TRIPURA UNIVERSITY

MASTER OF TECHNOLOGY (M.TECH)

IN

COMPUTER SCIENCE AND ENGINEERING

CURRICULUM STRUCTURE

FIRST & THIRD SEMESTER: JULY-DECEMBER
SECOND & FOURTH SEMESTER: JANUARY-JUNE

Tripura University (A Central University)
Suryamaninagar, Agartala, Tripura West-799022

Program Outcomes (PO)

The Program outcomes (PO) of M.Tech (CSE) are given below:

PO1: Knowledge about Technology: Students will have an understanding of the basic foundations of computing.

PO2: Problem Analysis Ability: Students will have an ability to adapt existing models, techniques, algorithms, etc. for efficiently solving problems.

PO3: Technology and Society: Students will have an ability to design, develop and evaluate new computer based systems for novel applications which meet the desired needs of real world.

PO4: Modern Technology: Students will have an ability to undertake original research at the computer vision & its related areas.

PO5: Problem Solving: Students will have an ability to independently carry out research /investigation and development work to solve practical problems.

PO6: Professional Ethics: Students will have an understanding of professional and ethical responsibility.

PO7: Society and IOT: Students will have an understanding of the impact of Internet of Things (IoT) related solutions in an economic, societal and environment context.

PO8: Technical Skill Development: Students will have an ability to apply mathematical foundations and algorithmic principles for modeling and simulation of engineering problems.

PO9: Communication Skill Development: Students will have an ability to write and present a substantial technical report/document.

PO10: Lifelong Learning: Students s will have an ability to learn independently and engage in lifelong learning.

SYLLABUS FOR M.TECH IN COMPUTER SCIENCE AND ENGINEERING (CSE)

M.Tech(CSE) Semester: I								
Theoretical Courses	**Subject Code**	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core / Optional/ Elective**
Paper-I	CSE 901C TH	Design & Analysis of Algorithms	100	04	0	0	04	C
Paper-II	CSE 902C TH	Wireless Communication & Mobile Computing	100	04	0	0	04	C
Paper-III	CSE 903C TH	Image Processing	100	04	0	0	04	C
Paper-IV	CSE 904C TH	Probability and Random Process	100	04	0	0	04	C (Offered by Department of Statistics)
Paper-V		Computer Skills 3	100	04	0	0	04	(As per University Norms) Compulsory Foundation
Sessional Courses	**Subject Code**	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core / Optional/ Elective**
Sessional 1	CSE 905C PR	Image Processing Lab	100	0	0	04	02	C
Sessional 2	CSE 906C PR	Mobile Computing Lab	100	0	0	04	02	C
Total			**700**	**20**	**0**	**08**	**24**	

Note.: C –Core, E- Elective, P – Practical, L- Lectures, T- Tutorial

M.Tech(CSE) Semester: II								
Theoretical Courses	**Subject Code**	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core/Optional/Elective**
Paper-VI	CSE 101E TH	Elective Papers:	100	04	0	0	04	E (Offered by Deptt. of CSE)
	CSE 1001 E1	Pattern Recognition						
	CSE 1001 E2	Software Engineering						
Paper-VII	CSE 1002C TH	Theory of Computation	100	04	0	0	04	C
Paper-VIII	CSE 1003C TH	Network Security & Cryptography	100	04	0	0	04	C
Paper-IX	CSE 1004E TH	Elective Papers:	100	04	0	0	04	E (Offered by Deptt. of CSE)
	CSE 1004 E1	Distributed Computing						
	CSE 1004 E2	Introduction of Quantum Computing						
Sessional Courses	**Subject Code**	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core / Optional/ Elective**
Sessional 1	CSE 1005C PR	Term Paper Leading to Thesis	100	0	0	04	02	C
Sessional 2	CSE 1006C PR	Design project	100	0	0	04	02	C
Total			**600**	**16**	**0**	**08**	**20**	

Note.: C –Core, E- Elective, P – Practical, L- Lectures, T- Tutorial

M.Tech(CSE) Semester: III Thesis Identification, Literature Survey and Plan of Work (Thesis: Phase-I)							
Subject Code	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core / Optional/ Elective**
CSE 1101C PR/CSE 1101E PR	Thesis Report Interim	100	0	0	04	04	Core (Open Elective for other Departments)
CSE 1102C PR/CSE 1102E PR	Thesis Seminar Interim (Presentation & VIVAVOCE)	200	0	0	04	04	Core (Open Elective for other Departments)
CSE 1103C PR	Technical Communication	100	0	0	04	02	C
CSE 1104C PR	Workshop and Seminars	100	0	0	02	02	C
CSE1105E TH	Elective Papers:	100	04			04	E
CSE 1105 E1	Business Ethics						E (Offered by Deptt. of MBA)
CSE 1105 E2	Fuzzy Set Theory						E (Offered by Deptt. of Mathematics)
CSE 1105 E3	Financial Management						E (Offered by Deptt. of Commerce)
CSE 1105 E4	Modern Control Systems						E (Offered by Deptt. of Electrical Engineering)
CSE 1105 E5	Big Data and Data Science						E (Offered by Deptt. of CSE)
CSE 1105 E6	IOT Applications and Communication Protocols						E (Offered by Deptt.of CSE)
CSE 1105 E7	Object Detection under Adverse Weather Conditions in Computer Vision						E (Offered by Deptt. of CSE)
CSE 1105 E8	Fluid Mechanics						E
Total		**600**	**04**	**0**	**14**	**16**	

Note.: C –Core, E- Elective, P – Practical, L- Lectures, T- Tutorial

M.Tech(CSE) Semester: IV Thesis Implementation (Thesis: Phase-II)							
Subject Code	**Subject Name**	**Marks**	**L**	**T**	**P**	**C**	**Core / Optional / Elective**
CSE 1201C PR/CSE 1201E PR	Thesis Report Final	200	0	0	08	08	Core (Open Elective for other Departments)
CSE 1202C PR/CSE 1202E PR	Thesis Seminar Final (Presentation &VIVAVOCE)	200	0	0	08	08	Core (Open Elective for other Departments)
CSE 1203C PR	Workshop and Seminars	100	0	0	02	02	C
CSE 1204E TH	Open Elective Paper	100	04			04	Open Elective*
Total		**600**	**04**	**0**	**18**	**22**	

* Open Elective: As offered by other departments of Tripura University in respective semester under CBCS

Note.: C –Core, E- Elective, P – Practical, L- Lectures, T- Tutorial

Total Credits: 82

SYLLABUS FOR M.TECH IN COMPUTER SCIENCE AND ENGINEERING

First Semester (Total Marks: 700, Total Credit: 24)

Theoretical Courses

Paper-I

CSE 901C TH: Design & Analysis of Algorithms **Credit:4**

Course Outcomes (CO):

i. Understand different complexity measures to analyze the complexity/performance of different algorithms.
ii. Understand advanced techniques such as greedy algorithms, dynamic programming and know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems.
iii. Understand and conduct mathematical proofs for computation and algorithms.

Syllabus:

Introduction: What is Algorithm? Algorithm and its specification. Time Complexity: Asymptotic Notation, Standard Notation and Common Functions, Asymptotic Analysis(Best, Worst, Average Case). Different cases of Time Complexity of Binary Search and Linear Search, Bubble Sort, Quick Sort, Merge Sort, Tournament Sort, Bucket Sort or Radix Sort, Insertion Sort, Selection Sort.
Greedy Algorithm: Activity Selection Problem, Elements of the Greedy Policy, Hoffman Coding, Task Scheduling Problem, Coin Changing Problem/Algorithm, Prim's Algorithm And Kruskal's Algorithm And Comparisons. Knapsack Problem. Scheduling with Minimizing Time in the System.
Shortest Path Algorithm: Dijkstra Algorithm,
Divide and Conquer Method: Multiplying large integers. Strassen Matrix Multiplication. **Dynamic Programming:** Elements of Dynamic Programming, Making Change, Knapsack Problem, Shortest Path (Floyd Algorithm), Matrix Chained Multiplication, Assembly Line Scheduling.
Exploring Graphs: Introduction,
Traversing Trees: Pre order, Post order Numbering. DFS, BFS, Acyclic Graphs. **Backtracking:** Knapsack Problem, Eight Queen's Problem
Branch and Bound: Assignment Problem.
Graph Algorithms:Single Source Shortest Path: Bellman Ford Algorithm, Dijkstra Algorithm.
All Pairs Shortest Path: Short Path of Floyd Warshall Algorithm, Johnson's Algorithm. **Computational Complexity:** Introduction to NP completeness, The Classes P and NP, Polynomial Reduction, NP Cook's Therom Complete Problems NP-completeness; Redurndancy. Approximation algorithms; Randomized algorithms; Linear programming; Special topics: Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primality testing, cryptographic computations),

References:

1. T. Cormen, C. Leiserson, R. Rivest, and C. Stein. Introduction to Algorithms (2nd edition). MIT Press/ McGraw-Hill

2. Michael T. Goodrich and Roberto Tamassia. Algorithm Design: Foundations, Analysis, and InternetExamples. John Wiley & Sons
3. J. Kleinberg and É. Tardos. Algorithm Design. Addison-Wesley, 2005
4. Hovwitt and Sahani, " Fundamental of Algorithm.

Paper-II

CSE 902C TH: Wireless Communication & Mobile Computing **Credit:4**

Course Outcomes (CO):

i. Learn the basics of wireless communications.
ii. Demonstrate fundamentals of different generations of cellular network architectures.
iii. Apply TCP/IP of mobile and wireless network
iv. Examine the security, energy efficiency, mobility etc. as well as their special features.

Syllabus:

Wireless Communication – Wired and wireless, Mobility of users and equipments, Overview of Electromagnetic Spectrum. Overview of Satellite Networks. Concepts of Spread Spectrum, CDMA System. Concepts of Cellular Network and related technologies like GSM, 3G network architecture and operations, 4G LTE network architecture and operations, Different architectural entities of 5G network and theiroperations, Migration from LTE to 5G.

Mobile Computing – Characteristics, Infrastructure vs Infrastructureless Networks, Wireless LANs - Data link layer protocols, TCP protocols. Routing Protocols in Mobile Adhoc Network (MANET), Overview of Bluetooth Technology. Overview of Sensor Networks. Concepts of Mobile IP, Wireless Application Protocols and others. Overall security requirements and considerations in wireless and mobile computing systems. Concepts of fault tolerance.

References:

1. V.K.Garg & J.E.Wilks:Wireless and Personal Communication Systems: Fundamentals and Applications, IEEE Press and Prentice Hall,1996.
2. T.S.Rappaport, B.D.Woerner and J.H. Reed:Wireless Personal Communications: The Evolution ofPCS,Dkyener Academic,1996.
3. G.I. Stuber: Principles of Mobile Communication, Kluener Academic,1996.
4. U.Black: Mobile and Wireless Networks, Prentice Hall PTR,1996.
5. Charles Parkins – Mobile Adhoc Networks
6. Wireless Communication- W. Stallings
7. Mobile Communication – J. Schiller
8. Introduction to Wireless and Mobile Systems – Dharma Prakash Agarwal and Qing-An Zeng
9. Mobile Computing – Raj Kamal
10. Research Papers of International Journals, Proceedings of Conferences and other online resources.

Paper-III

CSE 903 TH: Image Processing **Credit:4**

Course Outcomes (CO):

i. Understand the basic theory and algorithms/ techniques that are widely used in digital image processing.
ii. Understand image analysis algorithms.
iii. Understand current applications of Image Processing.
iv. Develop hands-on experience in using computers to process images.

Syllabus:

Introduction, image definition and its representation, neighbourhood. Orthogonal transformations like DFT,DCT, Wavelet.

Enhancement: contrast enhancement, smoothing and sharpening, filtering and restoration

Segmentation: pixel classification, global/local gray level thresholding, region growing, split/merge techniques, edge detection operators, Hough transform. Image feature/primitive extraction, component labelling, medial axis transform, skeletonization/thinning, shape properties, textural features – moments, gray level co-occurrence matrix, structural features, Fourier descriptor, polygonal approximation. Compression: coding, quantization, spatial and transform domain-based compression. Color image processing: color model, enhancement, and segmentation.

Mathematical morphology: basic concepts, erosion, dilation, opening, closing. Advanced applications likebiomedical image processing, digital watermarking, etc

References:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Addison-Wesley, California, 1993.
2. Rosenfeld and A. C. Kak, Digital Picture Processing, Vol. 1 & 2, 2nd ed. Academic Press, Inc. 1982.
3. Chanda and D. Dutta Mazumdar, Digital Image Processing and Analysis, Prentice Hall of India, NewDelhi, 2000.

Paper-IV

CSE 904C TH: Probability and Random Processes **Credit:4**

Course Outcomes (CO):

i. Understand concepts of probability, conditional probability and independence.
ii. Understand the axiomatic formulation of modern Probability and the concept of random processes and determine covariance and spectral density of stationary random processes.
iii. Understand and apply the concepts of filtering and prediction of a random process.

Syllabus:

1. **Sample space and events**, Probability axioms, conditional probability, independence of events, Bayes' rule. [3 lectures]
2. **Random variables** -discrete and continuous. Expectations, Moments, Tchebyshev's inequality, Characteristic function. Functions of one random variable. [6 lectures]
3. **Discrete distributions**: Binomial, Poisson, and continuous distributions: uniform, normal, exponential, gamma, Weibull etc. [7 lectures]

4. **Stochastic convergence** and limit theorems. [4 lectures]
5. **Mean Square Estimation**– linear regression. [3 lectures]
6. **General concepts** of stochastic processes, Markov chains, Markov processes [5 lectures]
7. **Power spectrum**, spectral representation, basic spectral estimation, [3 lectures]
8. **Entropy** [2 lectures]
9. **Random walks,** shot noise, deterministic signals in noise, [3 lectures]
10. **Queuing theory** (M/M/1 and M/M/C). [4 lectures]

References:

1. Probability, Random Variables and Stochastic Processes – fourth Edition" by A. Papoulis and S. U.Pillai, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Probability & Statistics with Reliability, Queuing and Computer Science Applications. Kishore S.Trivedi. Eastern Economy Edition, PHI.
3. Stochastic Processes. J. Medhi. 3rd Edition, New Age. International, 2009.
4. *Fundamentals* of *Mathematical Statistics*: A Modern Approach. S. C.*Gupta* (Prof.), Dr. V. K.
   Kapoor. Edition,Publisher, Sultan Chand, 2000.

Paper V

Computer Skill-III

Credit:4

Course Outcomes (CO):

i. Understand the various insights and fundamentals of programming languages (python/ C/ C++/ Java).
ii. To implement and solve various real world research problems using programming languages.
iii. Develop problem-solving skills: Think logically, computationally, and creatively to solve problems.
iv. To Identify and analyze a problem, design a solution algorithm as a systematic way of processing the necessary information to produce the required output, and implement the solution as a computer program.
v. Gain a broad exposure to topics in computing and its related disciplines.

Syllabus:

Python/ JAVA programming Language

Prescribed by the University centrally.

Sessional Courses

Sessional 1

CSE 905 PR: Image Processing Lab **Credit:2**

Course Outcomes (CO):

i. Develop hands-on experience in using computers to process images and solve various real world problems.
ii. Develop skills using programming languages for realization and implementation of image processing problems.

Syllabus:

Understanding about different types of Digital images; Conversion between image data types; Basics of image display; Arithmetic Operations; Histogram Analysis; Neighborhood Processing; Image Geometry; The Fourier Transform of an image; Image Segmentation, Edge Detection; Morphological Operation; Color Image Processing; Image Compression; Wavelet Analysis

References Book:

1. "Digital Image Processing using Matlab", Rafael C. Gonzalez, Richard E. Woods, Steven Eddins.
2. "Mastering in Matlab", Duane C. Hanselman. Pearson Education.

Sessional 2

CSE 906 PR: Mobile Computing Lab **Credit:2**

Course Outcomes (CO):

i. Learn the implementation of CDMA.
ii. Understand the frequency of the distribution in cellular network.
iii. Implement different routing protocols of ad-hoc network in different simulation tools.
iv. Pursue their research work in the field of Mobile Computing.

Syllabus:

Implementation of Code Division Multiple Access (CDMA); Write a program to divide a given area into equal hexagon and divide the given frequency range into the cells to create clusters; Study of Network Simulation tools; Implementation of AODV, DSR, OLSR and other routing protocols in simulation tool and their study; Implementation of wireless sensor network in simulation tool; Study assignment on: Bluetoothand Wireless Application Protocol (WAP).

References:

1. Mobile Communication – J. Schiller.
2. Mobile Computing – Raj Kamal.
3. Reseach Papers of International Journals, Proceedings of Conferences and other online resources.

Second Semester (Total Marks: 600, Total Credit:20)

Theoretical Courses

Paper-V

CSE 101E TH: Elective Papers **Credit:4**

CSE 101E1: Pattern Recognition

Course Outcomes (CO):

i. Understand the basics and fundamentals of statistical techniques commonly used in pattern recognition problem.
ii. Understand the concepts of machine learning and deep learning techniques and various real world problems that can be handled by learning algorithms/ techniques.
iii. Compare and contrast different pattern recognition algorithms.
iv. Apply the concepts of machine learning and deep learning algorithms in real life problems.
v. Understand the concepts of decision making and modelling as a problem solving approach.

Syllabus:

Introduction to pattern recognition and learning (supervised, unsupervised), training and test sets, feature selection.
Supervised learning and classification: Discriminant functions and decision boundaries Linear discriminant functions, relaxation procedure, non-separable behaviour Minimum distance classifier. Bayesian decision theory.Maximum likelihood classification. Parameter estimation, sufficient statistics, component analysis and discriminants (PCA, Fisher's) Nonparametric techniques. Density estimation, Parzen window, K-NN estimation, Decision Tree, SVM.
Unsupervised learning and clustering: Data description and clustering –similarity measures, criterion for clustering, Methods of clustering – partitional: KMean, KMode, KMedian, FCN, hierarchical, graph theoretic, density based, Cluster validity
Feature extraction and feature selection: Problems of dimensionality- Feature extraction --PCA-Feature selection –KarhunenLoeve, stochastic approximation, kernel approximation, divergence measures

References:

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York, 2000.
2. J. T. Tou and R. C. Gonzalez, Pattern Recognition Principles, Addison-Wesley, London, 1974.

CSE 101 E2: Software Engineering

Introduction and Brief Overview - Software process, modeling and analysis, software architecture, software design. **Software Modeling, Analysis, Testing** - Analysis modeling and best practices, traditional practice diagrams such as DFDs and ERDs etc, **Traditional Testing techniques** – white box and black box testing. **Object-Oriented Software Engineering - Concept of OO Software** – Design and Analysis, Overview of various UML diagrams and UML analysis modeling, analysis case studies, analysis tools, analysis patterns, OO software testing. **Case study with complete examples Software Architecture** -

Architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and interoperability issues, web application architectures, case studies. **Software Design** - Design best practices, design patterns, extreme programming, refactoring, design case studies, component technology, object oriented frameworks, distributed objects, object request brokers, case studies. Web Engineering, Clean room Engineering and other recent topics.

References:

1. G. Booch, J. Rumbaugh, and I. Jacobson, I. The Unified Modeling Language User Guide. Addison-Wesley, 1999
2. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley, 1995
3. M. Shaw and D. Garlan. Software Architecture: Perspectives on an Emerging Discipline. Prentice-Hall, 1996
4. L. Bass, P. Clements, and R. Kazman. Software Architecture in Practice, Addison-Wesley, 1998
5. J. Rumbaugh, I. Jacobson, and G.Booch. The Unified Modeling Language Reference Manual. Addison Wesley Longman, 1999.
6. Jacobson, G. Booch, and J. Rumbaugh, and I. Jacobson. The Unified Software Development Process. Addison Wesley Longman, 1999.
7. J. Rumbaugh, M. Blaha, W. Premerlani, F. Eddy, and W. Lorenson. Object-oriented Modeling and Design. PHI, EEE, 1997.
8. G. Booch. Object-Oriented Analysis and Design with Applications. Second Edition. Benjamin Cummings, 1994.
9. Jim Conallen. Building Web Applications with UML. Addison-Wesley, 2000.
10. K. Beck. Extreme Programming Explained. Pearson Education Asia, 2000.
11. Software engineering – design, reliability and management – Schuman Mar.
12. Software engineering – Pressman.

Paper-VII

CSE 1002C TH: Theory of Computation

Credit:4

Course Outcomes (CO):

i. Understand the requirements and applications of each phase of compiler and various compilation techniques needed to obtain high performance on modern computer architectures.
ii. Understand different optimization techniques and difference between them.
iii. Understand formal language theory and its application to computer science.
iv. Apply mathematical preliminaries to develop the basic components of language design.
v. Design simple computational machines using the concepts of language theory Correlate computability with formal computational machines.

Syllabus:

Optimization and decision problems, Reductions, Turing Machine as an acceptor and as an enumerator— **Techniques of Turing Machine construction** – parallel tracks and storage in control, subroutine Turing Machine, Church-Turing thesis, **Variants of Turing Machine** –multitape, **nondeterministic**—their equivalences with other models. Properties of recursively enumerable and recursive sets. Relations between unrestricted grammars and Turing Machines. **Linear Bounded Automata** —relation with Context Sensitive

Languages Enumeration of Turing Machines, existence of undecidable problems, Undecidable problems involving Turing Machines and CFG's. Universal Turing Machine as a model of general-purpose computer, **Post Correspondence Problem** – Applications, valid and invalid computations of Turing Machines. Time and Space complexity of Turing Machines, NP- completeness.

References:

1. John C. Martin: Introduction to languages and the theory of computation, 2nd Ed., McGraw Hill.
2. D.P. Bovet & P. Gescenzi: Introduction to Theory of Complexity, PH.
3. Rozenberg&Salomaa: Handbook of Formal languages, Vol. I&II.

Introduction: Introduction to language theory, tokens. Alphabets, definition of grammar Production rules, sentences, sentential forms, language definitions, derivations. **Regular languages:** Pumping Lemma of regular sets, Minimization of finite automata. Chomsky Hierarchy of languages. **Finite Automata:** Finite automaton, Deterministic, Non-Deterministic and equivalence. Transition diagrams, epsilon transitions, Equivalence of regular expressions and FA. Moore and Mealy machines. **Context Free Language:**

Relations between classes of languages, Context Free Grammar, Derivation trees, ambiguity simplification, Normal forms, applications. **Lexical Analysis:** Interface with input, parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, error reporting, and implementation. Regular definition, Transition diagrams, LEX. **Syntax analysis:** context free grammars, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, Bottom up parsing, operator precedence grammars, LR parsers (SLR, LALR, LR), YACC. **Pushdown Automata:** Pushdown automata, definitions, context free languages, construction of PDA for simple CFLs, Linear bounded automata. **Turing machines:** Turing machines, Introduction to computability, Universal Turing Machines, Types of Turing Machines, Techniques for construction of Turing machines, Halting problem. Assembler, Loader, Linker: basic concept; absolute and Relocatable, assemblers and macroprocessors Linkers- concept and design; loaders, different types. Editors and debuggers. Interpreters. Compilers: - Various phases; lexical analyzers- design. Parsing top down (L.L. (1) and recursive descent), bottom- up, (Shift – reduce concept to L.R. (1) symbol tables, error handling. Syntax – directed Translation – attributes and intermediate codes. Optimization concepts and machine code. Generation Use of LEX and YACC.

Reference Books:

1. John C. Martin: Introduction to languages and the theory of computation, 2nd Ed., McGraw Hill.
2. D.P. Bovet & P. Gescenzi: Introduction to Theory of Complexity, PH.
3. Rozenberg & Salomaa: Handbook of Formal languages, Vol. I&II.

Paper-VIII

CSE 1003C TH: Network Security & Cryptography **Credit:4**

Course Outcomes (CO):

i. Will be able to understand different threats and vulnerabilities of network and their countermeasures.
ii. Describe the services and processes used in network security.
iii. Use a variety of techniques for cryptography.
iv. Conduct research in the burgeoning fields of cryptography and network security.

Syllabus:

Network Security: Basic Security Concepts, Threats, Vulnerabilities, Different types of attacks, Digital Signatures, and Certification Authorities, Kerberos Key Exchange, Encryption on the World Wide Web, E-Mail Security, Operating System Security, LAN Security, Virtual Private Networks, Firewalls, Intrusion Detection, Crisis Management.

Suggested Text:

1. John E. Canavan, "Fundamentals of Network Security", Artech House, 2001.
2. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall, 2006.

References:

1. Matt Bishop and Sathyanarayana S.Venkatramanayya, "Introduction to Computer Security", Pearson Education, 2005.
2. Matt Bishop, "Computer Security: Art and Science", Pearson Education, 2003.
3. Nitesh Dhanjani and Justin Clarke, "Network Security Tools", O'Reilly, 2005.

Cryptography: Basics of stream cipher and block cipher, Methods of breaking cipher, Encryption Techniques such as, DES, IDEA, CAST, RC4, Diffie Hellman, RSA, Hashing techniques such as, MD5, SHA, Extended Euclidean Algorithm, Congruence, Chinese Remainder Theorem, Euler's Theorem, Primitive elements and conjugates in finite fields, Quadratic Reciprocity Law, Jacobi and Legendre's symbols, Gaussian Integers, Carmichael Numbers and strong pseudoprimes, Addition Chain Problems, Factorization schemes of Solovay-Strassen, Miller-Rabin, Pollard, Factor bases and Continued Fraction methods, Classical Cyphers and one time pad, Massey O'Mara, EI Gamal Schemes, Mental Poker, Access Control, Elliptic curve Cryptosystems and Factorization-Lenstra's Algorithm, Golay Code, MDS Codes, Krawtchouk Polynomials, Designs and codes-intersection numbers of t-designs.

References:

1. Bruce Schneier: Applied Cryptography, Second Edition: Protocols, Algorthms, Wiley
2. Neal Koblitz: A Course in Number Theory and Cryptography, Springer.
3. Itrlsnf& Rosen: Second Course in Number Theory, Springer.
4. Evangels Kramakis: Primality & Cryptography, John Wiley.
5. Mc Williams & Sloanne: Theory of Error Correcting Codes, Vol. I & II, Elsevier.
6. Steven Roman: Coding and Information Theory, Springer.
7. Atul Kahate: Cryptography and Network Security, Mc Graw Hill
8. Bernard Menezes: Network Security and Cryptography, Cengage Learning

Paper-IX

CSE 1004E TH: Elective Papers **Credit:4**

CSE 1004 E1: Distributed Computing

Course Outcomes (CO):

i. List and summarize the distributed computing principles, as well as the complications and difficulties that these principles entail.
ii. Understand the concepts of distributed computing, synchronous and asynchronous processes.
iii. Utilize the idea of shared data and files.
iv. Use a web-based distributed system.

v. Recognize how important distributed system security is.

Syllabus:

Introduction: Definitions, Motivations, Consequences, Examples, Advantages and Disadvantages, Design Challenges/Issues, System models, NOS, Middleware, Shared Memory Systems, Message Passing Systems, **Concept of time:** Physical Clock, Clock Drift, Skew, Clock Synchronization Algorithms, Network Time Protocol, Logical clocks, Vector Clocks, Causal ordering, Global State**Distributed Mutual Exclusion Algorithms:** Central-server algorithm, Ring-based algorithm, Lamport's algorithm, Ricart and Agrawala'salgorithm, Maekawa's voting-based algorithm, Suzuki-Kasami's Broadcast algorith, Raymond's tree-based algorithm, **Leader Election Algorithms and their complexity analysis:** LCR, HS, Chang Roberts, Peterson leader election algorithm, Bully Algorithm.**Guarded Commands -** Atomicity-Fairness Central and Distributed Schedulers. **Correctness Criteria -** proving safety and liveness properties. Client Server Computing. **Fault Tolerant Systems-**Fault Classification. **Distributed Consensus-**Byzantine Generals problem-Atomic Broadcast.

References:

1. George Coulouris: Distributed Systems: Concepts and Design, Pearson.
2. N.A.Lynch: Distributed Algorithms, Morgan Kayfmann Publishing Inc., CA,1996.
3. Tel: Introduction to Distributed Algorithms.
4. A.S. Tanenbaum: Distributed Operating Systems. Prentice Hall, N.J.,1995.

CSE 1004 E2: Introduction of Quantum

ComputingMathematical foundations and quantum mechanical principles

[8 lectures]

1. Finite dimensional inner product spaces, Hermitian and unitary operators, projection operators, commutators
2. Hilbert space as state space, Schrodinger equation and time evolution, measurement, Heisenberg uncertaintyrelation, Dirac notation, density operators, quantum entanglement

Qubits, quantum gates and quantum circuits [20 lectures]

1. Concept of qubit, representation of qubit in Bloch Sphere, Multi qubit quantum state representation
2. Single, Two and Multi-qubit quantum gates, Matrix representation of gates, universal gates for quantum computing.
3. Quantum Circuit, Reversible Computation using quantum circuits, quantum parallelism, quantum circuit representation, quantum computing language (QCL) for quantum process description, Quantum Circuit description languages
4. Quantum Adder Circuits, Quantum Fourier transform Circuit, Quantum Multiplier, Quantum Shift register.
5. Quantum Physical Machine Description, Quantum Circuit Cost.
6. Synthesis techniques for quantum circuit

Quantum algorithms [12 lectures]

1. Elements of quantum automata and quantum complexity theory.
2. Deutsch's algorithm, Deutsch-Jozsa Algorithm and the Bernstein-Vazirani Algorithm, Simon's

algorithm
3. Quantum Fourier transform, Shor's Algorithm and its applications.
4. Grover's algorithm for searching and its applications.

References:

1. Quantum Computation and Quantum Information by Michael Nielsen and Isaac Chuang, Cambridge Univ. Press.
2. P. Kaye, R. Laflamme, and M. Mosca, "An introduction to Quantum Computing", Oxford University Press

Good lecture notes:

1. John Preskill's lecture notes-http://www.theory.caltech.edu/people/preskill/ph229/
2. David Mermin's lecture notes-http://people.ccmr.cornell.edu/mermin/qcomp/CS483.html

Sessional Courses

Sessional 1

CSE 1005C PR: Term Paper Leading to Thesis

Credit:2

Course Outcomes (CO):

i. Understand the various advanced topics in computer science and engineering for real-world applications.
ii. Synthesize and integrate material from primary and secondary sources with their own ideas in research papers.

Sessional 2

CSE 1006C PR: Design Project

Credit:2

Course Outcomes (CO):

i. Solve certain real world practical problems in the domain of computer science and engineering and other interdisciplinary research areas.

Third Semester (Total Marks: 600, Total Credit: 16)

Thesis Identification, Literature Survey and Plan of Work (Thesis: Phase-I)

CSE 1101C PR: Thesis Report Interim

Credit:4

Course Outcomes (CO):

i. Conduct independent research in some advanced topics of Computer Science and Engineering and interdisciplinary research areas.
ii. Produce a thesis of publishable quality.

CSE 1102C PR: Thesis Seminar Interim (Presentation & Viva-Voce)

Credit:4

Course Outcomes (CO):

i. Effectively present and defend research orally with value added applications.

CSE 1103C PR: Technical Communication

Credit:2

Course Outcomes (CO):

i. Understand the various blocks of the writing process and apply them to technical writing tasks.
ii. Understand basic sources and methods of research and documentation on topics in computer science and engineering.
iii. Understand the ethics (Plagiarism) related to writing and publishing research works in well renowned Journals/ Conferences/ Books.

CSE 1104C PR: Workshop and Seminars

Credit:2

Course Outcomes (CO):

i. Understand advanced topics and various scope of research in the domain of computer science and engineering.
ii. Meet various well renowned researchers and experts in the domain of computer science and engineering.

CSE 1105 E TH: Elective Papers

Credit:4

CSE 1105 E1: Business Ethics
(Offered by Deptt. Of MBA)

CSE 1105 E2: Fuzzy Set Theory
(Offered by Deptt. Of Mathematics)

CSE 1105 E3: Financial Management
(Offered by Deptt. Of Commerce)

CSE 1105 E4: Modern Control System
(Offered by Deptt. Of Electrical Engineering)

CSE 1105 E5: Big Data and Data Science

Course Outcomes (CO):

i. Understand the key issues and basic building blocks of big data and its management.
ii. Understand the basic concepts of enabling techniques and scalable algorithms in the field of big data analytics.
iii. Understanding the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics.
iv. Apply algorithms to build machine intelligence.

Syllabus:

Data Science History; Pioneers; and Modern Trends, Taxonomy, The Curse of Big Data, New Types of Metrics, Three Classes of Metrics, Relationship among Metrics, 5V of Data Science **6L**

Introduction to Big data Platform, Traits of Big data, Challenges of Conventional Systems, Evolution Of Analytic Scalability, Analytic Processes and Tools, Analysis vs. Reporting **6L**

Modern Data Analytic Tools, Data Structure, Overview of R language, Data Types, Accessing Data, Cleaning Data **6L**

Basic Statistical Concepts: Sampling Distributions; Re-Sampling; Statistical Inference; Prediction Error, Hash Joins, Model-Free Confidence Intervals, K-means Clustering, Independent Sample Tests, Basic Association Analysis, Association Rule Speedup **8L**

Linear regression part 1, Linear regression part 2, Logistic regression, Naïve Bayes, Decision trees part 1, Decision trees part 2, Correlation and R-Squared for Big Data, Monte Carlo Simulations **6L**

Introduction to Hadoop/MapReduce, The MapReduce paradigm & Hadoop and HDFS overview, When to Use MapReduce, What MapReduce Can't Do, Comparison between SQL and NoSQL DBs, Overview on BigTable; Hive and Pig, Visualization tools **8L**

CSE 1105 E6: IOT Applications and Communication Protocols

Course Outcomes (CO):

i. Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration.
ii. Open source/commercial electronics platform for IoT-Raspberry Pi, Arduino , ArmMbedLPC.
iii. Open source /commercial enterprise cloud platform for IoT-Ayla, iO Bridge, Libellium, Axeda, Cisco fog cloud.

Syllabus:

Introduction and Applications:smart transportation, smart cities, smart living, smart energy, smart health, and smart learning.

Basic function and architecture of a sensor — sensor body, sensor mechanism, sensor calibration, sensor maintenance, cost and pricing structure, legacy and modern sensor network.

Development of sensor electronics — IoT vs legacy, and open source vs traditional PCB design style

Development of sensor communication protocols, Protocols: Modbus, relay, Zigbee, Zwave, X10,Bluetooth, ANT, etc.

Business driver for sensor deployment — FDA/EPA regulation, fraud/tempering detection, supervision, quality control and process management

Different kind of calibration Techniques: manual, automation, infield, primary and secondary calibration — and their implication in IoT

Powering options for sensors: battery, solar, Witricity, Mobile and PoE

Zigbee and Zwave — advantage of low power mesh networking. Long distance Zigbee. Introduction to different Zigbee chips.

Bluetooth/BLE: Low power vs high power, speed of detection, class of BLE. Introduction of Bluetooth vendors & their review. Wireless protocols such as Piconet and packet structure for BLE and Zigbee

Other long distance RF communication link. LOS vs NLOS links, Capacity and throughput calculation

Application issues in wireless protocols:power consumption, reliability, PER, QoS, LOS. PCB vs FPGA vs ASIC design. Prototyping electronics vs Production electronics. QA certificate for IoT-CE/CSA/UL/IEC/RoHS/IP65.
Basic introduction of multi-layer PCB design and its workflow
Electronics reliability-basic concept of FIT and early mortality rate
Environmental and reliability testing-basic concepts
Basic Open source platforms: Arduino, Raspberry Pi, Beaglebone
Introduction to Mobile app platform for IoT: Protocol stack of Mobile app for IoT, Mobile to server integration, iBeacon in IoS, Window Azure, Linkafy Mobile platform for IoT, Axeda, Xively
Database implementation for IoT : Cloud based IoT platforms, SQL vs NoSQL, Open sourced vs. Licensed Database, Available M2M cloud platform, AxedaXively, Omega NovoTech, Ayla Libellium, CISCO M2M platform, AT&T M2M platform, Google M2M platform.
Recent trends in home automation, IOT-locks, Energy optimization in home

References:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.
2. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li.
3. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by NicosKomninos.
4. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend

CSE 1105 E7: Object Detection under Adverse Weather Conditions in Computer Vision

Chapter-1: Introduction to Object Detection, **Chapter-2:** Challenges of adverse weathers in outdoor scenarios, **Chapter-3:** Particle behaviours in different bad weather, **Chapter-4:** scattering & absorption, **Chapter-5:** Image acquisition in presence of different particles, **Chapter-6:** Objects under thermal sensors for detection task, **Chapter-7:** Statistical feature analysis of different weather condition, **Chapter-8:** Background of Image degradation due to atmospheric/ weather conditions, **Chapter-9:** Object detection using visual sensor in degraded condition, **Chapter-10:** visibility enhancement of outdoor scenes in degraded conditions, **Chapter-11:** Influence of visibility enhancement for high level computational task in degraded outdoor scenes.

CSE 1105 E8 Fluid Mechanics

Fourth Semester ((Total Marks: 600, Total Credit: 22))

Thesis Implementation (Thesis: Phase-II)

CSE 1201C PR: Thesis Report Final **Credit:8**

Course Outcomes (CO):

i. Conduct independent research in some advanced topics of Computer Science and Engineering and interdisciplinary research areas.
ii. Produce a thesis of publishable quality.

CSE 1202C PR: Thesis Seminar Final (Presentation & Viva-Voce) **Credit:8**

Course Outcomes (CO):

i. Effectively present and defend research orally with value added applications.

CSE 1203C PR: Workshop and Seminars **Credit:2**

CSE 1204E TH: Elective Papers **Credit:4**