TECHNO INDIA UNIVERSITY
WESTBENGAL

EM 4, Sector V, Salt Lake, Kolkata-700091, West Bengal, India

Phone: +91 9836544416/17/18/19, Fax: +91 33 2357 1097

2-Years Master of Technology (M. Tech.)
Syllabus for Computer Science and Engineering (CSE)

First Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-PMA-T115	Advanced Numerical Methods	3	1	0	4
TIU-PCS-T101	Advanced Design and Analysis of Algorithms	3	0	0	3
TIU-PCS-T103	Advanced Database Management Systems	3	0	0	3
TIU-PCS-E#	Elective – I	3	1	0	4
TIU-PCS-E#	Elective – II	3	1	0	4
Practical					
TIU-PCS-L101	Advanced Design and Analysis of Algorithm Lab	0	0	3	2
TIU-PLS-L103	Advanced Database Management Systems Lab	0	0	3	2
Sessional					
TIU-PES-S199	Entrepreneurship Skill Development	0	0	2	2
Total Credits					**23**

ELECTIVE – I					
TIU-PCS-E101	Cryptography and Network Security	3	1	0	4
TIU-PCS-E103	Advanced Theory of Computation	3	1	0	4
TIU-PCS-E105	Knowledge Representation and Reasoning	3	1	0	4
TIU-PCS-E107	Advanced Digital Signal Processing	3	1	0	4

ELECTIVE – II					
TIU-PCS-E109	Mobile Computing and Wireless Communication	3	1	0	4
TIU-PCS-E111	Machine Learning	3	1	0	4
TIU-PCS-E113	Advanced Graph Theory	3	1	0	4
TIU-PCS-E115	Information Theory and Coding	3	1	0	4

Approved By:

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Syllabus

ADVANCED NUMERICAL METHODS

TIU-PMA-T115

CREDIT: 4 **L-T-P: 3-1-0**

1. Solution of Simultaneous Linear Equations - Direct Methods – Gauss Elimination, Gauss Jordan, LU Decomposition, Matrix Inversion.

2. Iterative Methods – Gauss - Jacobi, Gauss – Seidel

3. Relaxation method. Necessary and sufficient conditions for convergence. Speed of convergence. (Proofs not required) S.O.R. and S.U.R. methods. Gerschgorin's circle theorem. (Statement only).

4. Eigen value problem – Numerical largest value, Determination of Eigen value by iterative methods.

5. Quadratic Approximation, Cubic Spline Interpolation.

6. Least Square Curve Fitting, nonlinear regression

7. Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.

Text Books :

1. Sukhendu Dey, Shishir Gupta, Numerical Methods, McGraw Hill Pvt. Ltd.

2. P. Thangaraj, Computer-Oriented Numerical Methods, PHI Learning Pvt. Ltd.

3. Srimanta Pal, Numerical Methods: Principles, Analyses, and Algorithms, Oxford University Press.

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ADVANCED DESIGN AND ANALYSIS OF ALGORITHMS

TIU-PCS-T101

L-T-P: 3-0-0 **Credits: 3**

Introduction and basic concepts: Complexity measures, best case, worst-case and average-case complexity functions, problem complexity, review of basic data structures and algorithm design principles.
Sorting: Finding maximum and minimum, k largest elements in order; Sorting by selection, examples of different sorting algorithms.

Searching and set manipulation: Review of binary search, binary search trees, construction of optimal weighted binary search trees, Introduction to Hashing and its associated concepts.

Advanced Data Structures: Basic concepts of Fibonacci Heaps and the operations on these heaps, Introduction to Data Structures for Disjoint Sets and Disjoint-set operations, Analysis of union by rank with path compression.

Advanced Algorithm design techniques: Introduction to the Divide and conquer programming paradigm along with examples, Overview of Greedy algorithms and related problems, The Dynamic programming approach to problem solving along with relevant examples, Overview of the Amortized Analysis technique to measure algorithm efficiency.

Graphs and flow networks: Review of graph concepts and traversals, Overview of algorithms to construct minimum spanning trees, Introduction and overview of Shortest path algorithms, Network flows – Introduction to flow networks and overview of algorithms to compute maximum and minimum flows, Applications of network flow algorithms.

String processing algorithms: Introduction to String searching and Pattern matching, Overview of standard string matching algorithms.

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Computational Intractability: Introduction to NP-Hard and NP-Completeness, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs, Cook's theorem, Discussion of some standard NP-complete problems

Recommended Books:

Main Reading

1. T. H. Cormen, C. L. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, MIT Press.
2. J. Kleinberg and E. Tardos, Algorithm Design, Addison-Wesley.
3. Harry R. Lewis and Larry Denenberg, Data Structures and Their Algorithms, Harper Collins.
4. A. Gibbons, Algorithmic Graph Theory, Cambridge University Press.
5. D. E. Knuth, The Art Of Computer Programming-Vol-III, Narosa Publication

Supplementary Reading

1. Michael T. Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, John Wiley.
2. R. Sedgewick, Algorithms in C (Parts 1-5), Addison Wesley.
3. M. H. Alsuwaiyel, Algorithm Design Techniques and Analysis, World Scientific.
4. Gilles Brassard and Paul Bratley, Algorithmics : theory and practice, Prentice-Hall.
5. UdiManber, Introduction to Algorithms: A Creative Approach, Addison-Wesley.
6. Sara Baase and Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, Addison-Wesley.

ADVANCED DATABASE MANAGEMENT SYSTEMS

TIU-PCS-T103

L-T-P: 3-0-0 **Credits: 3**

Distributed Databases: Distributed DBMS Concepts and Design, Introduction, Functions and Architecture of DDBMS, Distributed Relational Database Design, Transparency in DDBMS, Distributed Transaction Management, Concurrency control, Deadlock Management, Database recovery, The X/Open Distributed Transaction Processing Model, Replication server, Distributed Query Optimization, Distribution and Replication in Oracle.

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Object Oriented Databases: Object Oriented Databases, Introduction, Weakness of RDBMS, Object Oriented Concepts, Storing Objects in Relational Databases, Next Generation, Database Systems, Object Oriented Data models, OODBMS Perspectives, Persistence, Issues in OODBMS, Object Oriented Database Management System Manifesto, Advantages and Disadvantages of OODBMS, Object Oriented Database Design, OODBMS Standards and Systems, Object Management Group, Object Database Standard ODMG, Object Relational DBMS, Postgres, Comparison of ORDBMS and OODBMS.

Web Databases: Web Technology And DBMS, Introduction, The Web, The Web as a Database, Application Platform, Scripting languages, Common Gateway Interface, HTTP Cookies, Extending the Web Server, Java, Microsoft's Web Solution Platform, Oracle Internet Platform, Semi structured Data and XML, XML Related Technologies, XML Query Languages.

Intelligent Databases: Enhanced Data Models for Advanced Applications, Active Database Concepts And Triggers, Temporal Database Concepts, Deductive databases, Knowledge Databases.

Current Trends: Mobile Database, Geographic Information Systems, Genome Data Management, Multimedia Database, Parallel Database, Spatial Databases, Database administration, Data Warehousing and Data Mining.

Recommended Books:

Main Reading

1. Thomas M. Connolly, Carolyn E. Begg, Database Systems - A Practical Approach to Design, Implementation, and Management, Pearson Education

Supplementary Reading

1. Ramez Elmasri and Shamkant B.Navathe, Fundamentals of Database Systems, Pearson Education.
2. M.Tamer Ozsuand Patrick Ualduriel, Principles of Distributed Database Systems, Pearson Education.
3. C.S.R. Prabhu, Object Oriented Database Systems, PHI.
4. Peter Rob and Corlos Coronel, Database Systems – Design, Implementation and Management, Thompson Learning, Course Technology.

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CRYPTOGRAPHY AND INFORMATION SECURITY

TIU-PCS-E101

L-T-P: 3-1-0 **Credits: 4**

Introduction to Cryptography: Terminology, Security Aspects, Attack Models, Classical Cryptography, Shift Cipher, Substitution Cipher, Vigenere Cipher, Basic Cryptanalysis.

Mathematics of Cryptography: Groups, Rings, and Fields, Integer Arithmetic, Modular Arithmetic, The Euclidean Algorithm, Finite Fields of The Form GF(p), Polynomial Arithmetic, Finite Fields Of the Form GF(2n), Linear Congruence.

Introduction to Number Theory: Prime Numbers, Primality Testing, Factorization, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Discrete Logarithms.

Conventional Encryption: Attacks on Encryption Schemes, Perfect Security, Cipher Machines, Modes of Operation (ECB,CBC, CFB, OFB), Multiple Encryption, DES, Triple-DES, AES,RC4 Stream Cipher, Attacks onDES.

Pseudo-random Number Generators (PRNGs) : Random and Pseudorandom Numbers, Next-bit Test, Removing Biases, ANSI X9.17 Generator Blum-Blum-Shub Generator, Statistical Tests.

Hash Functions and MAC: Standard hashes (MD5, SHA-1, SHA-256/384/512, RIPEMD-160), Birthday Attack, Collision freeness and recent attacks, Message Authentication Code (MAC) Algorithms, Authenticated Encryption.

Key Establishment and Public-key Cryptography: Key Management, Diffie-Hellman Key Exchange, Attacks on Diffie Hellman, RSA, Attacks on RSA, ElGamal, Attacks on ElGamal, Semantic Security and Chosen-cipher text Security, Provably Secure Schemes.
Integrity and Digital Signature: Message Integrity, Digital Signature, Authentication Protocol, Digital Signature Standards, Attacks on Digital Signature, Variation and Applications

Recommended Books:

Main Reading:

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI.
2. Douglous Stinson, Cryptography Theory and Practice, CRC Press.
3. Neal Koblitz, A course in number theory and cryptography, Springer.
4. B. Preneel, C. Paar and J. Pelzl, "Understanding Cryptography: A Textbook for Students and Practitioners".

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Supplementary Reading:

1. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press.
2. Johannes A. Buchmann, Introduction to Cryptography, Undergraduate text in Mathematics, Springer.
3. Das and C. E. VeniMadhavan, Public-Key Cryptography: Theory and Practice, Pearson Education Asia.
4. Victor Shoup, A Computational Introduction to Number Theory and Algebra, Cambridge University Press.

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ADVANCED THEORY OF COMPUTATION

TIU-PCS-E103

L-T-P: 3-1-0 **Credits: 4**

Brief review: Regular Languages, DFA. Non determism, NFA Minimization, Myhill-Nerode theorem.

Computability: Turing Machines, Enumeration of Turing Machines, Undecidability. Rice-Myhill-Shapiro theorem. Resource bounded computation. Notion of a computational resource.Tape reduction, Speedup theorems.

Time Complexity: Crossing Sequences and their applications. Hierarchy theorems.P vs NP.Time Complexity classes and their relationships. Notion of completeness, reductions.Cook-Levin Theorem.

Space Complexity: Space as a resource. Savitch's theorem, Inductive Counting. PSPACE, L and NL

Recommended Books:

Main Reading:

1. Mishra and Chandrasekaran, Theory of Computer Science, PHI
2. John E. Hofcroft, Formal Language and Automata Theory, Pearson
3. Dexter Kozen, Automata and Computability, Springer

Supplementary Reading:

1. Michael Sipser, Introduction to the Theory of Computation, PWS
2. Sanjeev Arora, Computational Complexity - A Modern Approach, Cambridge University Press

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KNOWLEDGE REPRESENTATION & REASONING

TIU-PCS-E105

L-T-P: 3-1-0 **Credits: 4**

Introduction: Including example problems, problem representation via logic, computer assisted reasoning in mathematics. Elementary set theory: What is a set, a relation, a function, set operations (intersection, union, etc),properties of binary relations (reflexivity, symmetry, transitivity, etc). Propositional logic: Theory, language, models, validity and satisfiability, inference rules, soundness and completeness, reasoning methods: truth tables, proof by contradiction. First-order logic: First order logic formulae, their meaning, validity and satisfiability, translating between natural language and first-order logic. Early knowledge representation formalisms: Non monotonic inheritance networks, frame-based systems. First-Order Logic: First order logic formulae, their meaning, reasoning problems, useful normal forms, inference calculus, undecidability and semi-decidability.

Modal Logic: Representation and reasoning on the semantic level: Modal logic, possible worlds semantics, model checking, satisfiability and validity, correspondence theory. Modal Logic: Reasoning calculi, agent applications: Logically omniscience problem, belief logic, epistemic logic, deduction in Hilbert systems, deduction via translation to first-order logic. Description logics: Language of description logics, meaning of description logic statements, reasoning calculi, introduction to the semantic web and ontologies using description logics. Icom: EER diagrams, relationship between EER diagram and description logic, reasoning about EER diagrams.

Non-standard reasoning services in description logics: Least common subsumes, most specific concepts, and their usage in description logic applications. Temporal logic: The temporal logic LTL, its extension to temporaries modal and description logics, their applications. Defaults, in propositional and first order logic: Defaults, motivation for ordered defaults, e.g. in description logics, their applications.

Recommended Books:

Main Reading

1. J. Hendler, H. Kitano, Handbook of Knowledge Representation, Elsevier
2. R.J. Brachman, H.J. Levesque, Knowledge Representation and Reasoning, Elsevier

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Supplementary Reading

1. Baader, Franz et al (eds.), Theory, implementation and applications, Cambridge University Press.
2. Logic in Computer Science: modeling and reasoning about systems, Huth, Michael and Mark Ryan, Cambridge University Press.

ADVANCED DIGITAL SIGNAL PROCESSING

TIU-PCS-E107

L-T-P: 3-1-0 **Credits: 4**

Introduction: Mathematical description of change of sampling rate– Interpolation and Decimation, Filter implementation for sampling rate conversion – direct form FIR structures, DTFT, FFT, Wavelet transform and filter bank implementation of wavelet expansion of signals.

Estimation and Prediction Techniques
Discrete Random Processes – Ensemble averages, Stationary processes, Autocorrelation and Auto covariance matrices. Parseval's Theorem, Wiener- Khintchine Relation – Power Spectral Density AR, MA, ARMA model based spectral estimation. Parameter Estimation, Linear prediction – Forward and backward predictions, Least mean squared error criterion – Wiener filter for filtering and prediction, Discrete Kalman filter.

Digital Signal Processor
Basic Architecture – Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA.

Application of DSP: Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control.

VLSI Implementation: Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

Recommended Books:

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Main Reading:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modelling", JohnWiley and Sons, Inc.
2. John G.Proaks, Dimitris G. Manolakis, "DigitalSignal Processing", Pearson Education.

Supplementary Reading:

1. Bernard Widrow, Samuel D. Stearns, Adaptive Signal Processing", Pearson Education, third edition.
2. Dionitris G. Manolakis, Vinay K. Ingle, Stepen M. Kogon,"Statistical & Adaptive signal processing, spectral estimation, signal modeling, Adaptivefiltering &Array processing", McGraw-Hill.
3. S. Salivahanan, A. Vallavaraj and C. Gnanapriya, "Digital Signal Processing", TMH.
4. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", Thomson India.
5. Lars Wanhammer, "DSP Integrated Circuits", Academic Press.
6. Ashok Ambardar,"Digital Signal Processing: A Modern Introduction", Thomson India edition.

MOBILE COMPUTING AND WIRELESS COMMUNICATIONS

TIU-PCS-E109

L-T-P: 3-1-0 **Credits: 4**

Module 1: MOBILE COMPUTING

Introduction: Challenges in mobile computing, coping with uncertainties, resource poorness, bandwidth, etc. Cellular architecture, co-channel interference, frequency reuse, capacity increase by cell splitting. Evolution of mobile system: CDMA, FDMA, TDMA, GSM.

Mobility Management: Cellular architecture, Co-channel interference, Mobility: handoff, types of handoffs; location management, HLR-VLR scheme, hierarchical scheme, predictive location management schemes. Mobile IP, cellular IP.

Publishing & Accessing Data in Air: Pull and push based data delivery models, data dissemination by broadcast, broadcast disks, directory service in air, and energy efficient indexing scheme for push based data delivery.

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File System Support for Mobility: Distributed file sharing for mobility support, Coda and other storage manager for mobility support.

Ad hoc Network Routing Protocols: Ad hoc network routing protocols, destination sequenced distance vector algorithm, cluster based gateway switch routing, global state routing, fish-eye state routing, dynamic source routing, ad hoc on-demand routing, location aided routing, zonal routing algorithm.

Mobile Transaction and Commerce: Models for mobile transaction. Kangaroo and joey transactions, team transaction. Recovery model for mobile transactions. Electronic payment and protocols for mobile commerce.

Module 2: WIRELESS COMMUNICATION

Overview of current wireless systems and standards; wireless channel models- path loss and shadowing models; statistical fading models; narrowband and wideband fading models; MIMO channels. Diversity in wireless communications - Non-coherent and coherent reception; error probability for uncoded transmission; realization of diversity: time diversity; frequency diversity: DSSS and OFDM; receiver diversity: SC, EGC and MRC; transmit diversity: space-time codes; Information theory for wireless communications- Capacity of fading channels: ergodic capacity and outage capacity; high versus low SNR regime; water filling algorithm; capacity of MIMO channels; Multiuser wireless communications: multiple access: FDMA, TDMA, CDMA and SDMA schemes; interference management: power control; multiuser diversity, multiuser MIMO systems.

Recommended Books:

Main Reading:

1.Jochen Schiller, Mobile Communications, Addison-Wesley.
2. Theodore S. Rappaport, Wirelass Communications – Principles and Practice, Prentice Hall
3. Stojmenovic and Cacute, Handbook of Wireless Networks and Mobile Computing, Wiley
4. A. J. Goldsmith, Wireless Communications, Cambridge University Press
5. A. F. Molisch, Wireless Communications, John Wiley
6. S. Haykin and M. Moher, Modern Wireless Communications, Pearson

Supplementary Reading:

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1. Mazliza Othman, Principles of Mobile Computing and Communications, SPD Publication.
2. Dr. ItiSahaMisra, Wireless Communication And Networks: 3G & Beyond, Mc-Grow Hill

MACHINE LEARNING

TIU-PCS-E111

L-T-P: 3-1-0 **Credits: 4**

UNIT-1

Introduction, Linear Classification, Perceptron Update rule, Perceptron convergence, generalization, Maximum Margin classification, Classification errors, regularization, Logistic regression, linear regression,

UNIT-2

Estimator bias and variance , active learning, Non-linear prediction, kernals, kernal regression, Support vectormachine(SVM) and kernels, kernel optimization, model selection, Model selection criteria

UNIT-3

Description length, Feature Selection, Combining Classifiers, boosting, margin, and complexity, margin and generalization, mixture models, Mixture and expectation maximization (EM) algorithm, Regularization.

UNIT-4

Clustering, Spectral Clustering, Markov Models, Hidden Markov Models(HMM), Bayesian Networks, Learning Bayesian Networks, Probabilistic inference, Collaborative filtering.

Recommended Books:

Main Reading

1. Pattern Classification., Richard, Duda, Peter Hart and David Stork, Wiley Interscience.
2. Machine Learning., Tom Mitchell, Tom, McGraw-Hill
3. Neural Networks for Pattern Recognition, Oxford University Press

Supplementary Reading

1. The Elements of Statistical Learning: Data Mining, Inference and prediction., Hastie, T.,
2. R. Tibshirani and J.H Friedman . , NY. Springer, ISBN: 9780387952840

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3. Information Theory, Interference and learning algorithms. MacKay, David, Cambridge,UK, Cambridge University Press

ADVANCED GRAPH THEORY

TIU-PCS-E113

L-T-P: 3-1-0 **Credits: 4**

Review of basics: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group; Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem, minimum spanning trees. Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger's theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatalgirth, circumference,

Matchings: Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bi-partitie and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem;

Extremal Problems: Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces.

Directed Graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branching.

Networks and flows: Flow cuts, max flow min cut theorem, perfect square.

Random Graphs: The basic models - use of expectations, simple properties of almost all graphs, almost determined variables – use of variance, Hamiltonian cycles, the phase transition.

Recommended Books:

Main Reading

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1. Douglas B. West, Introduction to Graph Theory, Prentice Hall of India
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science. Prentice-Hall.
3. Frank Harary, Graph Theory, Narosa.

Supplementary Reading

1. R. Ahuja, T. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications, Prentice-Hall.
2. Bollobas, Bela, Modern Graph Theory, Springer.
3. R. Diestel, Graph Theory, Springer.

INFORMATION THEORY AND CODING

TIU-PCS-E115

L-T-P: 3-1-0 **Credits: 4**

Information Theory: Uncertainty and information, average mutual information and entropy.

UNIT I

Source Coding: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, coding for Discrete less sources, Source coding theorem, fixed length and variable length coding, properties of prefix codes.

UNIT II

Shannon-Fano Coding, Huffman code, Huffman code applied for pair of symbols, efficiency calculations, Lempel-Ziv codes.

UNIT III

Linear Block Codes: Introduction to Linear block codes, Generator Matrix, Systematic Linear Block codes, Encoder Implementation of Linear Block Codes, Parity Check Matrix, Syndrome testing, Error Detecting and correcting capability of Linear Block codes.

UNIT IV

Hamming Codes, Probability of an undetected error for linear codes over a Binary Symmetric Channel, Weight Enumerators and Mac-Williams identities, Perfect codes, Application of Block codes for error control in data storage Systems.

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UNIT V

Cyclic Codes: Algebraic structure of cyclic codes, Binary Cyclic code properties, Encoding in systematic and non-systematic form, Encoder using (n-k) bit shift register, Syndrome Computation and Error detection, Decoding of Cyclic Codes.

UNIT VI

Convolutional Codes: encoding of Convolutional codes, Structural properties of Convolutional codes, state diagram, Tree diagram, Trellis Diagram, maximum, Likelihood decoding of Convolutional codes.

UNIT VII

Viterbi Algorithm, Fano, Stack Sequential decoding algorithms, Application of Viterbi and sequential decoding.

UNIT VIII

Bch Codes: Groups, fields, binary Fields arithmetic, construction of Falois fields GF (2m), Basic properties of Falois Fields, Computation using Falois Field GF (2m) arithmetic, Description of BCH codes, Decoding procedure for BCH codes.

Recommended Books:

Main Reading

1. SHU LIN and Daniel J. Costello, Jr. "Error Control Coding – Fundamentals and Applications", Prentice Hall Inc.

Supplementary Reading:

1. Bernard sklar,"Digital Communications – Fundamental and Application", Pearson Education, Asia.
2. Man Young Rhee, "Error Control Coding Theory", McGraw Hill.

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