# M.TECH CSE

[Syllabus]

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
BIT Mesra, Ranchi-835215

## Program Educational Objectives (PEO)

(a) Students are trained in such a way that makes them capable of exploiting and enhancing theoretical and practical knowledge in various domains of Computer Science.
(b) Students are imparted with strong base of knowledge that makes them suitable both for industry teaching and research.
(c) Students are trained to develop practical and efficient solutions to the challenges in the growing field of software industry so as to gain leadership positions in their organization and/or teams.
(d) Students are inculcated with the sensitivity towards ethics, public policies and their responsibilities towards the society so as to gain trust and respect of others as ethical team members.

## Program Outcomes (PO)

(a) In depth understanding of fundamental principles and concepts of various domains of Computer Science.

(b) Ability for analytical and critical thinking in order to analyse, design and improve existing tools and techniques.

(c) Ability to carry on independent research to solve practical problems and have a promising career in academics as well as industry.

(d) An ability to communicate effectively so as to write and present a substantial technical report/document.

(e) Knowledge of contemporary issues in the field of Computer Science and ability to engage in lifelong learning.

(f) Ability to work in teams, and aware of social needs , professional code of conduct, ethics and behavior.

## Semester I

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS1001 Database Modelling & Design
**Designation**: Required
**Pre-requisites**: UG level concepts of Database management systems
**Contact Hours/Type**: 40 lectures (50mins each)/Lecture
**Course Assessment methods**: Quizzes (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes**: After the completion of this course, students will able to:

a. Explain data entities, attributes and relationships using data models for depicting logical database designs.

b. Apply data modeling and mapping considerations to the collected data to represent management needs

c. Evaluate the database accessing strategies for design of efficient physical databases using concepts of indexing, normalization and de-normalization.

d. Assess design decisions to categorize and suggest solutions for distributed and federated databases.

e. Formulate methods for advanced concepts of data warehousing and OLAP applications for complex real world database design.

**Topics Covered**:

**Module 1**

**Introduction ER Model**: Fundamental ER constructs, Advanced ER constructs, Object Oriented Data Modelling.

**Module 2**

**ER Modelling in Logical Database Design**: Introduction, Requirements analysis and ER Modelling, View Integration, Entity clustering, Relational database concepts, Overview of SQL.

**Transformation of the ER Model to SQL**: Transformation Rules & SQL constructs Transformation steps.

**Module 3**

**Normalization**: Fundamentals of Normalization, Design of Normalised Tables, Normalization of Candidate Tables derived from ER diagram, Determining the minimum set of 3NF tables, Fourth & Fifth normal forms.

**Module 4**

**Access Methods**: Sequential Access Methods, Random Access Methods, Secondary Indexes, Denormalization, Join Strategies.

**Example of Relational DB design**: Requirements specification, Logical Design, Physical Design.

**Module 5**

**Distributed Data Allocation**: Introduction, Distributed & Multi database Design, General Data Allocation problem, Data allocation strategies.

**Module 6**

**Data Warehousing, OLAP and Data Mining**: Overview of Data warehousing, Logical Design, Physical Design, OLAP, Data Mining.

**Module 7**

**Advanced Database Technology**: Architecture for advanced technology, Object-oriented & Object – Relational Database, Spatial and Geographic Databases, Multimedia Databases, Temporal Databases, Text Databases, Active Databases, Real – Time Databases.

**Text Book:**

- T.J.Teorey - Database Modeling & Design, 3rd edition, Harcourt Asia Pte. Ltd., New Delhi, 2002

**Reference Books:**

- A.Silberchatz et.al. – Database System Concepts 3rd Edn. McGraw Hill Inc., 1997.
- R.Elmasri et.al. – Fundamentals of Database Systems, Addison Wesley, Indian Reprint,New Delhi, 2000.
- R.Rama Krishnan – Database Management Systems, McGraw Hill International Edn., New York, 1998.

**Department:** Computer Science and Engineering
**Course code and Title:** TCS1002Database Modelling and Design Lab
**Designation**: Required
**Pre-requisite(s):** UG level concepts of Database management systems
**Credits:** 2
**Contact Hours/Type**: Min 30 Hrs (three hrs per week)/Lab
**Course Assessment methods:** Mid Sem (Day to Day Evaluation): 60 Marks, End Sem (Performance test and Viva):40 Marks
**Course Outcomes :** After the completion of this course, students will able to:

a) Identify data elements and constraints for designing logical database representations Able to and be able to model databases using ER Modelling.
b) Classify data values into relations and apply constraints for physical database design along with constraints to ensure their integrity.
c) Solve queries in the Structured query language (SQL) to infer and retrieve information from the stored databases.
d) Evaluate and choose among different querying strategies like stored procedures to analyze efficiency in data retrieval.
e) Create cursors and triggers to effectively manipulate and manage database retrieval and updates and to implement exception handling in data bases.

**Department**: Applied Mathematics
**Course Code & Title**: MSE 1005 Probability and Statistical Analysis.
**Designation**: Required
**Pre-requisites**: Knowledge of sets, algebra, calculus.
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50mins each)/Lecture
**Course Assessment methods**: Quizzes (3) :30 Marks, Assignment test:10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will able to:

a) Explain the fundamentals of probability as a science which helps in taking decisions amidst uncertainty.
b) Describe the basic theorems in probability and their real life applications.
c) Explain the concept of random variables and probability models (distribution) and their use in characterising events.
d) Explain the concept of testing of a statistical hypothesis with real life applications.
e) Explain the concept and real life applications of stochastic processes.

**Topics Covered:**

**Module 1**

**Probability Theory:** Random Experiment Mathematical or Apriori Definition of Probability, Statistical or Aposteriori Definition of Probability, Axiomatic Definition of Probability, Conditional Probability Independent Events, Theorem of Total Probability, Baye's Theorem or Theorem of Probability of Causes, Bernoulli's Trails De Moivre-Laplace Approximation, Generalisation of Bernoulli's Theorem Multinomial Distribution.

**Module 2**

**Random Variables:** Discrete Random Variable, Probability Function, Continuous Random Variable, Probability Density Function Cumulative Distribution Function, (cdf), Properties of the cdf F (x), Special Distributions, Discrete Distributions, Continuous Distributions, Two-Dimensional Random Variables, Probability Function of (x ,y),Joint Probability Density Function, Cumulative Distribution Function,Properties of F (x, y), Marginal Probability Distribution, Conditional Probability Distribution, Independent RVs, Random Vectors, Marginal Probability Distribution of X {i, pi*}, Marginal Probability Distribution of Y: {j, P*j}.

**Module 3**

**Functions of Random Variables:** Function of One Random Variable, One Function of Two Random Variables,Two Functions of Two Random Variables, Statistical Averages Expected Values of a Two-Dimensional RV, Properties of Expected Values, Covariance and Correlation, Properties, Conditional Expected Values, Characteristic functions, Properties of MGF, Properties of Characteristic Function ,Comulant Generating Function (CGF), Joint Characteristic Function (`CGF).

**Module 4**

**Special Probability Distributions:** Introduction, Special Discrete Distributions - Binomial, Poission, Geometric and Hyper geometric Distributions and their Properties (mean, Variance etc) Special Continuos Distributions- Uniform, Exponential, Erlang and Normal Distributions as There Properties.

**Module 5**

**Tests of Hypotheses:** Parameters and Statistics, Sampling Distribution, Estimation and Testing of Hypotheses, Tests of significance, errors, Tailed Tests, critical values, Student's T- Distribution, Snedecor's F- Distribution and Chi- square Distribution and Their uses and Properties.

**Module 6**

**Random Processes:** Classification of Random Processes, Methods of Description of a Random Process, Special Classes of Random Processes, A verge Values of Random Processes, Stationarily, Example of a SSS Process, Analytical Representation of a Random Process, Autocorrelation Function and Its Properties of R (t),

**Module 7**

**Special Random Processes:**Definition of Gaussian Process, Properties, Processes Depending on Stationary Gaussian Process, Poisson Process, Probability Law for the poison Process {X (t)}, Second – Order Probability Function of a Homogeneous, Poisson Process, Mean and Autocorrelation of the Poisson Process, Properties of Poisson Process,Markov Process, Definition of a Markov Chain, Chapman – Kolmogorov Theorem, Classification of States of a Markov Chain

**Reliability Engineering:** Concepts of Reliability, Reliability of Systems, Maintainability and Availability.

**Content- Beyond- Syllabus:** NA

**Text Books and/or Reference Materials:**

**Text Book:**

- T. Veerarajan – Probability, Statistical, Random Processes 2nd Ed., TMH, New Delhi, 2003.

**Reference Book(S):**

- A. Papoulis & S.V. Pillai – Probability, random Variables and Stochastic Processes, 4th Ed., TMH, New Delhi.
- S.M. Ross- Probability Models, 6th Ed. Harcourt Asia Pte Ltd, New Delhi, 2000.
- R.V. Hogg and A.T. Craig- Introduction to Mathematical Statistics, 5th Ed, Pearson Education, New Delhi, 2004
- J.E. Freund and R.E. Walpole, Mathematical 5th Ed., PHI, New Delhi, 2000.

**Department**: Computer Science and Engineering

**Course Code & Title**: MSE1023 Computability and Complexity Theory

**Pre-requisites**: Concept on Automata Theory
**Designation**: Elective

**Credits**: 3

**Contact Hours/Type**: 40 lectures (50mins each)/Lecture
**Course Assessment methods**: Quizzes(3) :30 Marks, Assignment test:10 marks, End sem:60 Marks
**Course outcomes:** After the completion of this course, students will be able to:

a) Relate formal languages and mathematical models of computation .
b) Attain knowledge about different types of languages based on Halting status of Turing machine .
c) Understand the limitations on what computers can do, and learn examples of unsolvable problems
d) Analyse P, NP, NP-C, NP-Hard, Tractable and Intractable problems.
e) Learn to reduce a new problem to a previously solvable or unsolvable problem .

**Topics covered**

**Module-I**

Basic background on automata and languages, Types of automata and languages, Turing machines, k-tape Turing machines, non-deterministic Turing machines, Universal Turing machine, Halting problem

**Module-II**

Recursive enumerable languages, Recursive languages, Decidable and recognizable language, Turing-decidable languages, Turing-recognizable languages, Context Sensitive Language and Chomosky Hierarchy.

**Module-III+IV**

Primitive recursive function, partial recursive function, Recursive and recursive enumeration sets, Programming systems, Unsolvable problems, a non-recursive language and an unsolvable problem, Reducing one problem to another problem, Rice Theorem, More unsolvable problems, PCP

**Module-V**

Measuring complexity- Big Oh, small oh and other notations, Analyzing algorithms, Time and space complexity of a Turing machine, Complexity analysis of multi-tape TM

**Module-VI**

Complexity classes: P, NP, NP-C, NP-Hard problem, Additional NP-complete problems- clique, vertex cover, Hamiltonian cycle, coloring problem, graph isomorphism, Reduction from NP-C problem to another problem,

**Module-VII**

Tractable and Intractable problems

**Recommended Books**

1. Lewis H.R., Papadimitriou C.H.- Elements of the Theory of Computation:, PHI Publ. , 2nd edition, New Delhi

2. John Martin. Introduction to Languages and the Theory of Computation, 3rd ed. McGraw Hill, New York, NY, 2003.

**Department**: Computer Science and Engineering

**Course Code & Title**: TCS1025Advanced Operating System Concepts

**Pre-requisites:** Operating System, Data Structure and Algorithms

**Designation**: Required

**Credits**: 4

**Contact Hours/Type**: 40 lectures (50mins each)/Lecture

**Course Assessment methods**: Quizzes(3) :30 Marks, Assignment test:10 marks, End sem:60 Marks.

**Course Outcome**: After the completion of this course, students will be able:

a) To identify the concepts and mechanisms which form the basis of the design of advanced operating systems.
b) To associate the various alternative approaches to the solutions of the problems encountered in the design of advanced operating systems.
c) To apply the concepts and issues underlying the design of distributed systems.
d) To select appropriate approach while designing advanced operating system.
e) Able to design and analyze algorithms for distributed environment.

**Topics Covered:**

**Module 1**

Overview, Functions of an Operating System, Design Approaches, Types of Advanced Operating Systems. Synchronization Mechanisms, Concept of a Process, Concurrent Processes, Critical Section Problem, Other Critical Section Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Algorithms.

**Module 2**

Process Deadlocks, Models of Deadlock, Models of Resources,A graph theoretic model of a System State, Necessary and Sufficient conditions for a Deadlock, Systems with Single unit requests, Systems with only consumable resources, Systems with reusable resources.

**Module 3**

Distributed Operating Systems, Introduction, System ArcitectureTypes, Issues in Distributed Operating Systems, Communication Networks, Communication Primitives, Theoretical Foundations, Limitations of a distributed system, Lamport's logical clocks, Vector Clocks, Causal ordering of messages, Global state, Cuts of a distributed Computation, Termination detection.

**Module 4**

Distributed Mutual Exclusion, Classification of Mutual ExclusionAlgorithms, Preliminaries, Non token based algorithms, Lamport's algorithm, Token based algorithms, Suzuki Kasami's Broadcast algorithm, Singhal's heuristic algorithm, Raymond's tree based algorithm, Comparative performance analysis.

**Module 5**

Distributed Deadlock Detection, Preliminaries, Deadlock handling strategies, Issues with deadlock detection and resolution, Control organizations, Centralized, distributed and hierarchical algorithms, Agreement Protocols System models, A classification of agreement problems, Byzantine Agreement problem and its solution, Application of agreement algorithms.

**Module 6**

Distributed File Systems Mechanisms for building distributed file systems, Design issues, Distributed Shared Memory, Architecture, Algorithms for Implementing DSM, Memory Coherence and Coherence Protocols, Design Issues, Distributed Scheduling, Failure Recovery and Fault Tolerance, Resource Security and Protection, Access and Flow Control,

**Module 7**

Multiprocessor Operating Systems, Introduction, Basic Architecture, Interconnection networks for multi processor O/S, Caching, Hypercube Architectures, Structure of multi processor O/S, Threads, Process Synchronization, Processor Scheduling, Memory Management, Reliability and Fault tolerance

**Text Book:**

M. Singhal, N. Shivaratri, Advanced Concepts in Operating Systems, Tata McGraw- Hill, 2008.

**Refernce Books:**

W. Stallings, Operating Systems - Internals and Design Principles, Prentice Hall, 2008.
W. Stallings, Operating Systems, Macmillian Publishing, 2008.

**Department**: Computer Science and Engineering
**Course code and Title:** TCS1026Advanced Operating System Concepts Laboratory.
**Designation**: Required
**Pre-requisite(s):** Operating Systems, Programming in C/C++/JAVA. MPI and OpenMP Programming.
**Credits: 2**
**Contact Hours/Type**: Min 30 Hrs (three hrs per week)/Lab
**Course Assessment methods:** Mid Sem (Day to Day Evaluation): 60 Marks, End Sem (Performance test and Viva):40 Marks
**Course Outcomes :**

After the completion of this course, students will be :

a) Able to apply process synchronization techniques within uniprocessor/ Multiprocessor environment
b) Able to simulate deadlock prevention, avoidance and detection techniques.
c) Able to write programs used for recording the order of events occurring at different sites in the multiprocessor environment.
d) Able to write programs for Global state recording in distributed environment.
e) Able to simulate Token/Non-token based mutual exclusion algorithms in distributed environment.

**Department**: Computer Science and Engineering
**Course Code & Title**: TIS1019 Cryptography and Network Security
**Designation**: Breadth
**Credits**:3
**Pre-requisites**: UG level concepts of Computer Networking
**Contact Hours/Type**: 40 lectures (50mins each)/Elective
**Course Assessment methods**: Quizzes(3) :30 Marks, Assignment test:10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will be

a) Understanding the basic concept of Cryptography and Network Security & their mathematical models, and get familiar with different types of threats.
b) Learning and applying various ciphering techniques.
c) Apply Symmetric and Asymmetric cryptographic algorithms and standards in networks.
d) Familiarisation with network security designs using available secure solutions (such as PGP, SSL, IPSec, etc)
e) Examine the issues and structure of Authentication Service and Electronic Mail Security, and provide familiarity in Intrusion detection and Firewall Design Principles.

**Topics Covered:**

**Module I**

**Introduction to the Concept of Security:** Introduction, The Need of Security, Security Approaches, Principal of Security, Types of Attacks

**Module II**

**Cryptographic Techniques:** Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key Range and Key Size, Possible Types of Attacks

**ModuleIII**

**Computer-based Symmetric Key Cryptographic Algorithms:** Introduction, Algorithm Types and Models, An Overview of Symmetric Key Cryptography, Data Encryption Standard(DES), International Data Encryption Algorithm(IDEA), RC5, Blowfish, Advanced Encryption Standard(AES), Differential and Linear Cryptanalysis

**Module IV**

**Computer-based Asymmetric Key Cryptographic Algorithms:** Introduction, Brief History of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm, Some Other Algorithms

**Module V**

**Public Key Infrastructure (PKI):** Introduction, Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography standard(PKCS), XML, PKI and Security

**Module VI**

**Internet Security Protocols :** Basic Concepts, Security Socket Layer(SSL), Secure Hyper Text Transfer Protocol(SHTTP), Time stamping Protocol(TSP), Secure Electronic

Transaction(SET),SSL Versus SET, 3-D Secure Protocol, Electronic Money , Email Security, Wireless Application Protocol(WAP) Security, Security in GSM.

**Module VII**

**Network Security:** Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks (VPN)

**Text Book:**

AtulKahate – Cryptography and Network Security , 2nd Edition Tata McGraw Hill Publication, New Delhi-2006

**Reference Book:**

- Behrouz A. Forouzan and D. Mukhopadhyay- Cryptography & Network Security, 2nd Edition - 1st reprint 2010, McGraw Hill, New Delhi.
- Wade Trapple, Lawrence C. Washington- Introduction to Cryptography with coding Theory, 2nd Edition Pearson Education .

## Semester II

**Department**: Computer Science and Engineering
**Course Code & Title**: MSE1003Object Oriented Modelling and Design
**Designation**: Required
**Credits**:3
**Pre-requisites**: Object Oriented Programming skills
**Contact Hours / Type**: 40 lectures (50mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test:10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will be

a) Explain Object Modelling concepts.
b) Develop object-based models for Systems using UML.
c) Analyse and model software specifications.
d) Evaluate design decisions to provide solutions to real world software design problems.
e) Inculcate necessary skills to handle complexity in software design and apply efficient coding standards.

**Topics Covered:**

**Module 1**

**Introduction and Modelling:** What Is Object-Oriented ?What Is Object Oriented Development ? Object Oriented Themes, Evidence for Usefulness of Object Oriented Development, Modeling, The Object Modeling Technique, Objects and Classes, Links and Associations, Advanced Link and Association Concepts, Generalization and Inheritance, Grouping Constructs, A Sample Object Model.

**Module 2**

**Advanced Object Modelling:** Aggregation , Abstract Classes, Generalization as Extension and Restriction Multiple Inheritance, Metadata, Candidate Keys, Constraints.

**Module 3**

**Dynamic Modelling:** Events and States, Operations, Nested State Diagrams, Concurrency, Advanced Dynamic Modelling Concepts, A Sample Dynamic Model, Relation of Object and Dynamic Model.

**Module 4**

**Functional Modelling:** Functional Models, Data Flow Diagrams, Specifying Operations. Constraints A Sample Functional Model, Relation of Functional to Object and Dynamic Models.

**Module 5**

**Methodology Preview and Analysis:**OMT as a Software Engineering Methodology, The OMT Methodology, Impact of an Object-Oriented Approach, Overview of Analysis, Problem Statement, Automated Teller Machine Example, Object Modeling, Dynamic Modeling, Functional Modeling, Adding Operations, Iterating the Analysis.

**Module 6**

**System Design:** Overview of System Design, Breaking a System into Subsystems, Identifying Concurrency.Allocating Subsystems to Processor and Tasks Management of Data Stores, Handling Global Resources, Choosing Software Control Implementation, Handling Boundary conditions, Setting Trade-off Priorities, Common Architectural Frameworks, Architecture of the ATM System

**Module 7**

**Object Design and Implementation:** Overview of Object Design, Combining the Three Models, Designing, Algorithms, Design Optimization, Implementation of Control, Adjustment of Inheritance, Design of Associations, Object Representation, Physical Packaging, Documenting Design Decisions. Implementation Using a Programming Language, Implementation using a Database System, Implementation Outside a Computer. Object-Oriented Style, Reusability, Extensibility, Robustness, Programming – in-the-Large.

**Text Book:**

- J.Rumbaugh et.al – Object Oriented Modeling and Design, PHI, New Delhi, 2003

**Reference Book:**

- B. Bruegge and A. H. Dutoit. Object Oriented Software Engineering, 2nd Ed., Pearson Education, New Delhi, 2004.
- Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides :Design Patterns: Elements of Reusable Object-Oriented Software with Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process , Addison Wesley, 2003.
- UML for java Programmers by Robert Ceil Martin, Prentice Hall

**Department**: Computer Science and Engineering
**Course Code & Title**: MSE1004Object Oriented Modelling and Design Lab
**Designation**: Required
**Credits**:2
**Pre-requisites**: Object Oriented Programming skills
**Contact Hours/Type**: Min 30 Hrs (three hrs per week)/Lab
**Course Assessment methods:** Mid Sem (Day to Day Evaluation): 60 Marks, End Sem(Performance test and Viva):40 Marks
**Course Outcomes:** After the completion of this course, students will be

a) To prepare an IEEE-SRS from the given case study and draw use case diagrams, DFD and also prepare use case description document.
b) To create a complete UML class diagram for the given case study and apply iterative process to refine the class diagram if there is a change in requirements.
c) To create sequence, collaboration and state chart diagrams to analyze the dynamic behaviour of the system.
d) To create activity diagram, component and deployment diagram to analyze the environmental and deployment view of the system.
e) To model and design various real world systems using UML diagrams .

**Topics Covered:** SRS preparation, DFDs, All UML diagrams, Forward and Reverse Engg.(using Rational rose).

**Text Books:**

- Jason T .Roff,UML :A begineer's guide,TMH,N.Delhi,Ed:2012
- M.Blaha,James Rumbaugh,Object Oriented Modeling and Design Using UML,PHI,New Delhi,Ed:2nd,2006.

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS 2001 Data and Computer Communication Networks
**Designation**: Required
**Credit**s: 3
**Pre-requisites**: Fundamentals of Data Communication
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test:10 marks, End sem:60 Marks.
**Course Outcomes**: After the completion of this course, students will be able to

a. Visualize basic network topologies and their core components..
b. Understand the physical aspects of communication technology that allow data transfer to take place.
c. Eexplain the detailed knowledge of various protocols deployed at different levels of a network.
d. Mathematically analyze and compare competing protocols..
e. Identify, understand and design some core application domains and security models in the field of computer networks.

**Topics Covered**:

**Module 1**

**Data Communication:** Data Communications, Data Networking and Internet, Protocol Architecture, TCP/IP and Internet based Applications, Data Transmission, Data and Signals- periodic analog, Digital signals, Transmission Impairments, Data Rate Limits, Performance.

**Module 2**

**Transmission Methodologies:** Digital Transmission- Digital to digital Conversion, Analog to digital conversion, Transmission Modes. Analog Transmission- Digital to Analog conversion, Analog to Analog conversion. Bandwidth utilization- Multiplexing, Spread Spectrum

**Module 3**

**Data Link Layer:** Error detection and correction, Block Encoding, Linear Block Encoding, Cyclic codes, Checksum. Data link Control- Framing, Flow and Error Control, Noiseless Channel, Noisy Channel, HDLC, Point to point protocol.

**Module 4**

**Multiple Access & Local Area Networks:** Multiple Access, Random Access-CSMA, CSMA/CD, CSMA/CA. Controlled Access-Reservation, Polling, Token Passing in FDDI and CDDI. Channelization- FDMA, TDMA, CDMA. Wired LANs: Ethernet, IEEE standards, Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet.

**Module 5**

**Connecting Devices and Backbone Networks**: Bridges, Functions of a bridge, Bridge Protocol Architecture, Fixed routing, Spanning tree approach, Connecting devices like Repeaters, Hubs, Bridges, Two-layer switches, Routers and Three layer switches, Backbone networks, Bus Backbone, Star Backbone, Connecting remote LANs, Wireless LANs, Applications, Architecture, IEEE 802.11, Architecture and Services, Medium Access Control, Physical layer.

**Module 6**

**Network Layer and Transport Layer:** Internetwork protocols, principles of Internetworking, Internet protocol operation, IPV4:ICMP, ARP, IPV6, Internetwork Operations, Multicasting, IGMP, Routing Protocols- distance Vector, Link State routing, path-vector routing, Border Gateway Routing, OSPF, Integrated service Architecture, Differentiated services, service level agreements. Connection oriented transport protocol mechanism, TCP, TCP congestion control, UDP

**Module 7**

**Application Layer:** Domain Naming System, Remote Logging- Electronic mail & File Transfer, WWW and HTTP, web documents, HTTP transactions, Network Management system, SNMPV2, V3.

**Text Books:**

- Data and Computer communications Eighth edition by William Stallings
- Data communication and Networking Fourth edition by Behrouz A Forouzan

**Reference Books:**

- L.L. Peterson & B.S. Davie- Computer Networks: A Systems Approach, 3rd Edition, Morgan Kaufman Publication, New Delhi, 2006.
- P.C. Gupta- Data Communications and Computer Networks, PHI, New Delhi, 2006**.**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS 2002 Network Design Lab
**Designation**: Required
**Credits**:2
**Pre-requisites**: Fundamentals of Data Communication, Java programming
**Contact Hours/Type**: Min30 Hrs(three periods per week)/Lab
**Course Assessment methods**: Mid Sem (Day to Day Evaluation): 60 Marks, End Sem (Performance test and Viva):40 Marks
**Course Outcomes**: After the completion of this course, students will be able to:

a. Gain knowledge of facilities available in modern programming languages to write network programs.
b. Be able to write simple programs to demonstrate basic communication techniques.
c. Develop and deploy socket based communication programs.
d. Identify, capture and analyze protocol headers from live streams and analyze their contents.
e. Develop simple programs to simulate basic protocol structures.

**Topics Covered**: Networking devices and commands, Digital encoding/decoding techniques, Encryption/ decryption techniques, Socket interface for TCP and UDP protocols.

**Text Books:**

- Data and Computer communications Eighth edition by William Stallings
- Data communication and Networking Fourth edition by Behrouz A Forouzan

**Reference Books:**

- L.L. Peterson & B.S. Davie- Computer Networks: A Systems Approach, 3rd Edition, Morgan Kaufman Publication, New Delhi, 2006.
- P.C. Gupta- Data Communications and Computer Networks, PHI, New Delhi, 2006**.**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS 2037Design and Analysis of Parallel Algorithms
**Designation**:Elective
**Pre-requisites:** Data Structures, Design and Analysis of Computer Algorithms, Computer Architecture
**Contact Hours/Type:** 40 lectures (50 mins each)/Lecture
**Course Assessment Methods:** Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks.
**Credits: 3**
**Course Outcomes**: After the completion of this course, students will be

a) Identify the concepts of parallelism, scope of parallel computing and organization of parallel platforms.

b) Describe the basic methods of problem decomposition and data partitioning for efficient memory utilization and minimization of communication costs in parallel computers

c) Apply design and development principles in the construction of software systems of varying complexity.

d) Analyse a problem and identify the computing requirements appropriate for its solution.

e) Perform design and analysis of parallel algorithms in some of the fields mentioned under contents.

**Topics Covered:**

**Module 1**

**Introduction to Parallel Computing and Programming**: Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism, Limitations of Memory system performance, Dictionary of Parallel Computing Platforms Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process – Processor Mapping and Mapping Techniques.

**Module 2**

**Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overloads, Parallel Algorithm Models.

**Module 3**

**Dense Matrix Algorithms**: Matrix Vector Multiplication, Matrix – Matrix Multiplication, Solving a system of Linear Equations.

**Module 4**

**Sorting**: Issues in sorting on Parallel Computers, Sorting Networks, Bubble Sort and its variants, Quick Sort, Bucket and sample sort, other sorting Algorithms.

**Module 5**

**Graph Algorithms:** Definitions and Representation, Minimum Spanning Tree, Prim's Algorithm, Single Source shortest path : Dijkrtra's Algorithms All-pairs shortest paths, Transitive closure, Connected Components, Algorithms for Sparse Graphs.

**Module 6**

**Search Algorithms for Discrete Optimization Problems**: Definitions and Examples, Sequential Search Algorithms, Search Overhead Factor, Parallel Depth – First Search, Parallel Best – First Search, Speedup Anomalies in Parallel Search Algorithms.

**Module 7**

**Dynamic Programming:** Overview of Dynamic Programming, Serial Monadic DP Formulations, Nonserial Monadic DP Formulations, Serial Polyadic DP Formulations, Nonserial Polyadic DP Formulations.

**Fast Fourier Transform:** The serial Algorithm, The Binary – Exchange Algorithm, The Transpose Algorithm.

**Text Book:**

A Grama et.al – Introduction to Parallel Computing, 2nd ed. Pearson Education, New Delhi 2003.

**Reference Books:**

M.J. Quinn – Parallel Computing : Theory and Practice, 2nd ed., McGraw Hill, New York, 1994.

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS 2039 High Performance Computer Architecture
**Designation:** Required
**Credits:** 3
**Pre-requisites**: Computer architecture, Parallel Computing.
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks.
**Course Outcomes:** After the completion of this course, students will be:

a Describe different terminologies in High Performance Computer Architecture.
b Demonstrate and Implement the concepts of High Performance Computer Architecture.
c Compare and differentiate the different parallel architectures in terms of various parameters
d Evaluate performance metrics and scalability and selection criteria for parallelism and different parallel systems and able to modify it.
e Design effective high-performance systems as per users' criteria with proper justification by self or in a group.

**Topics Covered:**

**Module 1:**
**Parallel Computer Models :**The State of Computing, Multiprocessors and Multicomputers, Multivector and SIMD Computers, PRAM and VLSI Models, Architectural Development Tracks.
**Module 2:**
**Program and Network Properties :** Conditions for Parallelism, Program Partitioning and Scheduling, Program Flow Mechanism, System Interconnect Architectures.
**Module 3:**
**Principles of Scalable Performance:** Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.
**Module 4:**
**Processors and Memory Hierarchy:** Advanced Processor Technology, Super Scaler and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.
**Bus, Cache, and Shared Memory:** Bus Systems, Cache Memory Organizations, Shared-Memory Organizations, Sequential and Weak Consistency Models, Weak Consistency Models
**Module 5:**
**Pipelining and Superscalar Techniques:** Linear Pipeline Processors, Non Linear Pipeline Processor, Instruction Pipeline Design, Arithmetic Pipeline Design, Superscalar Pipeline Design
**Multiprocessors and Multicomputers:** Multiprocessor System Interconnects, Cache Coherence Synchronization Mechanism, Three Generations of Multicomputers, Message-Passing Mechanisms.
**Module 6:**
**Multivector and SIMD Computers:** Vector Processing Principles, Multivector Multiprocessor, Compound Vector Processing, SIMD Computer Organizations, The Connection Machine CM-5
**Scalable, Multithreaded and Data Flow Architecture:** Latency-Hiding Techniques, Principle of Multithreading, Fine-Grain Multicomputers, Scalable and Multithreaded

Architectures,Data Flow and Hybrid Architectures.

**Module 7:**

**Parallel Models, Languages, and Compilers:** Parallel Programming Models, Parallel languages and Compilers, Dependence Analysis of Data Arrays, Code Optimization and Scheduling, Loop Parallelization and Pipelining, Parallel Programming Environments, Shared-Variable Program Structures, Message-Passing Program Development, Mapping Programs onto Multicomputers, Instruction Level Parallelism.

**Text Book:**

- Hwang K., Jotwani N., Advanced Computer Architecture, 2nd Edition, Tata McGrawhill, India, 2010

**Reference Book:**

- Stone, H. S., High Performance Computer Architecture, 3rd Edition, Addison Wesley Publishing Company, USA.

**Department**: Computer Science and Engineering
**Course Code & Title**: TIS 2121 Biometric Security
**Pre-requisites**: UG level concepts of Security in computing.
**Designation**: Breadth
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will be

a) Describe the biometric fundamentals and types of biometrics.
b) Explain the various technologies related to two factor authentication system.
c) Applying the various techniques of biometric scanning, recognition and behavioural dynamics.
d) Analyse the various issues involved in biometric techniques.
e) Evaluate the biometric systems in relation to effectiveness and social issues like privacy concerns.

**Topics Covered:**
**Module 1 & 2**
**Biometric Fundamentals:** Introduction, Why biometrics, How Authentication Technologies work, Benefits of biometrics over traditional authentication systems, How Biometrics work, Benefits of biometrics in identification systems, Selecting a biometric for a system, Applications, Key biometric terms and processes, How biometric matching works, Accuracy in biometric systems.
**Module 3**
**Types of Biometrics:**
**Fingerprints and Hand Geometry:** Technical description, Characteristics, Competing technologies, Strengths–Weaknesses, Deployment.
**Facial and Voice Recognition:** Technical description, Characteristics, Strengths-Weaknesses, Deployment.
**Module 4**
**Iris and Retina scanning:** Technical description, Characteristics, Strengths – Weaknesses, Deployment. Retina vascular pattern.
**Signature Recognition and Keystroke Dynamics:** Signature Recognition and keystroke Dynamics
**Module 5**
**Behavioral and Esoteric Biometric Technologies:** Vein Pattern, Facial Thermography, DNA, Body Oder, Ear, Footprint and Foot Dynamics
**Module 6**
**Issues Involving Biometrics:** Biometric Liveness Testing, Biometric in Large-Scale Systems, Biometrics in Large-Scale Systems, Biometric Standards, Biometric Testing and Evaluation
**Module 7**
**Privacy, Policy and Legal Concerns Raised by Biometrics:** Biometrics and Privacy, Legal considerations of Government Use of Biometrics, Biometrics and the Feasibility of a National ID card, Case studies on Physiological, Behavioral and multifactor biometrics in identification systems.

**Text Books :**

- John D. Woodward, Jr. Nicholas M. Orlans Peter T. Higgins, "Biometrics**",** dreamtech, 2003.
- Samir Nanavathi,MichelThieme,RajNanavathi,"Biometrics -Identity verification in a network", Wiley Eastern, 2002.

**Reference Books :**

- John Chirillo and Scott Blaul," Implementing Biometric Security", Wiley EasternPublications, 2005.
- John Berger," Biometrics for Network Security", Prentice Hall, 2004.

**Department**: Computer Science and Engineering
**Course Code & Title**: 3050 Thesis
**Pre-requisites**: Electives of the Programme/Any research area
**Designation**: Required
**Credits**: 35
**Contact Hours/Type**: One Year (Three hours / week)/Research
**Course Assessment methods**: Internal Presentations and External Viva
**Course Outcomes:**
CO1-Analyse and review the existing literature on a research question.
CO2- Identify research problem and apply research methodology for solving it.
CO3- Applying modelling and Design techniques to generate solution strategies.
CO4-Evaluate and implement the various solutions.
CO5-Communicate the outcome of research ideas verbally and in writing in terms of research paper publication in journals/conferences.

**List of Electives: GROUP-I**

**1)**

**Department**: Computer Science and Engineering

**Course Code & Title**: MSE1023 Computability and Complexity Theory

**Pre-requisites**: Concept on Automata Theory

**Designation**: Elective

**Credits**: 3

**Contact Hours/Type**: 40 lectures (50mins each)/Lecture

**Course Assessment methods**: Quizzes(3) :30 Marks, Assignment test:10 marks, End sem:60 Marks

**Course outcomes:** After the completion of this course, students will be able to:

a) Relate formal languages and mathematical models of computation .
b) Attain knowledge about different types of languages based on Halting status of Turing machine .
c) Understand the limitations on what computers can do, and learn examples of unsolvable problems
d) Analyse P, NP, NP-C, NP-Hard, Tractable and Intractable problems.
e) Learn to reduce a new problem to a previously solvable or unsolvable problem .

**Topics covered**

**Module-I**

Basic background on automata and languages, Types of automata and languages, Turing machines, k-tape Turing machines, non-deterministic Turing machines, Universal Turing machine, Halting problem

**Module-II**

Recursive enumerable languages, Recursive languages, Decidable and recognizable language, Turing-decidable languages, Turing-recognizable languages, Context Sensitive Language and Chomosky Hierarchy.

**Module-III+IV**

Primitive recursive function, partial recursive function, Recursive and recursive enumeration sets, Programming systems, Unsolvable problems, a non-recursive language and an unsolvable problem, Reducing one problem to another problem, Rice Theorem, More unsolvable problems, PCP

**Module-V**

Measuring complexity- Big Oh, small oh and other notations, Analyzing algorithms, Time and space complexity of a Turing machine, Complexity analysis of multi-tape TM

**Module-VI**

Complexity classes: P, NP, NP-C, NP-Hard problem, Additional NP-complete problems- clique, vertex cover, Hamiltonian cycle, coloring problem, graph isomorphism, Reduction from NP-C problem to another problem,

**Module-VII**

Tractable and Intractable problems

**Recommended Books**

1. Lewis H.R., Papadimitriou C.H.- Elements of the Theory of Computation:, PHI Publ. , 2nd edition, New Delhi

2. John Martin. Introduction to Languages and the Theory of Computation, 3rd ed. McGraw Hill, New York, NY, 2003.

**2)**

**Department**: Computer Science and Engineering

**Course Code & Title**: MEC2011 Digital Image Processing Techniques

**Pre-requisites**: Knowledge of Digital Signal Processing, Human Visual system, Matrix operations, Basic Understanding on Probability Theory

**Designation**: Elective

**Credits**: 3

**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture

**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks

**Course Outcomes:** After the completion of this course, students will

a) Develop and understanding on the image formation, pixel characteristics and processing steps.
b) Have an ability to analyse the image quality using transformed and spatial domain filters
c) Have ability to segment and represent the image for computer vision tasks.
d) Have an ability to analyse the different image compression techniques and evaluate its performance.
e) Develop an ability to create and apply the image processing techniques in various applications in many areas.

**Topics Covered:**

**Module -1:**

Digital Image Fundamentals:Fundamental steps in Digital Image Processing, Components of an Image processing system, Digital Image Representation , Basic relationship between pixels, Color Modules, RGB and HSI color modules, Application of Fuzzy logic in Digital Image Processing.

**Module -2:**Image Enhancement:Image negatives , Histogram Equalization , Local Enhancement , Image Subtraction, Image Averaging , Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement methods.

**Module -3:**Image Transform:Fourier Transform ,Discrete Fourier Transform, Fast Fourier Transform, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, Homomorphic filtering, Convolution and Correlation Theorems, Wavelet Transforms, The Fast Wavelet Transforms.

**Module -4:**Image Restoration:Noise Models, Restoration in the presence of Noise-Only Spatial filtering , Mean filters , Adaptive filters Periodic Noise Reduction by Frequency Domain filtering , Inverse Filtering , Minimum Mean Square Error ( Wiener) Filtering, Geometric Mean Filter.

**Module -5:**Image Segmentation:Detection of Discontinuities, Point Detection, Line detection, Edge Detection, Thresholding , Optimal Global and Adaptive thresholding, Region-based Segmentation, Textural Images, Textural Feature extraction from Co-occurrence matrices .

**Module -6:** Representation and Description:Chain codes, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Regional Descriptors ,Use of the Principal Components for Description, Relational Descriptors.

**Module -7:**Image Compression:Fundamentals, Redundancy , Image Compression Models, Coding Theorems, Error-free Compression techniques like Variable- length Coding and Lossless Predictive Coding , Lossy Compression techniques like Lossy Predictive Coding and Wavelet Coding, Image Compression standards.

**Text Books**:

1. Digital Image Processing. 2/E by Rafael C. Gonzalez and Richard E. Woods. Pearson Education

2.Digital Image Processing and Analysis. by B. Chanda and D. Dutta Majumder PHI

3)

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS1027 Graph Theory and Applications
**Pre-requisites**: Data Structure, Discrete mathematics
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a) Attain knowledge about different types of graphs and their applications in real world.

b) Perceive the role of cut-set, cut-vertex and fundamental circuits in network flows.

c) Create an awareness of planar and dual graph.

d) Understand how to represent graphs in computer system

e ) Apply the concept of graph coloring and partitioning techniques in NP-problems

**Topics Covered:**

**Module 1**

**Introduction**: What is graph, Application of graphs, Finite and infinite graphs, incidence and degree, isolated Vertex pendant Vertex, and Null graph, paths and circuits, isomorphism, sub graphs, a puzzle with multicolored cubes, walks, paths, and circuits, Connected graphs, disconnected graphs and components, Euler graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits, The Traveling Salesman problem.

**Module 2**

**Trees and Fundamental circuits**: Trees, some properties of trees, pendant vertices in a tree, Distance and centers in a tree, Rooted and binary trees, On counting trees, Spanning trees, fundamental circuits, Finding all spanning trees of a Graph, Spanning trees in a Weighted graph.

**Module 3**

**Cut set, and cut vertices**: Properties of a cut set, all cut sets in a graph, Fundamental circuits and cut sets, connectivity and separability, Network flows, 1-Isomorphism, 2-Isomorphism.

**Module 4**

**Planar and Dual Graphs**: Combinatorial vs. Geometric Graphs, Planar graph, kuratowski's Two Graphs, Difference Representations of a planar graph, Detection of planarity, Geometric Dual, Combinatorial, Duel, More on criteria of planarity, Thickness and crossings.

**Module 5**

**Matrix Representation of Graphs**: Incidence Matrix Sub matrices of A(G), Circuits Matrix, Fundamental Circuit Matrix and Rank of B, An application to a switching Network, Cut-set Matrix, Relationships among A$f$ , B$f$ and C$f$ . path Matrix, Adjacency Matrix.

**Module 6**

**Coloring, Covering and partitioning**: Chromatic number, Chromatic partitioning, Chromatics polynomial, Coverings, Four color problem.

**Module 7**

**Directed Graphs**: What's a directed Graphs, Some types of Digraphs, Digraphs and binary Relations, Directed paths and connectedness, Euler Digraphs, Trees with Directed Edges, Fundamental Circuits in Digraphs, Matrices A, B and C of Digraphs, Adjacency Matrix of a Digraph, Paired Comparisons and Tournaments, Acyclic Digraphs and Decyelization.

**Text Book:**

Narasingh Deo, "Graph Theory with Applications to engineering and Computer Science", Prentice Hall of India, 2001.

**Reference Book:**

Douglas B. West, "Introduction to Graph theory", Pearson Education, 2002.

4)

**Department**: Computer Science and Engineering
**Course Code & Title**: MSE2005 Software Project Management
**Pre-requisites**: Software Engineering
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a) Apply the concepts of Project Management for developing software projects
b) Solve the software project evaluation issues.
c) Categorize the software projects for development using suitable process models
d) Estimate the software cost and risk for the software projects
e) Create a framework for managing various aspects of software projects like resource allocation, monitoring and control, contract and quality management etc.

**Topics to be covered:**

**Module 1**

**Introduction To Software Project Management And Step Wise Project Planning:** Introduction, What is a Project? Software Projects Versus Other Types of Project, Contact Management and Technical Project Management, Activities Covered by Software Project Management, Plans, Methods, and Methodologies, Some ways of Categorizing Software Projects, What is Management?, Problems with Software Projects, Setting Objectives, Stakeholders, The Business Case, Requirement Specification, Management Control, Overview of Project Planning (Step wise).

**Module 2**

**Project Evaluation**: Introduction, Strategic Assessment, Technical Assessment, Cost-Benefit Analysis, Cash Flow Forecasting, Cost- Benefit Evaluation Techniques, Risk Evaluation.

**Selection Of An Appropriate Project Approach**: Introduction, Choosing Technologies, Technical Plan Contents List, Choice of Process Models, Structure Versus Speed of Delivery, The Waterfall Model, The V- Process Model, The Spiral Model, Software Prototyping, Other ways of Categorizing Prototyping, Controlling Changes during Prototyping, Incremental Delivery, Dynamic Systems Development Method, Extreme Programming, Managing Iterative Processes.

**Module 3**

**Software Effort Estimation**: Introduction, Where are Estimates done? , Problems with Over-and Under- Estimates, The Basis for Software Estimating, Software Effort Estimation Techniques, Expert Judgement, Estimating by Analogy, Albrecht Function Point Analysis, Function Point Mark II, Object Points, A Procedural Code- Oriented Approach, COCOMO: A Parametric Model.

**Activity Planning**: Introduction, The Objectives of Activity Planning, When to Plan, Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Models, Formulating a Network Model, Adding the Time Dimension,

The Forward Pass, The Backward Pass, Identifying the Critical Path, Activity Float, Shortening the Project Duration, Identifying Critical Activities, Activity- On – Arrow Networks.

**Module 4**

**Risk Management**: Introduction, The Nature of Risk, Types of Risk, Managing Risk, Hazard Identification, Hazard Analysis, Risk Planning and Control, Evaluating Risks to the Schedule.

**Resource Allocation**: Introduction, The Nature of Resources, Identifying Resources Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost, Being Specific, Publishing the Resources Schedule, Cost Schedules, The Scheduling Sequence.

**Module 5**

**Monitoring And Control**: Introduction, Creating the Framework, Collecting the Data, Visualizing Progress, Cost Monitoring, Earned Value, Prioritizing Monitoring, Getting the Project Back to Target, Change Control.

**Managing Contracts**: Introduction, Types of Contract, Stages in Contract Placement, Typical Terms of a Contract, Contract Management, Acceptance.

**Module 6**

**Managing People And Organizing Teams**: Introduction, Understanding Behaviour, Organizational Behaviour: A Background, Selecting The Right Person For The Job, Instruction In The Best Methods, Motivation, The Oldham- Hackman Job Characteristics Model, Working In Groups, Becoming A Team, Decision Making, Leadership, Organizational Structures.

**Module 7**

**Software Quality**: Introduction, The Place Of Software Quality In Project Planning, The Importance Of Software Quality, Defining Software Quality, ISO 9126, Practical Software Quality Measures, Product Versus Process Quality Management, External Standards, Techniques To Help Enhance Software Quality, Quality Plans.

**Text Book:**

B.Huges and M.Cotterell- Software Project Management 3rd Edn, TMH, New Delhi, 2004.

**Reference Book:**

P.Jolote- Software Project Management in Practice, Pearson Education, New Delhi, 2002.

**List of Electives-GROUP-II**

**1)**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS 2037Design and Analysis of Parallel Algorithms
**Designation**:Elective
**Pre-requisites:** Data Structures, Design and Analysis of Computer Algorithms, Computer Architecture
**Contact Hours/Type:** 40 lectures (50 mins each)/Lecture
**Course Assessment Methods:** Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks.
**Credits: 3**
**Course Outcomes**: After the completion of this course, students will be

a) Identify the concepts of parallelism, scope of parallel computing and organization of parallel platforms.

b) Describe the basic methods of problem decomposition and data partitioning for efficient memory utilization and minimization of communication costs in parallel computers

c) Apply design and development principles in the construction of software systems of varying complexity.

d) Analyse a problem and identify the computing requirements appropriate for its solution.

e) Perform design and analysis of parallel algorithms in some of the fields mentioned under contents.

**Topics to be covered:**

**Module 1**

**Introduction to Parallel Computing and Programming**: Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism, Limitations of Memory system performance, Dictionary of Parallel Computing Platforms Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process – Processor Mapping and Mapping Techniques.

**Module 2**

**Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for containing Interaction Overloads, Parallel Algorithm Models.

**Module 3**

**Dense Matrix Algorithms**: Matrix Vector Multiplication, Matrix – Matrix Multiplication, Solving a system of Linear Equations.

**Module 4**

**Sorting**: Issues in sorting on Parallel Computers, Sorting Networks, Bubble Sort and its variants, Quick Sort, Bucket and sample sort, other sorting Algorithms.

**Module 5**

**Graph Algorithms:** Definitions and Representation, Minimum Spanning Tree, Prim's

Algorithm, Single Source shortest path : Dijkrtra's Algorithms All-pairs shortest paths, Transitive closure, Connected Components, Algorithms for Sparse Graphs.

**Module 6**

**Search Algorithms for Discrete Optimization Problems**: Definitions and Examples, Sequential Search Algorithms, Search Overhead Factor, Parallel Depth – First Search, Parallel Best – First Search, Speedup Anomalies in Parallel Search Algorithms.

**Module 7**

**Dynamic Programming:** Overview of Dynamic Programming, Serial Monadic DP Formulations, Nonserial Monadic DP Formulations, Serial Polyadic DP Formulations, Nonserial Polyadic DP Formulations.

**Fast Fourier Transform:** The serial Algorithm, The Binary – Exchange Algorithm, The Transpose Algorithm.

**Text Book:**

A Grama et.al – Introduction to Parallel Computing, 2nd ed. Pearson Education, New Delhi 2003.

**Reference Books:**

M.J. Quinn – Parallel Computing : Theory and Practice, 2nd ed., McGraw Hill, New York, 1994.

**2)**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS2023 Computational Geometry
**Pre-requisites**: Data Structure, Discrete Mathematics
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a Apply line-point duality to develop efficient algorithms.
b Develop expected case analyses for linear programming problems in small dimensions.
c Apply geometric techniques to real-world problems in graphics.
d Analyze randomized algorithms for small domain problems.
e Design linear programs geometrically.

**Topics covered:**

**Module 1**

**Introduction**: Convex Hull, Degeneracies and Roubustness, Application Domains, Line Segment intersection, The Doubly-Connected Edge List, Computing the Overlay of Two Subdivisions.

**Module 2**

Polygon Triangulation, Guarding and Triangulations, Partitioning a Polygon into Monotone Pieces, Triangulating a Monotone Polygon.

**Module 3**

Linear Programming, The Geometry of Casting, Half-Plane Intersection, Incremental linear Programming, Randomized Linear Programming, Unbounded Linear Programs,

Linear Programming in Higher Dimensions.

**Module 4**

1- Dimensional Range Searching, Kd- Tress, Range Trees, Higher Dimensional Range Trees, General Set of Points, Fractional Cascading

**Module 5**

Point location and Trapezoidal Maps, A Randomized Incremental Algorithm, Dealing with Degenerate Cases, Definition and basic properties of Voronoi Diagrams, Computing the Voronoi Diagram.

**Module 6**

Arrangements and Duality, Computing the Discrepancy, Duality, Arrangements of Lines, Levels and Discrepancy.

**Module 7**

More Geometric Data Structures, Interval Trees, Priority Search Trees, Segment Trees.

**Text Book:**

Mark de Berg, Marc van Kreveld, Mark Overmars, Otfried Schwarzkopf," Computational Geometry Algorithms and Applications", Springer, 2000.

**Reference Book:**

Michael J. Laszlo, "Computational Geometry and Computer Graphics in C++", PHI, New Delhi, 1999.

3)

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS2025 Mobile Computing
**Pre-requisites**: Computer Networks
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a Describe the basic concepts and principles in mobile computing and understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks

b Explain the structure and components for Mobile IP and Mobility Management and illustrate the network infrastructure requirements to support mobile devices and users.

c Analyse principles of disconnected operation: caching, hoarding, etc.as well as software adaptation and OS support and resource sharing.

d Appraise the design of existing middleware for supporting mobile devices along with an insight into case studies.

e Express the quality and performance of mobile applications in context software adaptation and OS support and resource sharing.

**Topics to be covered:**

**Module-I Mobile Computing Architecture:** Internet – The ubiquitous network; Schematic representation of mobile computing environment; The Three-Tier mobile computing architecture; Design considerations for mobile computing; Mobile computing through Internet; Making existing applications mobile-enabled.

**Module-II**

**Mobile Communications:** Introduction; The GSM architecture; Call routing in GSM; Network aspects in GSM; GSM frequency allocation; Authentication and security; GPRS system architecture and routing.

**Module-III**

**Mobility Management:** Mobility management; Location Management Principles and Techniques; Location Management Case studies: PCS, Mobile IP.

**Module-IV**

**Data Dissemination and Management:** Challenges; Data Dissemination; Mobile Data Caching; Mobile Cache Maintenance Schemes; Mobile Web Caching; Case studies.

**Module-V**

**Mobile Middleware:** Introduction; Adaption: The spectrum of adaption, Resource monitoring, Characterizing adaption strategies, Odyssey-An application aware adaption architecture, Sample Odyssey application; Mobile Agents: Agent architectures, Migration strategies, Communication strategies.

**Module-VI**

**Service Discovery Middleware:** Middleware services: Universally unique identifiers, Standardization, Textual Descriptions, Interfaces for standardization; Discovery and Advertisement Protocols: Unicast discovery, Multicast discovery and advertisement, Service catalogs; Garbage collection: Leasing, Advertised expirations; Eventing; Security: Jini, Service location protocol, Ninja; Interoperability.

**Module-VII**

**Device Operating System:** Introduction to Symbian Operating System; Symbian OS architecture; Applications for Symbian; Special feature:- Event Driven Multitasking using Active objects; Client-Server framework model on Symbian OS.

**Text Books:**[Modules: 1, 2, and 7]- Asoke K Talukder and Roopa R. Yavagal; Mobile Computing – Technology, Applications and Service Creation; TMH Publication, New Delhi, 2006.

[Modules: 3, 4, 5, and 6]- Frank Adelstein et.al.; Fundamentals of Mobile and Pervasive Computing; TMH Publication, New Delhi, 2005.

**4)**

**Department**: Computer Science and Engineering

**Course Code & Title**: TCS2021 Pattern Recognition and Image Analysis

**Pre-requisites**: Image processing ,Probability and Stastics

**Designation**: Elective

**Credits**: 3

**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture

**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks

**Course Outcomes:** After the completion of this course, students will

a Apply their knowledge on Real World Problems while converting these problems to computer compatible problems for Pattern Recognition and Image Processing

b Solve Decision making model using Statistical and Mathematical Decision Theory.

c Design clusters for various Pattern using classical and Modern clustering techniques

d Analyzing various Image Processing Techniques for Pattern Classification and Clustering.

e Develop Model for Pattern classification through various Image Processing Techniques.

**Topics Covered:**

**Module 1**

**Introduction**: Applications of Pattern Recognition, Statistical Decision Theory, Image Processing and Analysis, The Internet, Pointers to the Literature.

**Module 2**

**Statistical Decision Making**: Introduction, Bayes' Theorem, Multiple Features, Conditionally Independent Features, Decision Boundaries, Unequal Costs of Error, Estimation of Error Rates, The Leaving- One-Out Technique, Characteristic Curves, Estimating the Composition of Populations.

**Module 3**

**Nonparametric Decision Making**: Introduction, Histograms, Kernel and Window Estimators, Nearest Neighbor Classification Techniques, Adaptive Discriminant Functions, Minimum Squared Error Discriminant Functions.

**Module 4**

**Clustering**: Introduction, Hierarchical Clustering, Partitional Clustering.

**Module 5**

**Artificial Neural Networks**: Introduction, Nets without Hidden Layers, Nets with Hidden Layers, The Back- Propagation Algorithm, Hopfield Nets, An Application: Classifying Sex from Facial Images.

**Module 6**

**Processing Of Waveforms And Images**: Introduction, Gray Level Scaling Transformations, Equalization, Geometric Image Scaling and Interpolation, Smoothing Transformations, Edge Detection, Laplacian and Sharpening Operators, Line Detection and Template Matching, Logarithmic Gray Level Scaling, The Statistical Significance of Image Features.

**Module 7**

**Image Analysis**: Introduction, Scene Segmentation and Labeling, Counting Objects, Perimeter Measurement, Following and Representing Boundaries, Hough Transforms, Least Squares and Eigenvector Line Fitting, Fourier Transforms.

**Text Book:**

E.Gose et.al- Pattern Recognition and Image Analysis, PHI, New Delhi- 2004.

**Reference Books:**

a. R.O.Duda et.al- Pattern Classification 2nd Edn, John Wiley, New York, 2002.
b. R.C.Gonzalez and R.E.Woods- Digital Image Processing, 2nd Edn, Pearson Education, New Delhi- 2004.
c. M.Sonka et.al- Image Processing, Analysis, and Machine Vision- Vikas Publication, New Delhi- 2003.

**5)**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS2033 Interconnection Networks
**Pre-requisites**: Computer Networks
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a. Visualize the role of interconnection networks in different types of networks
b. Understand basic design choices and design trade-offs
c. Describe switching techniques and routing protocols
d. Identify physical constraints, network topologies and router architectures
e. Analyze advance issues in the design and implementation of interconnection networks

**Topics to be covered:**

**Module 1**

**Introduction**: Parallel computing and network, Parallel Computer Architectures, Network Design considerations, Classification of interconnection Network, Shared Medium networks, Direct Networks, Indirect Network, Hybrid Network, A unified view of direct and Indirect networks.

**Module 2**

**Network and Router Model**: Basic concept, Basic switching techniques, Virtual channels, Hybrid switching techniques, Optimizing Switching Techniques, A Comparisons of switching techniques, Engineering Issue.

**Module 3**

**Deadlock, live lock, and Starvation**: A theory of dead lock avoidance, Extensions, Alternative Approaches, Deadlock Avoidance in Switch Based networks, Deadlock prevention in Circuit switching and PCS, Dead lock Recovery, Live lock Avoidance Engineering issues.

**Module 4**

**Routing Algorithms**: Taxonomy of Routing algorithms, Deterministic Routing algorithms, Partially Adaptive algorithms, Fully adaptive algorithms, Maximally adaptive Routing algorithms Nonminimal Routing algorithms, Backtracking protocols, Routing in MINs, Routing in switch based networks with irregular Topologies, Engineering Issues.

**Module 5**

**Collective Communication Support**: Collective communication services, System support for collective communication, preliminary consideration, Models for Multicast Communication, Hardware Implementations of Multicast, Hardware support for barrier Synchronization and reduction, Software Implementation of Multicast , Engineering issues.

**Module 6**

**Fault Tolerant Routing**: Fault Induced Deadlock and Livelock, Channel and Network Redundancy, Fault Models, Fault Tolerant Routing in SAG and VCT Networks, Fault

Tolerant Routing in Wormhole Switched networks, Fault Tolerant Routing in PCS and Scouting Networks, Dynamics Fault Recovery, Engineering Issues.

**Module 7**

**Network Architectures**: Network Topology and Physical Constraints, Router Architectures, Engineering Issues.

**Text Book**:

Jose Duato et al., "Interconnection Networks an Engineering Approach", Morgan Kaufman Publishers, 2003.

**Reference Book**:

Dally et al., "Principles And Practices of Interconnection Networks", Elsevier Science Publications, 2005.

**6)**

**Department**: Computer Science and Engineering
**Course Code & Title**: TCS2027 Grid Computing
**Pre-requisites**: Computer Networks
**Designation**: Elective
**Credits**: 3
**Contact Hours/Type**: 40 lectures (50 mins each)/Lecture
**Course Assessment methods**: Quizzes' (3):30 Marks, Assignment test: 10 marks, End sem:60 Marks
**Course Outcomes:** After the completion of this course, students will

a) Describe the concept of Grid Computing, Existing Grid Projects, Scheduling and Security aspects of Grid.
b) Differentiate different Grid Models and Security Models
c) Design scheduling algorithms/criteria is Grid systems.
d) Analyze the scientific aspects of grid application like Data Management, Distribution, Scheduling, etc.
e) Implement own Gird System considering the challenges is grid environment.

**Topics to be Covered:**

**Module 1**

**Introduction:** Motivation; Definitions of Grid Computing; Evolution of the Grid; Differences with similar efforts (Meta, cluster, heterogeneous, Internet); Examples of usage; Research possibilities / scope in Grid Computing; Thrust areas.

**Module 2**

**High Performance computing:** PACX-MPI, MPI-Connect, P-MPI; I-WAY experiment.

**Module 3**

**Earliest Grid Tools / Projects:** Condor Part 1, Part 2; Globus Part 1, Part 2; Nimrod.

**Module 4**

**Grid Basics - Technologies / Challenges:** Security - Different models: SSL, Kerberos, SASL, GSI, Others; Information Services: NWS.

**Module 5**

**HPC:**Scheduling HPC applications in Grids: AppLeS, Scheduling Parameter sweep applications, Metascheduling Part1, Part2; Grid RPC mechanisms - Part1, Part2; Rescheduling; Computational Steering,

**Module 6**

**Grids:** Scientific visualization of Grid applications; Grid Applications - Everywhere and Cactus experiments; Data management: Data distribution, Redistribution, Data cache maintenance.

**Module 7**

**Recent Efforts / Challenges:** Grid economy; Grid simulation - SimGrid, GridSim, MicroGrid; Grid standards and forums - OGSA, GGF and Other topics.

**Text Books:**


1. **[Module: 1]**
   Ian Foster, Carl Kesselman; The Grid: Blueprint for a New Computing Infrastructure (2nd edition)**;** Morgan Kaufmann Publishers; 2nd edition, 2003.
2. **[Module: 2, 3, and 4]**
   Francine Berman, Geoffrey Fox, Tony Hey; Grid Computing: Making the Global Infrastructure a Reality; John Wiley & Sons, 2003.
3. **[Modules: 5, 6, and 7]**Jarek Nabrzyski, Jennifer M. Schopf, Jon Weglarz; Grid