Memory Architectures, and Memory control circuits.

UNIT V INTERCONNECT AND CLOCKING STRATEGIES 6

Interconnect Parameters - Capacitance, Resistance, and Inductance, Electrical Wire Models, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- Carry out transistor level design of the most important building blocks used in digital CMOS VLSI circuits.
- Discuss design methodology of arithmetic building block
- Analyze tradeoffs of the various circuit choices for each of the building block.

TEXT BOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B Nikolic, "Digital Integrated Circuits: A Design Perspective". Second Edition, Feb 2003, Prentice Hall of India.
2. Jacob Baker "CMOS: Circuit Design, Layout, and Simulation, Third Edition", Wiley IEEE Press 2010 3rd Edition.

REFERENCES:

1. M J Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
2. N.Weste, K. Eshraghian, "Principles of CMOS VLSI Design". Second Edition, 1993 Addision Wesley.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT103 **DSP INTEGRATED CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES:

- To familiarize the concept of DSP and DSP algorithms.
- Introduction to Multirate systems and finite wordlength effects
- To know about the basic DSP processor architectures and the synthesis of the processing elements

UNIT I INTRODUCTION TO DSP INTEGRATED CIRCUITS 9

Introduction to Digital signal processing, Sampling of analog signals, Selection of sample frequency, Signal- processing systems, Frequency response, Transfer functions, Signal flow graphs, Filter structures, Adaptive DSP algorithms, DFT-The Discrete Fourier Transform, FFT Algorithm, Image coding, Discrete cosine transforms, Standard digital signal processors, Application specific ICs for DSP, DSP systems, DSP system design, Integrated circuit design.

UNIT II DIGITAL FILTERS AND FINITE WORD LENGTH EFFECTS 9

FIR filters, FIR filter structures, FIR chips, IIR filters, Specifications of IIR filters, Mapping of analog transfer functions, Mapping of analog filter structures, Multi rate systems, Interpolation with an integer factor L, Sampling rate change with a ratio L/M, Multi rate filters. Finite word length effects - Parasitic oscillations, Scaling of signal levels, Round-off noise, Measuring round-off noise, Coefficient sensitivity, Sensitivity and noise.

UNIT III DSP ARCHITECTURES 9

DSP system architectures, Standard DSP architecture-Harvard and Modified Harvard architecture. Ideal DSP architectures, Multiprocessors and multi computers, Systolic and Wave front arrays, Shared memory architectures.

UNIT IV SYNTHESIS OF DSP ARCHITECTURES 9

Synthesis: Mapping of DSP algorithms onto hardware, Implementation based on complex PEs, Shared memory architecture with Bit - serial PEs. Combinational & sequential networks- Storage elements - clocking of synchronous systems, Asynchronous systems -FSM

UNIT V ARITHMETIC UNIT AND PROCESSING ELEMENTS 9

Conventional number system, Redundant Number system, Residue Number System, Bit-parallel and Bit-Serial arithmetic, Digit Serial arithmetic, CORDIC Algorithm, Basic shift accumulator, Reducing the memory size, Complex multipliers, Improved shift-accumulator. Case Study: DCT and FFT processor

TOTAL: 45 PERIODS

OUTCOMES:

- Get to know about the Digital Signal Processing concepts and its algorithms
- Get an idea about finite word length effects in digital filters
- Concept behind multi rate systems is understood.
- Get familiar with the DSP processor architectures and how to perform synthesis of processing elements

TEXT BOOKS:

1. B.Venkatramani, M.Bhaskar, "Digital Signal Processors", Tata McGraw-Hill, 2002.
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002.

REFERENCES:

1. Keshab Parhi, "VLSI Digital Signal Processing Systems design & Implementation", John Wiley & Sons, 1999.
2. Lars Wanhammer, "DSP Integrated Circuits", Academic press, New York, 1999.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT104 **CAD FOR VLSI CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn VLSI Design methodologies
- Understand VLSI design automation tools
- Study modelling and simulation

UNIT I INTRODUCTION TO VLSI DESIGN FLOW 9

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

UNIT II LAYOUT, PLACEMENT AND PARTITIONING 9

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

UNIT III FLOOR PLANNING AND ROUTING 9

Floor planning concepts, Shape functions and floorplan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

UNIT IV SIMULATION AND LOGIC SYNTHESIS 9

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT V HIGH LEVEL SYNTHESIS 9

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

TOTAL: 45 PERIODS

OUTCOMES: At the end of this course, the students should be able to:

- Outline floor planning and routing
- Explain Simulation and Logic Synthesis
- Discuss the hardware models for high level synthesis

TEXT BOOKS:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.

REFERENCES:

1. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World Scientific 1999.
2. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT105 **ANALOG IC DESIGN** **L T P C**

3 1 0 4

OBJECTIVES

- To study MOS devices modelling and scaling effects.
- To familiarize the design of single stage and multistage MOS amplifier and analysis their frequency responses.
- To study the different design parameters in designing voltage reference and OPAMP circuits.

UNIT I MOSFET METRICS **9+3**

Simple long channel MOSFET theory - SPICE Models - Technology trend, Need for Analog design - Sub-micron transistor theory, Short channel effects, Narrow width effect, Drain induced barrier lowering, Sub-threshold conduction, Reliability, Digital metrics, Analog metrics, Small signal parameters, Unity Gain Frequency, Miller‟s approximation

UNIT II SINGLE STAGE AND TWO STAGE AMPLIFIERS **9+3**

Single Stage Amplifiers - Common source amplifier with resistive load, diode load, constant current load, Source degeneration Source follower, Input and output impedance, Common gate amplifier - Differential Amplifiers - differential and common mode response, Input swing, gain, diode load and constant current load - Basic Two Stage Amplifier, Cut-off frequency, poles and zeros

UNIT III FREQUENCY RESPONSE OF SINGLE STAGE AND TWO STAGE AMPLIFIERS **9+3**

Frequency Response of Single Stage Amplifiers - Noise in Single stage Amplifiers - Stability and Frequency Compensation in Single stage Amplifiers, Frequency Response of Two Stage Amplifiers, - Noise in two stage Amplifiers - Stability, gain and phase margins, Frequency Compensation in two stage Amplifiers, Effect of loading in feedback networks

UNIT IV CURRENT MIRRORS AND REFERENCE CIRCUITS **9+3**

Cascode, Negative feedback, Wilson, Regulated cascode, Bandgap voltage reference, Constant Gm biasing, supply and temperature independent reference, curvature compensation, trimming, Effect of transistor mismatch in analog design

UNIT V OP AMPS **9+3**

Gilbert cell and applications, Basic two stage OPAMP, two-pole system response, common mode and differential gain, Frequency response of OPAMP, CMFB circuits, slew rate, power supply rejection ratio, random offset, systematic offset, Noise, Output stage, OTA and OPAMP circuits - Low voltage OPAMP

TOTAL: 45+15 PERIODS

OUTCOMES:

- To design MOS single stage, multistage amplifiers and OPAMP for desired frequencies
- Analyze Stability, frequency response, and Noise in MOS amplifiers

TEXT BOOKS:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2000
2. Philip E.Allen, "CMOS Analog Circuit Design", Oxford University Press, 2013

REFERENCES:

1. Paul R.Gray, "Analysis and Design of Analog Integrated Circuits", Wiley Student edition, 5th edition, 2009.
2. R.Jacob Baker, "CMOS: Circuit Design, Layout , and Simulation", Wiley Student Edition, 2009

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2. https://swayam.gov.in

19PVL101 **VLSI DESIGN LABORATORY- I** **L T P C**
0 0 4 2

OBJECTIVES:

The laboratory-based study for the entire program is clubbed under three categories. One is the FPGA based design methodology; the second is the simulation of analog building blocks, and analog and digital CAD design flow. Experiments pertaining to the former two topics are covered in this lab course and those pertaining to the latter will be covered in VLSI Design Lab II.

FPGAs are important platform used throughout the industry both in their own right in building complete systems. They are also used as validation/verification platforms prior to undertaking cost and time intensive design and fabrication of custom VLSI designs. Starting from high level design entry in the form VHDL/Verilog codes, the students will be carrying out complete hardware level FPGA validation of important digital algorithms. In addition, exercises on the SPICE simulation of the basic CMOS analog building blocks will be carried out.

EXPERIMENTS:

1. Understanding Synthesis principles. Back annotation.
2. Test vector generation and timing analysis of sequential and combinational logic design realized using HDL languages.
3. FPGA real time programming and I/O interfacing.
4. Interfacing with Memory modules in FPGA Boards.
5. Verification of design functionality implemented in FPGA by capturing the signal in DSO.
6. Real time application development.
7. Design Entry Using VHDL or Verilog examples for Digital circuit descriptions using HDL languages sequential, concurrent statements and structural description.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to: After completing this course, given a digital system specification, the student should be able to map it onto FPGA paltform and carry out a series of validations design starting from design entry to hardware testing. In addition, the student also will be able to design and carry out time domain and frequency domain simulations of simple analog building blocks, study the pole zero behaviors of feedback-based circuits and compute the input/output impedances.

19PVT201 **TESTING OF VLSI CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES: The students should be made to:

- Understand logic fault models
- Learn test generation for sequential and combinational logic circuits

UNIT I TESTING AND FAULT MODELLING **9**

Introduction to testing - Faults in Digital Circuits - Modelling of faults - Logical Fault Models -Fault detection - Fault Location - Fault dominance - Logic simulation - Types of simulation -Delay models - Gate Level Event - driven simulation.

UNIT II TEST GENERATION **9**

Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.

UNIT III DESIGN FOR TESTABILITY **9**

Design for Testability - Ad-hoc design - generic scan-based design - classical scan-based design- system level DFT approaches.

UNIT IV SELF - TEST AND TEST ALGORITHMS **9**

Built-In self-test - test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test Algorithms - Test generation for Embedded RAMs.

UNIT V FAULT DIAGNOSIS **9**

Logical Level Diagnosis - Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits- Self-checking design - System Level Diagnosis.

TOTAL: 45 PERIODS

OUTCOMES: At the end of this course, the students should be able to:

- Prepare design for testability
- Discuss test algorithms
- Explain fault diagnosis

TEXT BOOKS:

1. A.L.Crouch, "Design Test for Digital IC"s and Embedded Core Systems", Prentice Hall International, 2002.
2. M.Abramovici, M.A.Breuer and A.D. Friedman, "Digital systems and Testable Design", JaicoPublishing House, 2002.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory And Mixed- Signal VLSI Circuits", Kluwer Academic Publishers, 2002.
2. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002.

E- RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT202 **VLSI SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce techniques for altering the existing DSP structures to suit VLSI implementations.
- To introduce efficient design of DSP architectures suitable for VLSI

UNIT I PIPELINING AND PARALLEL PROCESSING OF DIGITAL FILTERS 9

Introduction to DSP systems - Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, Longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power.

UNIT II ALGORITHMIC STRENGTH REDUCTION TECHNIQUE I 9

Retiming - definitions and properties, Unfolding - an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms - 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge-sort architecture, parallel rank-order filters.

UNIT III ALGORITHMIC STRENGTH REDUCTION –II 9

Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters - Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV BIT-LEVEL ARITHMETIC ARCHITECTURES 9

Bit-level arithmetic architectures - parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon‟s bit-serial multipliers using Horner‟s rule, bit-serial FIR filter, CSD representation, CSD multiplication using Horner‟s rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters

UNIT V NUMERICAL STRENGTH REDUCTION, WAVE AND ASYNCHRONOUS PIPELINING 9

Numerical strength reduction - subexpression elimination, multiple constant multiplication, iterative matching, synchronous pipelining and clocking styles, clock skew in edge-triggered single phase clocking, two-phase clocking, wave pipelining. Asynchronous pipelining bundled data versus dual rail protocol.

TOTAL: 45 PERIODS

OUTCOME:

• Ability to modify the existing or new DSP architectures suitable for VLSI.

TEXT BOOKS:

1. Keshab K. Parhi, " VLSI Digital Signal Processing Systems, Design and implementation ", Wiley, Interscience, 2007.
2. U. Meyer - Baese, " Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004.

E- RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVT203 LOW POWER VLSI DESIGN L T P C
3 0 0 3

OBJECTIVES:

- Identify sources of power in an IC.
- Identify the power reduction techniques based on technology independent and technology dependent
- Power dissipation mechanism in various MOS logic style.
- Identify suitable techniques to reduce the power dissipation.
- Design memory circuits with low power dissipation.

UNIT I POWER DISSIPATION IN CMOS 9

Physics of power dissipation in CMOS FET devices - Hierarchy of limits of power - Sources of power consumption - Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques For Leakage Power Reduction - Basic principle of low power design.

UNIT II POWER OPTIMIZATION 9

Logic level power optimization - Circuit level low power design - Standard Adder Cells, CMOS Adders Architectures-BiCMOS adders - Low Voltage Low Power Design Techniques, Current Mode Adders - Types Of Multiplier Architectures, Braun, Booth and Wallace Tree Multipliers and their performance comparison

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power system - low voltage low power static Random access and dynamic Random access memories - low power clock, Inter connect and layout design - Advanced techniques - Special techniques.

UNIT IV POWER ESTIMATION 9

Power Estimation techniques - logic power estimation - Simulation power analysis -Probabilistic power analysis.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power - Behavioral level transform - software design for low power.

TOTAL: 45 PERIODS

OUTCOMES:

- The student will get to know the basics and advanced techniques in low power design which is a hot topic in today"s market where the power plays major role.
- The reduction in power dissipation by an IC earns a lot including reduction in size, cost and etc.

TEXT BOOKS:

1. AbdelatifBelaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995.
2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995.

REFERENCES:

1. DimitriosSoudris, C.Pignet, Costas Goutis,"Designing CMOS Circuits for Low Power"Kluwer, 2002.
2. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.

E-RESOURCES

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2. https://swayam.gov.in

19PVL201 **VLSI DESIGN LABORATORY - II** **L T P C**
0 0 4 2

OBJECTIVE:

The focus of this course the CAD based VLSI design flow. The entire VLSI design industry makes use of this design flow in some for or the other. Proficiency and familiarity with the various stages of a typical „state of this design flow is a prerequisite for any student who wishes to be apart of either the industry or their search in VLSI over one full semester exposure to various stages of a typical state of the art CAD VLSI tool be provided by various experiments designed to bring out the key aspects of simulation, and power and clock routing modules. ASIC RTL realization of an available open source MCU

EXPERIMENTS :

To synthesize and understand the Boolean optimization in synthesis. Static timing analyses procedures and constraints. Critical path considerations. Scan chain insertion, Floor planning, Routing and Placement procedures. Power planning, Layout generation, LVS and back annotation, Total power estimate. Analog circuit simulation. Simulation of logic gates, Current mirrors, Current sources, Differential amplifier in Spice. Layout generations, LVS, Back annotation

TOTAL: 60 PERIODS

OUTCOMES:

The student would have hands on experience in the carrying out a complete VLSI based experiments using / CADENCE/ TANNER/ Mentor/Synopsis

19PVE201 **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 analyzing 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 your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)

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 Google Scholar • When picking papers to read - try to: • 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 of them, • Favour papers from well-known journals and conferences,	4th week	**6%** (the list of standard papers and reason for selection)
	• Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th 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 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 andconclusion) **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 of your paper	13th week	**10% (**formatting, 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

19PVPX01 **DEVICE MODELING - I** **L T P C**

3 0 0 3

OBJECTIVES

- To study the MOS capacitors and to model MOS Transistors
- To understand the various CMOS design parameters and their impact on performance of the device.
- To study the device level characteristics of BJT transistors

UNIT I MOS CAPACITORS **9**

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Non equilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon-Oxide Interface, Effect of Interface Traps and Oxide Charge on Device Characteristics, High-Field Effects, Impact Ionization and Avalanche Breakdown, Band-to-Band Tunneling, Tunneling into and through Silicon Dioxide, Injection of Hot Carriers from Silicon into Silicon Dioxide, High-Field Effects in Gated Diodes, Dielectric Breakdown

UNIT II MOSFET DEVICES **9**

Long-Channel MOSFETs, Drain-Current Model, MOSFET I –V Characteristics, Subthreshold Characteristics, Substrate Bias and Temperature Dependence of Threshold Voltage, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source-Drain Series Resistance, MOSFET Degradation and Breakdown at High Fields.

UNIT III CMOS DEVICE DESIGN **9**

MOSFET Scaling, Constant-Field Scaling, Generalized Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length, Various Definitions of Channel Length, Extraction of the Effective Channel Length, Physical Meaning of Effective Channel Length, Extraction of Channel Length by C–V Measurements.

UNIT IV CMOS PERFORMANCE FACTORS **9**

Basic CMOS Circuit Elements, CMOS Inverters, CMOS NAND and NOR Gates, Inverter and NAND Layouts, Parasitic Elements, Source–Drain Resistance, Parasitic Capacitances, Gate Resistance, Interconnect R and C, Sensitivity of CMOS Delay to Device Parameters, Propagation Delay and Delay Equation, Delay Sensitivity to Channel Width, Length, and Gate Oxide Thickness, Sensitivity of Delay to Power-Supply Voltage and Threshold Voltage, Sensitivity of Delay to Parasitic Resistance and Capacitance, Delay of Two-Way NAND and Body Effect, Performance

Factors of Advanced CMOS Devices, MOSFETs in RF Circuits, Effect of Transport Parameters on CMOS Performance, Low-Temperature CMOS

UNIT V BIPOLAR DEVICES 9

n–p–n Transistors, Basic Operation of a Bipolar Transistor, Modifying the Simple Diode Theory for Describing Bipolar Transistors, Ideal Current–Voltage Characteristics, Collector Current, Base Current, Current Gains, Ideal IC–VCE Characteristics, Characteristics of a Typical n–p–n Transistor, Effect of Emitter and Base Series Resistances, Effect of Base–Collector Voltage on Collector Current, Collector Current Falloff at High Currents, Nonideal Base Current at Low Currents, Bipolar Device Models for Circuit and Time-Dependent Analyses Basic dc Model, Basic ac Model, Small-Signal Equivalent-Circuit Model, Emitter Diffusion Capacitance, Charge-Control Analysis, Breakdown Voltages, Common-Base Current Gain in the Presence of Base–Collector Junction Avalanche, Saturation Currents in a Transistor, Relation Between BV_{CEO} and BV_{CBO}.

TOTAL: 45 PERIODS

OUTCOMES:

To design and model MOSFET and BJT devices to desired specifications.

TEXT BOOKS:

1. Behzad Razavi, "Fundamentals of Microelectronics" Wiley Student Edition, 2nd Edition.
2. J P Collinge, C A Collinge, "Physics of Semiconductor devices" Springer 2002 Edition.

REFERENCES:

1. Yuan Taur and Tak H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, Second Edition.

E-RESOURCES

1. https://nptel.ac.in
2. https://swayam.gov.in

19PVPX02 **RF IC DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the various impedance matching techniques used in RF circuit design.
- To understand the functional design aspects of LNAs, Mixers, PLLs and VCO.
- To understand frequency synthesis.

UNIT I IMPEDANCE MATCHING IN AMPLIFIERS 9

Definition of 'Q\ series parallel transformations of lossy circuits, impedance matching using ***V,*** 'PI' and T networks, Integrated inductors, resistors, Capacitors, tunable inductors, transformers.

UNIT II AMPLIFIER DESIGN 9

Noise characteristics of MOS devices, Design of CG LNA and inductor degenerated LANs. Principles of RF Power Amplifiers design

UNIT III ACTIVE AND PASSIVE MIXERS 9

Qualitative Description of the Gilbert Mixer - Conversion Gain, and distortion and noise , analysis of Gilbert Mixer – Switching Mixer - Distortion in Unbalanced Switching Mixer -Conversion Gain in Unbalanced Switching Mixer - Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

UNIT IV OSCILLATORS 9

LC Oscillators, Voltage Controlled Oscillators, Ring oscillators, Delay Cells, tuning range in ring oscillators, Tuning in LC oscillators, Tuning sensitivity, Phase Noise in oscillators, sources of phase noise

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

Phase Detector/Charge Pump, Analog Phase Detectors, Digital Phase Detectors, Frequency Dividers, Loop Filter Design, Phase Locked Loops, Phase noise in PLL, Loop Bandwidth, Basic Integer-N frequency synthesizer, Basic Fractional-N frequency synthesizer

TOTAL: 45 PERIODS

OUTCOMES:

To understand the principles of operation of an RF receiver front end and be able to design and apply constraints for LNAs, Mixers and Frequency synthesizers

TEXT BOOKS:

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002

REFERENCES:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999
2. Jia-sheng Hong, "Microstrip filters for RF/Microwave applications", Wiley, 2001
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits", Cambridge University Press ,2003.

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2. https://swayam.gov.in

19PVPX03 DESIGN OF ANALOG FILTERS AND SIGNAL CONDITIONING CIRCUITS **L T P C 3 0 0 3**

OBJECTIVE:

This course deals with CMOS circuit design of various Analog Filter architectures. The required signal conditioning techniques in a Mixed signal IC environment are also dealt in this course.

UNIT I FILTER TOPOLOGIES **9**

The Bilinear Transfer Function - Active RC Implementation, Transconductor-C Implementation, Switched Capacitor Implementation, Biquadratic Transfer Function, Active RC implementation, Switched capacitor implementation, High Q, Q peaking and instability, Transconductor-C Implementation, the Digital Biquad.

UNIT II INTEGRATOR REALIZATION **9**

Lowpass Filters, Active RC Integrators – Effect of finite Op-Amp Gain Bandwidth Product, Active RC SNR, gm-C Integrators, Discrete Time Integrators.

UNIT III SWITCHED CAPACITOR FILTER REALIZATION **9**

Switched capacitor Technique, Biquadratic SC Filters, SC N-path filters, Finite gain and bandwidth effects, Layout consideration, Noise in SC Filters.

UNIT IV SIGNAL CONDITIONING TECHNIQUES **9**

Interference types and reduction, Signal circuit grounding, Shield grounding, Signal conditioners for capacitive sensors, Noise and Drift in Resistors, Layout Techniques.

UNIT V SIGNAL CONDITIONING CIRCUITS **9**

Isolation Amplifiers, Chopper and Low Drift Amplifiers, Electrometer and Transimpedance Amplifiers, Charge Amplifiers, Noise in Amplifiers

TOTAL: 45 PERIODS

OUTCOMES:

The student will apply the operational and design principles for all the important active analog filter configurations. The student also will gain working knowledge of signal conditioning techniques and the necessary guide lines in a Mixed signal IC environment.

TEXT BOOKS:

1. Ramson Pallas-Areny, John G. Webster "Sensors and Signal Conditioning" , A wiley Inter science Publication, John Wiley & Sons INC,2001.
2. R.Jacob Baker, "CMOS Mixed-Signal Circuit Design", John Wiley & Sons, 2008.

REFERENCES:

1. Schauman, Xiao and Van Valkenburg, "Design of Analog Filters", Oxford University Press, 2009.

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19PVPX04 **NANO SCALE DEVICES** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce novel MOSFET devices and understand the advantages of multi-gate devices
- To introduce the concepts of nanoscale MOS transistor and their performance characteristics
- To study the various nano scaled MOS transistors

UNIT I INTRODUCTION TO NOVEL MOSFETS **9**

MOSFET scaling, short channel effects - channel engineering - source/drain engineering - high k dielectric - copper interconnects - strain engineering, SOI MOSFET, multigate transistors - single gate - double gate - triple gate - surround gate, quantum effects - volume inversion - mobility - threshold voltage - inter subband scattering, multigate technology - mobility - gate stack

UNIT II PHYSICS OF MULTIGATE MOS SYSTEMS **9**

MOS Electrostatics - 1D - 2D MOS Electrostatics, MOSFET Current-Voltage Characteristics - CMOS Technology - Ultimate limits, double gate MOS system - gate voltage effect - semiconductor thickness effect - asymmetry effect - oxide thickness effect - electron tunnel current - two dimensional confinement, scattering - mobility

UNIT III NANOWIRE FETS AND TRANSISTORS AT THE MOLECULAR SCALE **9**

Silicon nanowire MOSFETs - Evaluvation of I-V characteristics - The I-V characteristics for non-degenerate carrier statistics - The I-V characteristics for degenerate carrier statistics - Carbon nanotube - Band structure of carbon nanotube - Band structure of graphene - Physical structure of nanotube - Band structure of nanotube - Carbon nanotube FETs - Carbon nanotube MOSFETs - Schottky barrier carbon nanotube FETs - Electronic conduction in molecules - General model for ballistic nano transistors - MOSFETs with 0D, 1D, and 2D channels - Molecular transistors - Single electron charging - Single electron transistors

UNIT IV RADIATION EFFECTS **9**

Radiation effects in SOI MOSFETs, total ionizing dose effects - single gate SOI - multigate devices, single event effect, scaling effects

UNIT V CIRCUIT DESIGN USING MULTIGATE DEVICES **9**

Digital circuits - impact of device performance on digital circuits - leakage performance trade off -multi VT devices and circuits - SRAM design, analog circuit design - transconductance - intrinsic gain - flicker noise - self heating -band gap voltage reference - operational amplifier - comparator designs, mixed signal - successive approximation DAC, RF circuits.

TOTAL : 45 PERIODS

OUTCOMES

- To design circuits using nano scaled MOS transistors with the physical insight of their functional characteristics

TEXT BOOKS:

1. J P Colinge, "FINFETs and other multi-gate transistors", Springer - Series on integrated circuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006

REFERENCES:

1. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Ed., Cambridge University Press, Cambridge UK, 2000

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19PVPX05 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator - Modified Bus Structures and Memory access in PDSPs - Multiple access memory - Multi-port memory - VLIW architecture- Pipelining - Special Addressing modes in P-DSPs - On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture - Assembly language syntax - Addressing modes - Assembly language Instructions - Pipeline structure, Operation - Block Diagram of DSP starter kit - Application Programs for processing real time signals.

UNIT III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction -DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools - Application Programs for processing real time signals.

UNIT IV ADSP PROCESSORS 9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions - Application programs -Filter design, FFT calculation.

UNIT V ADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio - Architecture of TMS320C6X - Architecture of Motorola DSP563XX - Comparison of the features of DSP family processors.

TOTAL: 45 PERIODS

OUTCOMES:

Students should be able to:

- Become Digital Signal Processor specialized engineer
- DSP based System Developer

TEXT BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing - Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012
2. B.Venkataramani and M.Bhaskar, "Digital Signal Processors - Architecture, Programming and Applications" - Tata McGraw - Hill Publishing Company Limited. New Delhi, 2003.

REFERENCES:

1. RulphChassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A John Wiley & Sons, Inc., Publication, 2005
2. User guides Texas Instrumentation, Analog Devices, Motorola.

E- RESOURCES

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19PVPX06 **NETWORKS ON CHIP** **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand the concept of network - on - chip
- Learn router architecture designs
- Study fault tolerance network - on - chip

UNIT I INTRODUCTION TO NOC **9**

Introduction to NoC - OSI layer rules in NoC - Interconnection Networks in Network-on-ChipNetwork Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service Support

UNIT II ARCHITECTURE DESIGN **9**

Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design - Adaptive Router Architecture Design.

UNIT III ROUTING ALGORITHM **9**

Packet routing-Qos, congestion control and flow control - router design - network link design -Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routing for 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and Adaptive Routing Algorithms

UNIT IV TEST AND FAULT TOLERANCE OF NOC **9**

Design-Security in Networks-on-Chips-Formal Verification of Communications in Networks-on Chips-Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on-Chips.

UNIT V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP **9**

Three-Dimensional Networks-on-Chips Architectures. - A Novel Dimensionally-Decomposed Router for On-Chip Communication in 3D Architectures - Resource Allocation for QoS On-Chip Communication - Networks-on-Chip Protocols-On-Chip Processor Traffic Modeling for Networks-on-Chip

TOTAL: 45 PERIODS

OUTCOMES: At the end of this course, the students should be able to:

- Compare different architecture design
- Discuss different routing algorithms
- Explain three dimensional networks - on-chip architectures

TEXT BOOKS:

1. ChrysostomosNicopoulos, Vijaykrishnan Narayanan, Chita R.Das" Networks-on - Chip " Architectures Holistic Design Exploration", Springer.
2. Fayezgebali, Haythamelmiligi, HqhahedWatheq E1-Kharashi "Networks-on-Chips theory and practice CRC press.

REFERENCES:

1. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-on-Chip Architectures" 2013
2. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-on-Chip" 2014
3. SantanuKundu, SantanuChattopadhyay "Network-on-Chip: The Next Generation of System on-Chip Integration",2014 CRC Press

E- RESOURCES

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2. https://swayam.gov.in

19PVPX07 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs.* circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations - L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossles models

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths - gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses - Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic ,SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eye diagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify sources affecting the speed of digital circuits.
- Able to improve the signal transmission characteristics.

TEXT BOOKS:

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003.
2. Eric Bogatin , Signal Integrity - Simplified , Prentice Hall PTR, 2003.

REFERENCES:

1. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
2. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.

E - RESOURCES

1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html
2. HSPICE from synopsis, www.synopsys.com/products/ mixedsignal/hspice/hspice.html
3. SPECCTRAQUEST from Cadence, http://www.specctraquest.com

19PVPX08 DIGITAL CONTROL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- The student learns the principles of PI,PD,PID controllers.
- The student analyses time and frequency response discrete time control system.
- The student is familiar with digital control algorithms.
- The student has the knowledge to implement PID control algorithms.

UNIT I CONTROLLERS IN FEEDBACK SYSTEMS 9

Review of frequency and time response analysis and specifications of first order and second order feedback control systems, need for controllers, continuous time compensations, continuous time PI, PD, PID controllers, digital PID controllers.

UNIT II BASIC DIGITAL SIGNAL PROCESSING IN CONTROL SYSTEMS 9

Sampling theorem, quantization, aliasing and quantization error, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

UNIT III MODELING OF SAMPLED DATA CONTROL SYSTEM 9

Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state space description, first companion, second companion, Jordan canonical models, discrete state variable models (elementary principles only).

UNIT IV DESIGN OF DIGITAL CONTROL ALGORITHMS 9

Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.

UNIT V PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS 9

Algorithm development of PID control algorithms, standard programmes for microcontroller implementation, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems, DSP implementation of motor control system.

TOTAL: 45 PERIODS

OUTCOMES:

- Describe continuous time and discrete time controllers analytically.
- Define and state basic analog to digital and digital to analog conversion principles.
- Analyze sampled data control system in time and frequency domains.
- Design simple PI, PD, PID continuous and digital controllers.
- Develop schemes for practical implementation of temperature and motor control systems.

TEXT BOOKS:

1. John J. D'Azzo, "Constantive Houpios, Linear Control System Analysis and Design", Mc Graw Hill,1995.

2. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.

REFERENCES:

1. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.

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19PVPX09 EMBEDDED SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES : The students should be made to:

- Learn design challenges and design methodologies
- Study general and single purpose processor
- Understand bus structures

UNIT I EMBEDDED SYSTEM OVERVIEW 9

Embedded System Overview, Design Challenges - Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Single-Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR 9

Basic Architecture, Pipelining, Superscalar and VLIW architectures, Programmer‟s view, Development Environment, Application-Specific Instruction-Set Processors (ASIPs) Microcontrollers, Timers, Counters and watchdog Timer, UART, LCD Controllers and Analog-to-Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES 9

Basic Protocol Concepts, Microprocessor Interfacing - I/O Addressing, Port and Bus-Based I/O, Arbitration, Serial Protocols, I^2C, CAN and USB, Parallel Protocols - PCI and ARM Bus, Wireless Protocols - IrDA, Bluetooth, IEEE 802.11.

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS 9

Basic State Machine Model, Finite-State Machine with Datapath Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, Dataflow Model, Real-time Systems, Automation: Synthesis, Verification : Hardware/Software Co-Simulation, Reuse: Intellectual Property Cores, Design Process Models.

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

Compilation Process - Libraries - Porting kernels - C extensions for embedded systems - emulation and debugging techniques - RTOS - System design using RTOS.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain different protocols
- Discuss state machine and design process models
- Outline embedded software development tools and RTOS

TEXT BOOKS:

1. Bruce Powel Douglas, "Real time UML, second edition: Developing efficient objects for embedded systems", 3rd Edition 1999, Pearson Education.
2. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.

REFERENCES:

1. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
2. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.

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19PVPX10	SOFT COMPUTING AND OPTIMIZATION TECHNIQUES	L T P C 3 0 0 3

OBJECTIVES:

- To learn various Soft computing frameworks.
- To familiarizes with the design of various neural networks.
- To understand the concept of fuzzy logic.
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in conventional optimization techniques.
- To understand the various evolutionary optimization techniques

UNIT I NEURAL NETWORKS 9

Machine Learning using Neural Network, Learning algorithms, Supervised learning Neural Networks-Feed Forward Networks, Radial Basis Function, Unsupervised Learning Neural Networks- Self Organizing map, Adaptive Resonance Architectures, Hopfield network

UNIT II FUZZY LOGIC 9

Fuzzy Sets- Operations on Fuzzy sets-Fuzzy Relations- Membership Functions-Fuzzy Rules and Fuzzy Reasoning-Fuzzy Inference Systems-Fuzzy Expert Systems-Fuzzy Decision Making

UNIT III NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems - Coactive Neuro-Fuzzy Modeling - Classification and Regression Trees - Data Clustering Algorithms - Rule base Structure Identification -Neuro-Fuzzy Control - Case Studies.

UNIT IV CONVENTIONAL OPTIMIZATION TECHNIQUES 9

Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradient-conjugate gradient, Newton's Method, Marquardt Method, Constrained optimization -sequential linear programming, Interior penalty function method, external penalty function method.

UNIT V EVOLUTIONARY OPTIMIZATION TECHNIQUES 9

Genetic algorithm - working principle, Basic operators and Terminologies, Building block hypothesis, Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.

TOTAL: 45 PERIODS

OUTCOMES: Upon Completion of the course, the students will be able to

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Able to use the optimization techniques to solve the real world problems

TEXT BOOKS:

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications,Prentice Hall,1995.

REFERENCES:

1. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Sof Computing, Prentice-Hall of India, 2003.

E - RESOURCES

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2. https://swayam.gov.in

19PVPX11 **RECONFIGURABLE ARCHITECTURES** **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand concept of reconfigurable systems
- Learn programmed FPGAs
- Study flexibility on routability

UNIT I INTRODUCTION **9**

Domain-specific processors, Application specific processors, Reconfigurable Computing Systems - Evolution of reconfigurable systems - Characteristics of RCS advantages and issues. Fundamental concepts & Design steps -classification of reconfigurable architecture-fine, coarse grain & hybrid architectures - Examples

UNIT II FPGA TECHNOLOGIES & ARCHITECTURE **9**

Technology trends- Programming technology- SRAM programmed FPGAs, antifuse programmed FPGAs, erasable programmable logic devices. Alternative FPGA architectures: Mux Vs LUT based logic blocks - CLB Vs LAB Vs Slices- Fast carry chains- Embedded RAMs- FPGA Vs ASIC design styles.

UNIT III ROUTING FOR FPGAS **9**

General Strategy for routing in FPGAs- routing for row-based FPGAs - segmented channel routing, definitions- Algorithm for I segment and K segment routing - Routing for symmetrical FPGAs, Flexibility of FPGA Routing Architectures: FPGA architectural flexibility on Routability- Effect of switch block flexibility on routability - Tradeoffs in flexibility of S and C blocks

UNIT IV HIGH LEVEL DESIGN **9**

FPGA Design style: Technology independent optimization- technology mapping- Placement. High-level synthesis of reconfigurable hardware, high- level languages, Design tools: Simulation (cycle based, event driven based) - Synthesis (logic/HDL vs physically aware) - timing analysis (static vs dynamic)- verification physical design tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS **9**

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

TOTAL: 45 PERIODS

OUTCOMES: At the end of this course, the students should be able to:

- Compare FPGA routing architectures
- Discuss FPGA applications
- Explain high level synthesis

TEXT BOOKS:

1. Christophe Bobda, "Introduction to Reconfigurable Computing –Architectures, Algorithms and Applications", Springer, 2010.
2. Clive "Max" Maxfield, "The Design Warrior"s Guide to FPGAs: Devices, Tools And Flows", Newnes, Elsevier, 2006.

REFERENCES:

1. Jorgen Staunstrup, Wayne Wlf, "Hardware/Software Co- Design: Priciples and practice", Kluwer Academic Pub, 1997.
2. Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.

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19PVPX12 ADVANCED MICROPROCESSOR AND ARCHITECTURES L T P C
3 0 0 3

OBJECTIVES:

- To study 80386 and pentium processor
- To understand CISC and RISC Architectures
- To Learn ARM processor

UNIT I 80386 AND PENTIUM PROCESSOR 9

80386 PROCESSOR: Basic programming model - Memory organization - Data types - Instruction set - Addressing mode - Address translation - Interrupts -PENTIUM PROCESSOR : Introduction to Pentium processor architecture - Special Pentium Registers - Pentium Memory Management - Introduction to Pentium pro processor - Pentium Pro Special Features.

UNIT II CISC and RISC ARCHITECTURE 9

Introduction to RISC architectures: RISC Versus CISC - RISC Case studies: MIPS R4000 - SPARC - Intel i860 - IBM RS/6000.

UNIT III ARM PROCESSOR 9

ARM Programmer‟s Model - Registers - Processor Modes - State of the processor - Condition Flags - ARM Pipelines - Exception Vector Table - ARM Processor Families - Typical 3 stage pipelined ARM organization-Introduction to ARM Memory Management Unit.

UNIT IV ARM ADDRESSING MODES AND INSTRUCTION SET 9

ARM Addressing Modes - ARM Instruction Set Overview - Thumb Instruction Set Overview -LPC210X ARM Processor Features.

UNIT V PIC MICROCONTROLLER AND MOTOROLA 68HC11 MICROCONTROLLER 9

Instruction set, addressing modes - operating modes- Interrupt system- RTC-Serial Communication Interface - A/D Converter PWM and UART. **MOTOROLA:** CPU Architecture - Instruction set - interrupts- Timers- I^2C Interfacing -UART- A/D Converter - PWM

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Discuss ARM addressing modes
- Outline ARM instruction set
- Explain PIC microcontroller and motorola 68HC11 microcontroller

TEXT BOOKS:

1. Andrew Sloss, "ARM System Developer"s Guide", Morgan Kaufmann Publishers, 2005
2. Barry B Brey, "The Intel Microprocessor, Pentium and Pentium Pro Processor, Architecture Programming and Interfacing", Prentice Hall of India, 2002.

REFERENCES :

1. Daniel Tabak, "Advanced Microprocessors", McGraw Hill Inc., 1995.
2. David E Simon "An Embedded Software Primer", Pearson Education, 2007

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SEMESTER III

19PVT301 ANALOG TO DIGITAL INTERFACES L T P C
3 0 0 3

OBJECTIVES

- To understand the importance of sampling the input analog signal for digitization and enabling circuit architectures
- To understand the principles of Analog to Digital and Digital to Analog conversion of signals.
- To understand the importance of calibration techniques for achieving precision during data conversion

UNIT I SAMPLE AND HOLD CIRCUITS 9

Sampling switches, Conventional open loop and closed loop sample and hold architecture, Open loop architecture with miller compensation, multiplexed input architectures, recycling architecture switched capacitor architecture.

UNIT II SWITCHED CAPACITOR CIRCUITS AND COMPARATORS 9

Switched-capacitor amplifiers, switched capacitor integrator, switched capacitor common mode feedback. Single stage amplifier as comparator, cascaded amplifier stages as comparator, latched comparators.

UNIT III DIGITAL TO ANALOG CONVERSION 9

Performance metrics, reference multiplication and division, switching and logic functions in DAC, Resistor ladder DAC architecture, current steering DAC architecture.

UNIT IV ANALOG TO DIGITAL CONVERSION 9

Performance metric, Flash architecture, Pipelined Architecture, Successive approximation architecture, Time interleaved architecture.

UNIT V PRECISION TECHNIQUES 9

Comparator offset cancellation, Op Amp offset cancellation, Calibration techniques, range overlap and digital correction.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design Analog to Digital and Digital to Analog data converters based on data precision requirements

TEXT BOOKS:

1. Behzad Razavi, "Principles of data conversion system design", S. Chand and company Ltd, 2000.

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19PVPX13 SELECTED TOPICS IN ASIC DESIGN L T P C
3 0 0 3

OBJECTIVES:

- The course focuses on the semi-custom IC Design and introduces the principles of design logic cells, I/O cells and interconnect architecture, with equal importance given to FPGA and ASIC styles.
- The entire FPGA and ASIC design flow is dealt with from the circuit and layout design point of view.

UNIT I INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN 9

Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort.

UNIT II PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS 9

Anti-fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA –Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III PROGRAMMABLE ASIC ARCHITECUTRE 9

Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze / Nios based embedded systems – Signal probing techniques.

UNIT IV LOGIC SYNTHESIS, PLACEMENT AND ROUTING 9

Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.

UNIT V HIGH PERFORMANCE ALGORITHMS FOR ASICS/ SOCS. SOC CASE STUDIES 9

DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.

TOTAL: 45 PERIODS

OUTCOMES:

After completing this course:

- The student would have gained knowledge in the circuit design aspects at the next transistor and block level abstractions of FPGA and ASIC design. In combination with the course on CAD for VLSI, the student would have gained sufficient theoretical knowledge for carrying out FPGA and ASIC designs.

TEXT BOOKS:

1. Douglas J. Smith, HDL Chip Design, Madison, AL, USA: Doone Publications, 1996.
2. Jose E. France, YannisTsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.

REFERENCES :

1. M.J.S.Smith, " Application - Specific Integrated Circuits", Pearson,2003.
2. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing ", McGraw Hill, 1994.

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19PVPX14 DESIGN AND ANALYSIS OF COMPUTER ALGORITHMS L T P C
3 0 0 3

OBJECTIVES:

- To discuss the algorithmic complexity parameters and the basic algorithmic design techniques.
- To discuss the graph algorithms, algorithms for NP Completeness Approximation Algorithms and NP Hard Problems.

UNIT I INTRODUCTION 9

Polynomial and Exponential algorithms, big "oh" and small "oh" notation, exact algorithms and heuristics, direct / indirect / deterministic algorithms, static and dynamic complexity, stepwise refinement.

UNIT II DESIGN TECHNIQUES 9

Subgoals method, working backwards, work tracking, branch and bound algorithms for traveling salesman problem and knapsack problem, hill climbing techniques, divide and conquer method, dynamic programming, greedy methods.

UNIT III SEARCHING AND SORTING 9

Sequential search, binary search, block search, Fibonacci search, bubble sort, bucket sorting, quick sort, heap sort, average case and worst case behavior

UNIT IV GRAPH ALGORITHMS 9

Minimum spanning, tree, shortest path algorithms, R-connected graphs, Even's and Kleitman's algorithms, max-flow min cut theorem, Steiglitz's link deficit algorithm.

UNIT V SELECTED TOPICS 9

NP Completeness Approximation Algorithms, NP Hard Problems, Strasseu's Matrix Multiplication Algorithms, Magic Squares, Introduction To Parallel Algorithms and Genetic Algorithms, Monte-Carlo Methods, Amortised Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- Will be able to apply the suitable algorithm according to the given optimization problem.
- Ability to modify the algorithms to refine the complexity parameters.

TEXT BOOKS:

1.D.E.Goldberg, "Genetic Algorithms : Search Optimization and Machine Learning", Addison Wesley, 1989.
2.E.Horowitz and S.Sahni, "Fundamentals of Computer Algorithms", Galgotia Publications, 1988.

REFERENCES :

1.Sara Baase, "Computer Algorithms : Introduction to Design and Analysis", Addison Wesley, 1988.
2.T.H.Cormen, C.E.Leiserson and R.L.Rivest, "Introduction to Algorithms", Mc Graw Hill, 1994.

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19PVPX15 DEVICE MODELING – II L T P C
3 0 0 3

OBJECTIVES:

- To understand device physics and device modelling aspects
- To study simulators to characterize the device models

UNIT I MOSFET DEVICE PHYSICS 9

MOSFET Basic operation, Level 1, Level 2, Level 3 models, Noise sources in MOSFET, Flicker noise modeling, Thermal noise modelling, Influence of process variation, modeling of device mismatch for Analog/RF Applications.

UNIT II DEVICE MODELLING 9

Prime importance of circuit and device simulations in VLSI; Nodal, mesh, modified nodal and hybrid analysis equations. **Solution of network equations:** Sparse matrix techniques, solution of nonlinear networks through Newton-Raphson technique, convergence and stability.

UNIT III MULTISTEP METHODS 9

Solution of stiff systems of equations, adaptation of multistep methods to the solution of electrical networks, general purpose circuit simulators.

UNIT IV MATHEMATICAL TECHNIQUES FOR DEVICE SIMULATIONS 9

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

UNIT V SIMULATION OF DEVICES 9

Computation of characteristics of simple devices like p-n junction, MOS capacitor and MOSFET; Small-signal analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- To design and model MOSFET devices, taking into consideration process dependant parameters
- To utilize device level simulators

TEXT BOOKS:

1.Arora, N., "MOSFET Models for VLSI Circuit Simulation", Springer-Verlag, 1993
2.Chua, L.O. and Lin, P.M., "Computer-Aided Analysis of Electronic Circuits: Algorithms and Computational Techniques", Prentice-Hall., 1975

REFERENCES:

1.Fjeldly, T., Yetterdal, T. and Shur, M., "Introduction to Device Modeling and Circuit Simulation", Wiley-Interscience., 1997
2.Grasser, T., "Advanced Device Modeling and Simulation", World Scientific Publishing Company., 2003

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19PVPX16 DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand fundamentals of digital images
- Learn different image transforms
- Study concept of segmentation

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images. Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morphological processing, extension to gray scale morphology.

UNIT II IMAGE TRANSFORMS 9

1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform.

UNIT III SEGMENTATION OF GRAY LEVEL IMAGES 9

Histogram of gray level images, multilevel thresholding, Optimal thresholding using Bayesian classification, Watershed and Dam Construction algorithms for segmenting gray level image. Detection of edges and lines: First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

UNIT IV IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING 9

Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration. Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing.

UNIT V IMAGE COMPRESSION 9

Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Discuss image enhancement techniques
- Explain color image processing
- Compare image compression schemes

TEXT BOOKS:

1. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice-Hall, Addison-Wesley, 1989.
2. Bovik (ed.), "Handbook of Image and Video Processing", Academic Press, 2000.

REFERENCES :

1. B. Jähne, "Practical Handbook on Image Processing for Scientific Applications", CRC Press,1997.
2. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.

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19PVPX17 **MEMS AND NEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of quantum mechanics and nano systems.

UNIT I OVERVIEW **9**

New trends in Engineering and Science: Micro and Nanoscale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES **9**

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

UNIT IV MICRO ACTUATORS **9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS **9**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the student should be able to:

- Discuss micro sensors
- Explain micro actuators
- Outline nanosystems and Quantum mechanics

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.
2. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.

REFERENCES :

1.Stephen D. Senturia," Micro system Design", Kluwer Academic Publishers,2001
2.Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002.

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19PVPX18 SCRIPTING LANGUAGES FOR VLSI L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Study scripting languages
- Understand security issues
- Learn concept of TCL phenomena

UNIT I INTRODUCTION TO SCRIPTING AND PERL 9

Characteristics of scripting languages, Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, Working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments.

UNIT II ADVANCED PERL 9

Finer points of Looping, Subroutines, Using Pack and Unpack, Working with files, Navigating the file system, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, Tied variables, Interfacing to the operating systems, Security issues.

UNIT III TCL 9

The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.

UNIT IV ADVANCED TCL 9

The eval, source, exec and up-level commands, Libraries and packages, Namespaces, Trapping errors, Event-driven programs, Making applications 'Internet-aware', 'Nuts-and-bolts' internet programming, Security issues, running un trusted code, The C interface.

UNIT V TK AND JAVA SCRIPT 9

Visual tool kits, Fundamental concepts of TK, TK by example, Events and bindings, Geometry managers, PERL-TK. JavaScript – Object models, Design Philosophy, Versions of JavaScript, The Java Script core language, Basic concepts of Python. Object Oriented Programming Concepts (Qualitative Concepts Only): Objects, Classes, Encapsulation, Data Hierarchy.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain advanced TCL
- Discuss TK and Java script

TEXT BOOKS:

1. Brent Welch,"Practical Programming in Tcl and Tk",Fourth Edition, 2003.
2. David Barron, "The World of Scripting Languages", Wiley Publications, 2000.

REFERENCES :

1.Guido van Rossum, and Fred L. Drake ", Python Tutorial, Jr., editor, Release 2.6.4
2.Randal L. Schwartz, "Learning PERL", Sixth Edition, O"Reilly.

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19PVPX19 HARDWARE - SOFTWARE CO-DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To acquire the knowledge about system specification and modelling.
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation.

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Single-Processor Architectures with one ASIC and many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II HARDWARE / SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization, HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms.

UNIT III HARDWARE / SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co- Synthesis Algorithm for Distributed System- Case Studies with any one application.

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments, Future Developments in Emulation and Prototyping ,Target Architecture-Architecture Specialization Techniques, System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems, Mixed Systems and Less Specialized Systems.

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification, Languages for System-Level Specification and Design System-Level Specification, Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL: 45 PERIODS

OUTCOMES:

- To assess prototyping and emulation techniques
- To compare hardware / software co-synthesis.
- To formulate the design specification and validate its functionality by simulation

TEXT BOOKS:

1.Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design" Kaufmann Publishers,2001.
2.Jorgen Staunstrup, Wayne Wolf ,"Hardware/Software Co-Design: Principles and Practice", Kluwer Academic Pub,1997.

REFERENCES :

1.Ralf Niemann, "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.

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19PVPX20 SELECTED TOPICS IN IC DESIGN L T P C
3 0 0 3

OBJECTIVES:

- This course deals with the supply circuit modules which are crucial modules in an IC design. Clock generation circuits play a major role in High Speed Broad Band Communication circuits, High Speed I/O"s, Memory modules and Data Conversion Circuits.
- This course focuses on the design aspect of Clock Generation circuits and their design constraints.

UNIT I VOLTAGE AND CURRENT REFERENCES 9

Current Mirrors, Self Biased Current Reference, startup circuits, VBE based Current Reference, VT Based Current Reference, Band Gap Reference , Supply Independent Biasing, Temperature Independent Biasing, PTAT Current Generation, Constant Gm Biasing

UNIT II LOW DROP OUT REGULATORS 9

Analog Building Blocks, Negative Feedback, AC Design, Noise and Noise Reduction Techniques, Stability, LDO Efficiency, LDO Current Source, LDO Current Source Using Opamp.

UNIT III OSCILLATOR FUNDAMENTALS 9

General considerations, Ring oscillators, LC oscillators, Colpitts Oscillator, Jitter and Phase noise in Ring Oscillators, Impulse Sensitivity Function for Ring Oscillators, Phase Noise in Differential LC Oscillators.

UNIT IV PHASE LOCK LOOPS 9

PLL Fundamental, PLL stability, Noise Performance, Charge-Pump PLL Topology, CPPLL Building blocks, Jitter and Phase Noise performance.

UNIT V CLOCK AND DATA RECOVERY 9

CDR Architectures, Tias and Limiters, CMOS Interface, Linear Half Rate CMOS CDR Circuits, Wide capture Range CDR Circuits.

TOTAL: 45 PERIODS

OUTCOMES:

This course provides the essential know how to a designer to construct Supply reference circuits and Clock Generation Circuits for given design specifications and aids the designer to understand the design specifications related to Supply and Clock Generation Circuits.

TEXT BOOKS:

1.BehzadRazavi, "Design of Integrated circuits for Optical Communications", McGraw Hill, 2003.
2.Floyd M. Gardner ,"Phase LocK Techniques" John wiley& Sons, Inc 2005.

REFERENCES :

1.Gabriel.A. Rincon-Mora, "Voltage references from diode to precision Higher order band gap circuits",Johnwiley& Sons, Inc 2002.
2.High Speed Clock and Data Recovery, High-performance Amplifiers Power Management "springer, 2008.

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