

Maulana Azad National Institute of Technology, Bhopal
Department of Computer Science & Engineering

**Syllabus for M.Tech (Information Security) I Semester to IV
Semester**

M.TECH- I SEMESTER

IS 511 Mathematical Foundation of Information Security

Number Theory and Algebra: Integer Arithmetic, Integers set Z , Z_n , Z_n^* , Greatest common divisors in Z , Euclidean algorithm, Extended Euclidean Algorithm, Additive and Multiplicative inverses in Z_n , Modular Arithmetic, Linear Diophantine equations, Linear Congruence, Groups, Ring, Field, Lattice, Galois Field over prime numbers and power of 2, Lattice reduction, Sieve algorithms; Euler's Phi-function, Fermat's little theorem, Euler's theorem, primality testing, factorization, Chinese remainder theorem, Quadratic congruence, Discrete logarithm problem, Index calculus algorithms; Matrices, Graph Theory in Network Security, Decision and Game Theory for Security.

COs

- Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving related to information security.
- Understand underlying Mathematical concepts required for cryptology.
- Be able to use effectively algebraic techniques for computer security.
- Understand some basic properties of graphs and related discrete structures, and be able to relate these to information security.
- Be able to use Decision and Game Theory for improvising system's security.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Cryptography and Network Security, Behrouz A. Forouzan, The McGraw-Hill.
- Introduction to Linear Algebra 5th Edition, Gilbert Strang, Wellesley Cambridge Press.
- Decision and Game Theory for Security, 6th International Conference, GameSec 201.

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IS 512 Computer and Network Security

Introduction to computer and network security. Basic concepts, threat models, common security goals, Cryptography and cryptographic protocols, including encryption, authentication, message authentication codes, hash functions, one way functions, public key cryptography, secure channels, zero knowledge in Practice, models and methods for security protocol analysis. Malicious code analysis and defense. Viruses, Worms, spyware, rootkits, botnets, etc. and defenses against them, Detecting Attackers. Software security. Secure software Engineering, defensive programming, buffer overruns and other implementation Flaws. Language based security: analysis of code for security errors, safe languages, and sandboxing techniques. Operating system security. Memory Protection, access control, authorization, authenticating users, enforcement of Security, security evaluation, trusted devices, digital rights management. Network security. Network based attacks, Kerberos, X.509, firewalls, intrusion Detection systems, DoS attacks and defense. Case studies: DNS, IPsec. Web Security. Securing Internet Communication, XSS attacks and defenses, etc. Advanced topics. Security monitoring, surreptitious communication, data remanence, trusted devices, privacy and security of low powered devices (RFID) electronic voting, quantum cryptography, penetration analysis, digital rights management and copy protection, security and the law.

COs

- To master information security governance, and related legal and regulatory issues.
- To understand external and internal threats to an organization.
- Ability to develop effective security plug-in.
- To Study protocols for security services.
- To be familiar with network security designs using available security solutions Such as PGP, SSL, IP Sec.

Textbook

- William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice Hall.

Reference book

- Computer Security: Dieter Gollman, Wiley India Introduction to Network Security, Krawetz, Cengage.

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IS 513 Cybercrime And Information Warfare

Introduction of cybercrime, the evolution of cybercrime, challenges of cyber Crime, categorizing cybercrime, cyber terrorism, virtual crimes, perception of Cyber criminals. Cyber Crime Cases: Money Laundering, Bank Fraud, Advance Fee Fraud, Malicious Agents, Stock Robot Manipulation, Identity Theft, Digital Piracy, Intellectual Property Crime, Internet Gambling. Perception of cyber criminals: hackers, insurgents and extremist groups, Interception of data, surveillance and protection, criminal copy right infringement, cyber stalking. Hiding crimes in cyberspace and methods of Concealment. Privacy in cyber space: web defacements and semantic attacks, DNS attacks, code injection attacks. The challenges of fighting cybercrime: Opportunities, General challenges, Legal Challenges Information Warfare concept: information as an intelligence weapon, attacks and retaliation, attack and defense. Information Warfare Strategies and Tactics from a Military Perspective, Information Warfare Strategies and Tactics from a Corporate Perspective, Strategies and Tactics from a Terrorist and Criminal Perspective An I-War risk analysis model, implication of I-WAR for information managers, Perceptual Intelligence and I-WAR, Handling Cyber Terrorism and information warfare, Jurisdiction.

COs

- Identify and document potential security breaches of computer data that suggest violations of legal, ethical, and/or societal standard.
- Ability to apply firewalls, data encryption, and other preventative methods.
- Learn about Anonymity techniques.
- Study of privacy and security at risk in the global information society.
- Study of Information Warfare concept.
- Ability to monitor abnormal behavior of end user through honey pot.
- Learn how information may be exploited as an intelligence weapon.

Text Book

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Principles of cybercrime, Jonathan Clough Cambridge University Press.
- Understanding cybercrime: Phenomena, challenges and legal response.
- Cyber security and cyber warp. W. Singer and Allan Friedman.
- Information Warfare: Corporate attack and defence in digital world, William Hutchinson, Mathew Warren, Elsevier.

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Departmental Elective-I

IS 531 Data Mining

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis; Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

COs

- Study of different sequential pattern algorithms
- Study the technique to extract patterns from time series data and its application in real world.
- Can extend the Graph mining algorithms to Web mining
- Help in identifying the computing framework for Big Data

Textbook

- Jiawei Han and M Kamber , Data Mining Concepts and Techniques, , Second Edition, Elsevier Publication, 2011.

Reference books

- Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
- G Dong and J Pei, Sequence Data Mining, Springer, 2007.

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IS 532 Operating System & Design

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems, Process abstraction, Process management, system calls, Threads, Symmetric Multiprocessing and microkernels. Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for Synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies, Memory management, virtual memory concept, virtual Machines, I/O management, File and disk management, Operating system Security. Distributed Operating system: architecture, Design issues, distributed mutual Exclusion, distributed deadlock detection, shared memory, Distributed Scheduling. Multiprocessor operating systems: architecture, operating system Design issues, threads, process synchronization, process scheduling, memory Management, reliability and fault tolerance.

COs

- Learn the design issues of operating system.
- Learn issues related to management of processes in different operating systems.
- Key issues in operating system security.
- Learn design issues of distributed and multiprocessor system.

Textbooks

- Operating system internal and design principles, William Stallings.
- Operating system, a concept based approach, DM Dhamdhere

Reference book

- Advanced concept in operating system M. Singhal, N.G Shivratri

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IS 533 Web Search & Information Retrieval

Information retrieval model, Information retrieval evaluation, Searching the Web, Document Representation, Query languages and query operation, Metadata search, Indexing and searching, Scoring and ranking feature vectors, Ontology, domain specific search, parallel and distributed information retrieval, Text and multimedia languages, Social networks.

COs

- To identify basic theories and analysis tools as they apply to information retrieval.
- To develop understanding of problems and potentials of current IR systems.
- To learn and appreciate different retrieval algorithms and systems.
- To apply various indexing, matching, organizing, and evaluating methods to IR problem.
- To become aware of current experimental and theoretical IR research.

Textbook

- C. D. Manning, P. Raghavan and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008 (available at <http://nlp.stanford.edu/IR-book/>).

Reference books

- Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman.
- B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, Addison-Wesley, 2009 (available at <http://ciir.cs.umass.edu/irbook/>).
- R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

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IS 534 Digital Image Processing

Introduction to Image Processing Systems, Digital Image Fundamentals:-Image model, Relationship between Pixels, Imaging geometry, Camera model. Image Sensing and Acquisition. Sampling and quantization. Image Enhancement and in spatial Domain: Point processing, Neighborhood Processing, High pass filtering, High boost filtering, zooming. Image Enhancement based on Histogram medaling. Image Enhancement infrequency domain: 1D& 2D Fourier transform, Low pass frequency domain Filter, High pass frequency domain filters, Homomorphic filtering. Image Segmentation: - Detection of discontinuation by point detection, line Detection, edge detection. Edge linking and boundary detection:-Local Analysis, global by graph, theoretic techniques, Thresh-holding, Morphology, Representation and description. Discrete image transform. Image Compression. Wavelet transformation.

COs

- To study image fundamentals and mathematical transforms necessary for Image processing.
- To apply image enhancement techniques and image restoration procedures for security.
- To enable student to use image compression and segmentation techniques.

Textbook

- Digital Image Processing Gonzalez & Wood

Reference books

- Digital Image Processing A. K. Jain
- Image Processing Dhananjay K.Techkedath

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IS 535 Internet of Things (IoT)

Introduction to IoT, IoT Applications, RFID, Wireless Networks, Sensors, GPS, Devices and Gateways, Routing and data dissemination, Network Topologies, MAC for IoT, Data management. Development issues, Localizations, Time synchronization, IoT architectures, IoT System design and Tools.

COs

- To learn basics of IoT.
- To learn unique characteristics and challenges of IoT
- To Understand State of the Art – IoT Architecture.

Text Book

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014.
- Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.

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Departmental Elective-II

IS 541 Advanced Data Structures

Review of algorithm analysis, Optimal Binary search trees, balanced binary search trees, Binary heaps, advanced heap structures, Binomial heaps, Fibonacci heaps. Amortized analysis, Splay trees. Dictionaries, Disjoint set structures. Data Structures for External Memory, External sorting, String matching. Introduction to Randomized Data structures and algorithms.

COs

- To understand some of the application specific Advanced Data Structures and analyze their complexity for different operations.
- To successfully decide how the use of a particular data structure can reduce running time of different applications.

Textbook

- Data Structures Algorithms & Applications in C++ - SartazSahani.
- Introduction to algorithms Cormen and Rivest.

Reference book

- Randomized algorithms R.Motwani and P. Raghavan

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IS 542 Information Theory & Coding

Information and entropy information measures, Shannon's concept of Information. Channel coding, channel mutual information capacity (BW), Theorem for discrete memory less channel, information capacity theorem, Error detecting and error correcting codes, Types of codes: block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques, Compression: loss less and lossy, Huffman codes, LZW algorithm, Binary Image compression schemes, run length encoding, CCITT group 3 1-DCompression, CCITT group 3 2D compression, CCITT group 4 2DCompression. Convolutional codes, sequential decoding. Video image Compression: CITT H 261 Video coding algorithm, audio (speech) Compression. Cryptography and cipher.

COs

- The aim of this course is to introduce the principles and applications of information theory.
- The course will study how information is measured in terms of probability and entropy.
- The students learn coding schemes, including error correcting codes, The Fourier perspective; and extensions to wavelets, complexity, compression, and efficient coding of audio-visual information.

Textbook

- Fundamentals in information theory and coding, Monica Borda, Springer.
- Communication Systems: Analog and digital, Singh and Sapre, TataMcGraw Hill.
- Multimedia Communications Fred Halsall.

Reference books

- Information Theory, Coding and Cryptography R Bose.
- Multimedia system Design Prabhat K Andleigh and KiranThakrar.

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IS 543 Biometric

Introduction and Definitions of biometrics, Traditional authenticated methods and technologies. Biometric technologies: Fingerprint, Face, Iris, HandGeometry, Gait Recognition, Ear, Voice, Palm print, On-Line Signature Verification, 3D Face Recognition, Dental Identification and DNA. The Law and the use of Multibiometrics systems. Statistical measurement of Biometric. Biometrics in Government Sector and Commercial Sector. Case Studies of biometric system, Biometric Transaction. Biometric System Vulnerabilities.

COs

- Perform R&D on biometrics methods and systems.
- A good understanding of the various modules constituting a biometric system.
- Familiarity with different biometric traits and to appreciate their relative significance.
- A good knowledge of the feature sets used to represent some of the popular biometric traits.
- Evaluate and design security systems incorporating biometrics.
- Recognize the challenges and limitations associated with Biometrics.

Textbook

- Biometrics for network security, Paul Reid, Hand book of Pearson

Reference books

- D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition, Springer Verlag, 2003.
- A. K. Jain, R. Bolle, S. Pankanti (Eds.), BIOMETRICS: Personal Identification in Networked Society, Kluwer Academic Publishers, 1999.
- J. Wayman, A.K. Jain, D. Maltoni, and D. Maio (Eds.), Biometric Systems: Technology, Design and Performance Evaluation, Springer, 2004.
- Anil Jain, Arun A. Ross, Karthik Nanda kumar, Introduction to biometric, Springer, 2011.
- Biometric Systems: Technology, Design and Performance Evaluation, J. Wayman, A.K. Jain, D. Maltoni, and D. Maio

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IS 544: Privacy: Data & User Protection

Introduction:-The increasing vulnerabilities of networks, Privacy issues, Privacy cost assessments in cyber attack, privacy-enhancing technologies, VPN, Privacy in RFID, Privacy in cyber physical systems and Internet of Things (IoT), Privacy measurement, Privacy policies and Enforcement, P3PPolicy, Policy Enforcement Techniques, Issues, Models of Privacy, Machine Readable Policy. Internet Privacy:- Internet Privacy, Importance of good password, Minimizing your Online Digital Fingerprints, Preventing Identity Theft and Fraud, Risk. Web Privacy:-Dangers of Wireless Networks and “Hotspots”, Securing Devices, Using Encryption to Hide and Keep Safe your Personal Digital Items, Information and Data, Torrent File Sharing and Anonymous on the web, Secure, Private and Anonymous Usenet. Social Networks Privacy and security on Social Media. Threats to privacy in OSNs Threats regarding awareness, control, trustworthiness. Children’s Privacy, Online Advertising, Digital Afterlife, Health and Genetic Privacy.

COs

- The general theme of this course is to provide students an overview for the security and privacy with a set of techniques.
- Which enable them to address the security & privacy challenges.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Complete guide to Internet Privacy, Anonymity and Security (Matthew Bailey).
- Internet Privacy: Options for adequate realization edited (Johannes Buchman).

Open Elective-I

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IS 571 Distributed System

Definitions and Objectives, Issues in Distributed Computing, Distributed Computing Models, Inherent limitations; Introduction, Abstraction Layers, RPC Mechanisms, RMI, Naming Service, Message Passing Systems and Models; Concurrent programming concept, process migration, communicating sequential processes, Distributed Scheduling – Deadlocks and Dealing with Deadlocks; Extending mutual exclusion, Dijkstra's solutions, Lamport's DME Ricart and Agarwala's optimal algorithm for DME; Lamport's logical clocks and its limitation, Election Algorithms in Ring and broadcast networks; Classification - Byzantine Agreement problem, Consensus problem – Relationships – Applications; Architecture - Design and Implementation Issues - Algorithms for implementation Other approaches; Features - File Sharing Semantics, File Caching Schemes, File Replication, Design principles, Case Studies; Failure Classifications - Checkpoints, Synchronous and Asynchronous check pointing, Recovery, Commit protocols, Static and dynamic voting protocols; ACID Properties, Concurrency Control, commit protocols: 2PC, 3PC.

COs

- To expose students to both the abstraction and details of file systems.
- To provide students with contemporary knowledge in parallel and distributed computing.
- To focus on performance and flexibility issues related to systems design decisions.
- Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs.

Textbook

- Distributed Systems: Principles and Paradigms. A. Taunenbaum.

Reference books

- Hagit Attiya, Jennifer Welch, "Distributed Computing: Fundamentals, Simulations, and Advanced Topics", 2/E, Jon Wiley & sons, March 2004.
- Nancy Lynch, "Distributed Algorithms", Morgan Kaufmann Publication, 1996.
- Mukesh Singhal, Niranjana G. Shivaratri (Contributor), "Advanced Concepts in Operating Systems: Distributed, Database, and Multiprocessor Operating Systems", MGH, 1994.
- Jim Farley, "Java Distributed Computing", 1/E, 1998.
- Michael Reilly, "Java Network Programming and Distributed Computing", Addison Wesley, 2002.

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IS 572 Object Oriented Design & Modeling

Object Orientation, OMT Methodology, Object and Class, Link and Association Generalization, Aggregation Multiple Inheritance, Packages. Object Meta modelling, Metadata and Metamodels, Functional Modelling. Pseudocode, Pseudocode with the Object Navigation Notation, ONN Constructs, combining ONN Constructs. Analysis: Object Model, Data Dictionary, Dynamic Model, Functional Model. System Design: Devising an Architecture, Database Management Paradigm, Object Identity, Policies for Detailed Design Dealing with temporal data. Detailed Design:- Object Model Transformations, Elaborating the Object Model, Elaborating the Functional Model, Evaluating the Quality of a Design Model.

Cos

- Master the fundamental principles of OO programming.
- Master key principles in OO analysis, design, and development.
- Master common patterns in OO design and implement them.
- Be familiar with alternative development processes.
- Be familiar with group/team projects and presentations.
- Be exposed to technical writing and oral presentations.

Textbook

- Object-Oriented Modeling and Design by Michael Blaha / William Premerlani, Prentice Hall.

Reference books

- Object oriented software engineering using UML patterns and java, Bernd Bruegge and Dutoit, Pearson publications.
- Object oriented software engineering, Lethbridge and Laganiere, TataMcGraw Hill

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IS 573 Optimization Techniques

Engineering application of Optimization, Formulation of design problems as mathematical programming problems, General Structure of Optimization Algorithms, Constraints, The Feasible Region, Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming, Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc. Real life Problems and their mathematical formulation as standard programming problems.

Cos

- Formulate optimization problems.
- Understand and apply the concept of optimality criteria for various type of optimization problems.
- Solve various constrained and unconstrained problems in Single variable as well as multivariable.
- Apply the methods of optimization in real life situation.

Textbook

- Laurence A. Wolsey (1998). Integer programming. Wiley. ISBN 978-0-471-28366-9.

Reference books

- Practical Optimization Algorithms and Engineering Applications Andreas Antoniou.
- An Introduction to Optimization Edwin K., P. Chong & Stanislaw h. Zak.
- Dimitris Bertsimas; Robert Weismantel (2005). Optimization over integers. Dynamic Ideas. ISBN 978-0-9759146-2-5.
- John K. Karlof (2006). Integer programming: theory and practice. CRC Press. ISBN 978-0-8493-1914-3.
- H. Paul Williams (2009). Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
- Michael Jünger; Thomas M. Lieblich; Denis Naddef; George Nemhauser; William R. Pulleyblank; Gerhard Reinelt; Giovanni Rinaldi; Laurence A. Wolsey, eds. (2009). 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5.
- Der-San Chen; Robert G. Batson; Yu Dang (2010). Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4.

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IS 574 Cloud Computing

Cloud Computing: Introduction, Working of cloud computing, benefits; Understanding Cloud Computing: Developing cloud computing services, Discovering cloud services; Cloud Computing for Everyone: Centralizing email communications, Cloud computing for community; Cloud Computing for the Corporation: Managing Schedules, Managing Projects; Using Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Project Management. Outside the Cloud: Other Ways to Collaborate Online: Collaborating via Web-Based Communication Tools, Collaborating via Social Networks and Groupware.

COs

- To understand the systems, protocols and mechanisms that support cloud computing.
- To develop applications for cloud computing
- To understand the hardware necessary for cloud computing
- To design and implement a novel cloud computing application.

Textbook

- Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.

Reference book

- Implementing and Developing Cloud Computing Applications by DAVID E.Y. SARNA, CRC Press

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IS 575 Support Vector Machine

Fundamentals of classification and Regression, Hard-margin and soft-margin SVMs, concepts of kernels and feature spaces, basics of optimization and quadratic programming ,elements of statistical learning theory and generalization theory, implementation issues, SMO algorithm , selected advanced topics (multi-classification, support vector regression) , Application of SVM to real life classification and regression problems.

COs

- The focus of this course is on obtaining practical experience with using SVMs and on understanding the core concepts the theory is built on.
- There are many free SVM libraries available, as well as commercial packages. After this course, students will be able to pick any of these tools, and use them correctly (and optimally) in their research fields.
- Not as a black-box, but with understanding of the inner-workings, being aware of potential issues that may occur.

Textbook

- Support Vector Machine and Kernel methods, K.P. Soma

Reference books

- Learning with Kernels, B. Schölkopf, A. J. Smola (2002)
- Support Vector Machines for Pattern Classification, S. Abe (2005)

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IS 514 Laboratory-I

Network and Cyber Security Laboratory

Cryptography- Secret-Key Encryption, Public-Key Encryption, One-time padding, MAC (Message Authentication Code), Digital Signatures, Diffie-Hellman Key Exchange.

Intrusion Detection System: Network enumeration through port scanning, SYN Flooding. Threats and Vulnerabilities- Cross Site Scripting (XSS) & Buffer Overflow Attack, Code Injection Attacks: SQL Injection, PHP Injection, and Command Injection. DNS Vulnerability Analysis- DNS Spoofing, DNS Cache Poisoning, DNS Pharming, DNS Cache Analysis, WHOIS Query to Research Domains OS Attack – OS Finger printing, Banner Grabbing through telnet, Analysis of Hibernated and hosts file. Email- E-mail Spoofing, E-mail Bombing, Header Analysis of E-mail Malware Analysis- Malware Classification: Polymorphic and Metamorphic Malware, Virus, Rabbit, Trojans, Back Door, Spyware. Understand the Tools and Techniques – IEXPRESS 2.0, CAY KARAT, Damm Web Application Vulnerabilities (DWAV), WebGoat, ProRat Trojan, Key Logger, Steganographer etc.

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IS 515 Laboratory-II

This lab is based on electives that the student chooses from departmental elective I and departmental elective II.

IS 516 Seminar-I

Seminars are conducted throughout the semester as per the schedule given in the time-table. Students can choose any recent topic for their presentation. Minimum two presentations are given by each student consisting of one credit each. Topics are decided with the mutual concern/ discussion with the mentor.

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M.TECH- II SEMESTER

IS 521 Cryptography

Simple Cryptosystems: Enciphering Matrices, Encryption Schemes, Symmetric and Asymmetric Cryptosystems, Cryptanalysis, Block ciphers, Use of Block Ciphers, Multiple Encryption, Stream Ciphers, Affine cipher, Vigenere, Hill, and Permutation Cipher, Secure Cryptosystem. Public Key Cryptosystems: The idea of public key cryptography, The Diffie– Hellman Key Agreement Protocol, RSA Cryptosystem, Bit security of RSA, ElGamal Encryption, Discrete Logarithm, Knapsack problem, Zero- Knowledge Protocols, From Cryptography to Communication Security, Oblivious Transfer.

Symmetric Techniques: Stream Cipher: A5, RC4

Asymmetric Techniques: Cryptography in Embedded Hardware

Different type of attack: CMA, CPA, CCA

COs

- The goal is to become familiar with basic techniques to protect data in computer and communication environments against several different varieties of fraud
- Compare and contrast a range of different cryptosystems from an applied viewpoint
- List and elaborate the differences between secret key and public key cryptosystems
- Recognize the different modes of operation for block ciphers and their applications
- To understand the concepts of improving systems' security by quantifying secrecy
- Be able to decide which cipher should be chosen for a particular security problem

Textbook

- Cryptography and Network Security: Principles and Practice, William Stallings

Reference books

- Bruce Schneier, "Applied Cryptography: Protocols, Algorithms, and SourceCode in C" John Wiley & Sons, Inc, 2nd Edition, 1996.
- Wenbo Mao, "Modern Cryptography Theory and Practice", Pearson Education, 2004.
- AtulKahate, "Cryptography and Network Security", Tata McGrew Hill, 2003
- Cryptography Theory and Practice, Douglas R. Stinson.

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IS 522 Database Security & Access Control

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control(DAC), Non- Discretionary Access Control , Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations, Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy, Biba's integrity model, Clark-Wilson model, Domain type enforcement model , mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system, Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multiline Insurance Company. Smart Card based Information Security, Smart card operating system-fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR,PPS Security techniques- user identification , smart card security, quality assurance and testing , smart card life cycle-5 phases, smart card terminals.

Cos

- In this course, the students will be enabled to understand and implement classical models and algorithms.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various access control models and to analyze their behavior.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli.
- <http://www.smartcard.co.uk/tutorials/sct-itsc.pdf> : Smart Card Tutorial.

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IS 523 Digital Forensics

Introduction to Digital Forensics, Computer Forensics, Mobile Device Forensics, Network Forensics, Forensics Data analysis and Web Forensics. Evidence - Sources of Digital Evidence, Digital Forensics Investigation, Evidence Gathering Techniques. Cyber Crime Investigation through Data Mining Techniques – Introduction, Data Mining, Data Mining for Digital Forensics, Classification of Crime Data, Frame Work for Web Forensics, Apriori Algorithm, Pruning. Ontology – Motivation for text mining, Text Characteristics, Information Retrieval, Information Extraction, Text Mining Process, Goals, Inverted Index Live Forensics – Incident on Windows, Linux, and Apple computers, basic registry analysis, MRUs and history file analysis. Network Forensics – network analyzer basic, packet capturing, span ports, upstream tools and tcp dump, Wire shark, Wireless sniffing, Log and SIEM searches Examination and analysis techniques- Search techniques, Manual browsing. Disk Forensics – file systems, encryptions issues, SSD challenges, slack space, partitions Lab: dd and its many options, strings, scalpel, Sleuth Kit. File System Forensics – malware analysis, magic numbers, digital steganography, browser forensics, PST and OST files. Social Media Forensic: - Email Forensics: browser tools, SQL query, IOC finder ,Microblogs , Street Gangs , Terrorist Activity , White Collar Crimes. Mobile Forensics – IOS and Android, acquisition challenges, encryption on the devices, rooting and jail breaking. Android Forensics – Introduction, Acquiring physical image of an Android Device, Connecting a device via data cable, Imaging the Memory Card, USB Debugging, Preparing the Hero for Rooting, creating a DD image of memory, Examination of memory, Analysis with the Celle Brite.

COs

- Conduct digital investigations that conform to accepted professional standards Ability to apply current practices for processing crime and incident scenes.
- Ability to apply perform forensic analysis in various operating system environments
- Ability to explore protocols for collecting and protecting digital evidence
- Ability to apply current practices for data discovery recovery and acquisition.
- Ability to demonstrate the recovery of image files.
- Ability to conduct basic network forensic analysis.
- Ability to perform e-mail investigations.
- Ability to effectively extract, gather and acquire Evidences.
- Develop method to correlate techniques to make chain of evidences

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Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Handbook of Digital Forensics and Investigation, Eoghan Casey BS MA.
- Windows Registry Forensics: Advanced Digital Forensic Analysis of the windows registry.
- The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensic (By John Sammons).
- Digital Forensics Explained (By Greg Gogolin).

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Departmental Elective-III

IS 551 Cluster & Grid Computing

Cluster Computing: Introduction, Hardware for cluster computing, Software architectures for cluster computing based on shared memory (OpenMP) and message-passing (MPI/PVM) models, Performance evaluation tools, Configuring and Tuning Clusters. Grid Computing: The Evolution Grid Technologies, Programming models – A Look at a Grid Enabled Server and Parallelization Techniques, Grid applications, Grid architecture, Grid relationship to other Distributed Technologies, Computational and Data Grids, Semantic grids, Grid Management systems: Security, Grid-Enabling software and Grid enabling network services, Virtualization Services for Data Grids; Case Study, Setting up Grid, deployment of Grid software and tools.

COs

- To learn concepts of shared and distributed memory based parallelization.
- To develop algorithm for cluster environment.
- To perform case studies on grid computing.

Textbooks

- R. Buyya, High Performance Cluster Computing , Prentice Hall, USA, 1999.
- Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann, 1998.

Reference book

- Foster and C. Kesselman, The Grid : Blueprint for a New Computing Infrastructure , Morgan Kaufmann Publishers , 1999.

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IS 552 Natural Language Processing

Regular Expressions and Automata, N-grams, Part-of-Speech Tagging, Hidden Markov and Maximum Entropy Models, Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification, Language and Complexity, The Representation of Meaning, Computational Semantics, Computational Lexical Semantics, Information Extraction, Question Answering and Summarization, Machine Translation.

COs

- The goal of NLP evaluation is to measure one or more qualities of an algorithm or a system
- The metric of NLP evaluation on an algorithmic system allows for the integration of language understanding and language generation.

Textbook

- Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition D. Jurafsky and J. Martin.

Reference book

- Foundations of Statistical Natural Language Processing Manning and H. Schutze

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IS 553 Secure Software Engineering

Process and Product, Problems of software practitioner, software reliability engineering, Setting system failure intensity objectives and Engineering, software reliability strategies and Implementing Operational Profiles and applying operational Profiles. Preparing for Test, Executing Test and Guiding Test.UML for Security, Model based security engineering with UML, Design principles for secure systems and security patterns. Applications of Secure Software engineering Using UML.

COs

- Make a point for why security cannot be a side issue in software engineering.
- Argue that security concerns must inform every phase of software development.
- Show how security requirements are incorporated into software systems today
- Textbook
- No text book is recommended, subject will be taught using the material available on internet and research papers.

References

- John Musa D, “Software Reliability Engineering”, 2nd Edition, Tata McGraw-Hill, 2005(Units I, II and III)
- Jan Jürjens, “Secure Systems Development with UML”, Springer;• 2004

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IS 554 Machine Learning

Supervised Learning-Feature Selection, Cross Validation, Bootstrapping, Normalization Classification: Naïve Bayes, Bayesian Network, C4.5, ID3, Support Vector Machine, Extreme Learning Machine, Neural Network, VC Dimension, Regularization, Regression: Linear, Polynomial, Multiple Linear Regression, Support Vector Regression. Committee Machines/ Ensemble Learning: Bagging, Boosting. Unsupervised Learning- Clustering: K-Nearest Neighbour, K-Means, Fuzzy K-Means, Hierarchical Clustering, Single Linkage, Complete Linkage, Average Linkage, Non Spherical Clustering Algorithms. Statistical Testing Methods, Probabilistic Inference, Neural Network, Deep Learning Neural Network, Evolutionary Algorithms. Machine Learning Applications: Text Classification, Disease Diagnosis, Biometric Systems, Real Valued Classification.

COs

- To teach students what is Machine Learning.
- To make students learn about the Theoretical/ Practical understanding techniques of machine learning algorithms.
- To perform case study of various Machine Learning tools.
- To perform case study of state of art problem and their possible solution using machine learning.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Bishop, C. M. (2006), Pattern Recognition and Machine Learning, Springer, ISBN 0-387-31073-8
- MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar (2012) Foundations of Machine Learning, MIT Press ISBN 978-0-262- 01825-8
- Mitchell, T. (1997). Machine Learning, McGraw Hill. ISBN 0-07-042807-7

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IS 555 Professional Communication

Communication: A vital necessity for good management; Etiquettes Oral communication: Effective presentation skills; negotiation skills. Recruitment and selection, written test – structural, situational and psychological analysis, principles of interviewing reducing stress, retaining control, setting objectives for the interview, planning and preparation – the challenge of face to face skills.

Written communication skills: Netiquettes, writing resume, writing persuasive proposals and memorandum; planning and meetings, setting agendas for the meetings, writing and circulating minutes, notices.

Developing other skills – I: Leadership skills; time management skills; stress management, and emotional intelligence; development of an ideal mix of skills.

Developing Other Skills – II: Group communication: kinds of discussions – forum discussions, panel discussions, symposium discussion and group discussions.

COs

- Communicate effectively in written and spoken English to transfer complex knowledge and ideas to technical and nontechnical audiences.
- Identify and use appropriate sources of information when developing professional documents.
- Maintain and develop appropriate, effective and professional forms of documentation.
- Demonstrate effective team membership skills and contribute collaboratively within diverse team environments.
- Articulate and reflect on the industry expectations of competence and conduct in engineering and computing professions.

Text Books & References

- Effective Business Communications – Murphy (Allied pub.)
- The Essence of Effective Communication - Ron Ludlow & Fergus Panton, (PHI)
- Effective Technical Communication – M Ashraf Rizvi, (Tata McGraw Hill)
- Personal Development of Life and Work – Wallace & Masters (Thomson Publishing)
- Communication in Organizations - Dalmar Fisher (Jayco Publishing)
- Technical Communication [A Reader Centered Approach] – Anderson (Cengage Publication)The Bass handbook of Leadership – Bernard and Ruth Bass

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- Skillful Time Management – peter LevinEnglish for Engineers & Scientist – Sangeeta Sharma and Binod Mishra (Delhi: PHI)

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Departmental Elective-IV

IS 561 Steganography & Digital Watermarking

Steganography: Overview, History, Methods for hiding (text, images, audio, video, speech etc.), Issues: Security, Capacity and Imperceptibility, Frameworks for secret communication (pure Steganography, secret key, publickey steganography), Steganography algorithms (adaptive and non-adaptive), Steganography techniques: Substitution systems, Spatial Domain, Transform domain techniques, Spread spectrum, Statistical steganography, Cover Generation and cover selection, Tools :EzStego, FFEncode, Hide 4 PGP, Hide and Seek, S Tools etc.) Steganalysis: Active and Malicious Attackers, Active and passive steganalysis, Detection, Distortion, Techniques: LSB Embedding, LSB Steganalysis using primary sets, Texture based Digital Watermarking: Introduction, Difference between Watermarking and Steganography, History, Classification (Characteristics and Applications), Types and techniques (Spatial-domain, Frequency-domain, and Vector quantization based watermarking), Attacks and Tools (Attacks by Filtering, Remodulation, Distortion, Geometric Compression, Linear Compression etc.), Watermark security & authentication.

COs

- Learn the concept of information hiding.
- Survey of current techniques of steganography and learn how to detect and extract hidden information.
- Learn watermarking techniques and through examples understand the concept.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Peter Wayner, “Disappearing Cryptography – Information Hiding: Steganography & Watermarking”, Morgan Kaufmann Publishers, New York, 2002.
- Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, TonKalker, “Digital Watermarking and Steganography”, Margan Kaufmann Publishers, New York, 2008.
- Information Hiding: Steganography and Watermarking-Attacks and Countermeasures by Neil F. Johnson, Zoran Duric, Sushil Jajodia
- Information Hiding Techniques for Steganography and Digital Watermarking by Stefan Katzenbeisser, Fabien A. P. Petitcolas

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IS 562 Security Threats & Modeling

UNIT I

Introduction: Security threats, its sources, Target Assets and vulnerabilities, Consequences of threats, Active/ Passive Threats, Web-threats, Network Threats, E-mail threats, Sabotage-Internal treats- Environmental threats - Threats to Server security, Insider threats, Cybercrimes, hackers and Intruders

UNIT II

Attack Tree, Attack Graphs, Types of Attack Scenarios and Detection Approaches, Threat exploitation and analysis: Session Hijacking – Phishing – DNS Pharming – Tab-nabbing – Clickjacking – XSS – SQL – Command Injection – IP Spoofing, Email-Spoofing, Information Hiding (Stenography), Buffer Overflow Virology- Worms, Virus, Spam 's, Ad ware, Spy ware, Trojans, Backdoors, Bots, Malware.

UNIT III

Security Threat Management: Risk Assessment - Forensic Analysis – Security threat correlation – Threat awareness - Vulnerability sources and assessment- Vulnerability assessment tools -Threat identification - Threat Analysis – Threat Modeling - Model for Information Security Planning. Footprinting- Scanning- Enumeration - basic banner grabbing, Enumerating Common Network services.

UNIT IV

Security models – Access Control Matrix Model, Take-Grant Protection Model Secure Web Engineering Privacy- Privacy Issues, Privacy in social networks, Privacy Models, Privacy preserving Data Mining techniques, Privacy enhancing technology, Web Privacy, Security Policies – Security Policies and Procedures, Writing Security Policies, Sample Security Policies, Types: Integrity policies, Confidentiality policies, WWW Policies, Same Origin Policy, E-mail Security Policies, etc. Security certification – Security monitoring and auditing, Forensics Investigator

UNIT V

Security protocols – Transport layer protocols – SSL – Electronic mail security – PEM and S/MIME security protocol – Pretty Good Privacy – Web Security - Firewalls design principles – Trusted systems – Electronic payment protocols. Intrusion detection – password management – Viruses and related Threats – Virus Counter measures, Virtual Private Networks. Application Level Security: HTTP Vs HTTPS, SSL, IPV6 Security Requirements Specifications: Antivirus, Firewalls, IDS, IPS, Log Files, Honey Pots, Honey NetSecure Software Engineering: Need for secure systems, Software security issues, Secure Software Life Cycle, Secure Programming Vs Defensive Programming, Proactive security development process, Secure design principles and Patterns, Insecure Code Samples, Code Reviews and Static Analysis, Security Testing, Creating a Software Security Programs

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COs

- Learn the sources of security threats and attack scenarios.
- Learn threat management by assessing, analyzing or applying models.
- Practically understand and implement security programs.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Joseph M Kizza, “Computer Network Security”, Springer Verlag, 2005
- Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press,2004.
- William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Prentice Hall, 2008.
- Thomas Calabres and Tom Calabrese, “Information Security Intelligence: Cryptographic Principles& Application”, Thomson Delmar Learning, 2004
- Chapter 9: Legal, Privacy, and Ethical Issues in Computer Security

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IS 563 Malware Analysis & Reverse Engineering

Fundamentals of Malware Analysis (MA), Reverse Engineering Malware (REM) Methodology, Brief Overview of Malware analysis lab setup and configuration, Introduction to key MA tools and techniques, Behavioral Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining ClamAV Signatures, Creating Custom ClamAV Databases, Using YARA to Detect Malware Capabilities, Creating a Controlled and Isolated Laboratory, Introduction to MA Sandboxes, Ubuntu, Zeltser's REMnux, SANS SIFT , Sandbox Setup and Configuration New Course Form, Routing TCP/IP Connections, Capturing and Analyzing Network Traffic, Internet simulation using INetSim, Using Deep Freeze to Preserve Physical Systems, Using FOG for Cloning and Imaging Disks ,Using MySQL Database to Automate FOG Tasks, Introduction to Python ,Introduction to x86 Intel assembly language, Scanners: Virus Total, Jotti, and NoVirus Thanks, Analyzers: Threat Expert, CWSandbox, Anubis, Joebox, Dynamic Analysis Tools: Process Monitor, Regshot, HandleDiff, Analysis Automation Tools: Virtual Box, VM Ware, Python , Other Analysis Tools Malware Forensics Using TSK for Network and Host Discoveries, Using Microsoft Offline API to Registry Discoveries , Identifying Packers using PEiD, Registry Forensics with Reg Ripper Plug-ins : , Bypassing Poison Ivy's Locked Files , Bypassing Conficker's File System ACL Restrictions, Detecting Rogue PKI Certificates. Malware and Kernel Debugging Opening and Attaching to Processes, Configuration of JIT Debugger for Shellcode Analysis, Controlling Program Execution, Setting and Catching Breakpoints, Debugging with Python Scripts and Py Commands, DLL Export Enumeration, Execution, and Debugging, Debugging a VMware Workstation Guest (on Windows), Debugging a Parallels Guest (on Mac OS X). Introduction to WinDbg Commands and Controls, Detecting Rootkits with WinDbgScripts, Kernel Debugging with IDA Pro. Memory Forensics and Volatility Memory Dumping with MoonSols Windows Memory Toolkit, Accessing VM Memory Files Overview of Volatility, Investigating Processes in Memory Dumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA. Researching and Mapping Source Domains/IPs Using WHOIS to Research Domains, DNS Hostname Resolution, Querying Passive DNS, Checking DNS Records, Reverse IP Search New Course Form, Creating Static Maps, Creating Interactive Maps.

COs

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- To understand the concept of malware and reverse engineering.
- Implement tools and techniques of malware analysis.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference book

- Michael Sikorski, Andrew Honig “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software” publisher Williampollock

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IS 564 Parallel Algorithms

Parallel algorithms: Introduction, Terminology, Pipelining & data parallelism, Control parallelism, scalability.

PRAM algorithms: Serial and Parallel computation; Processor arrays, Multiprocessors & Multi-computers, Flynn's taxonomy, Speedup Scaled Speedup and Parallelizability. Parallel Programming Languages, Mapping & Scheduling;

Matrix Multiplication Algorithm: Sequential, Processor arrays, Multi-computers.

Fourier transform: Introduction, Discrete, Inverse discrete, Fast Fourier transform. Sorting algorithms, Dictionary operation, Graph algorithm, Combinatorial Search

References

Parallel computing by Michael J. Quinn.

The Design of Parallel and Analysis Algorithms by Selim G. AkM.

Course Outcomes

1. To get knowledge of basics of parallel computing.
2. To get knowledge of parallel programming languages
2. Understanding different arallel algorithms

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IS 565 Soft Computing

Introduction to neural networks, working of an artificial neuron, Perceptron Back propagation algorithm, Adalines and Madalines. Supervised and unsupervised learning, Counter-propagation networks, Adaptive Resonance Theory, Kohonen's Self Organizing Maps, Neocognitron, Associative memory, Bidirectional Associative Memory. Introduction to fuzzy logic and fuzzy sets, fuzzy relations, fuzzy graphs, fuzzy arithmetic and fuzzy if-then rules, Process control using fuzzy logic, Decision-making fuzzy systems, Applications of fuzzy logic, Hybrid systems like neuro-fuzzy systems. Evolutionary Computation: Population-based Search: genetic algorithms and evolutionary computation, Genetic Programming. Swarm optimization, Antcolony optimization. Search techniques like Simulated Annealing, Tabu search etc.

COs

- To familiarize with soft computing concepts.
- To introduce the ideas of Neural networks, fuzzy logic and use of heuristics based on human experience.
- To introduce the concepts of Genetic algorithm and its applications to soft computing using some applications.

Textbook

- Soft Computing and Intelligent Systems Design F. O. Karray and C. DeSilva.

Reference book

- Neural Networks, Fuzzy Logic and Genetic Algorithms Rajsekaran and Pai,

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Open Elective-II

IS 581 Image Analysis

Document Analysis and Recognition: handwriting, signatures, etc., physical and logical structures of documents, Document Image Processing, Document Models, Handwriting Models and Analysis and recognition, Multi-lingual Processing, Physical and Logical Analysis,- Graphics Recognition, Map and Line Drawing Understanding, etc Text Analysis and Processing, Natural Language Issues, Information Extraction and Filtering, Performance Evaluation, Document Authentication and Validation, Medical Image Analysis: molecular/cellular imaging to tissue/organ imaging, computational anatomy (modelling normal anatomy and its variations),computational physiology (modelling organs and living systems Satellite image acquisition techniques, Remote Sensing, Image Pre-processing, Image enhancement, Image Registration, Spatial Feature Extraction, Image classification, applications.

Cos

- To learn how satellite images are acquired and processed.
- To learn applications of satellite image processing.
- To extract the relevant information from on sheet and off sheet document.
- To develop the software to understand the hand written document.
- To understand the medical imaging in terms of anatomy of organ , sensing and futuristic decision.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Nabeel A.Murshed, Flavio Bortolozzi, Advances in Document Image Analysis, pontifical catholic university of parana 1997
- Lawrence O'Gorman, Rangachar Kasturi, Document imaging System IEEE Computer Society Press, 01-Jan-1997
- Henry S. Baird, Horst Bunke, Kazuhiko Yamamoto, Structured Document image Analysis, Springer Science & Business Media, 06- Dec-2012

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- John C. Russ, J. Christian Russ ,Introduction to Image processing And Analysis, Taylor & Francis Group 2008.
- Atam P. Dhawan, Medical Image Analysis, 2nd Edition, Wiley-IEEE Press, 2008.
- Lena Costaridou, Medical Image Analysis Methods, July 13, 2005 by CRC Press.
- Toennies, Klaus D., Guide to Medical Image Analysis, 2012
- Isaac N. Bankman, PhD ,Handbook of Medical Image Processing and Analysis (Second Edition), 2008.

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IS 582 Statistical Methods

Introduction to Statistics, Meaning of Statistics as a Science, Importance of Statistics. Scope of Statistics, Introduction to Data Analysis, Population and Sample, Types of characteristics , Types of data, Notion of a statistical population, Methods of sampling, Presentation of Data, Data Visualization, Measures of Central Tendency, Measures of Dispersion, Moments, Skewness and Kurtosis, Theory testing ,Optimization, Hypothesis Testing, Bayesian Statistics,7 Subjective Probabilities, Heuristic analysis, Histograms:, Regression, Correlation, Error, Relational Databases, Cleaning Data.

COs

- Have good working knowledge of the most commonly used statistical methods, including statistical modeling and the omnipresent role of variability.
- Efficient design of studies and construction of effective sampling plans exploratory data analysis formal inference process.
- Have background in probability, statistical theory, and mathematics, including especially calculus, linear algebra and symbolic and abstract thinking.
- Have good mastery of several standard statistical software packages and facility with data management strategies

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata.
- Dawn Griffiths: Modern Head First Statistics, O Reilly Publication
- Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers
- Mukhopadhyay, P.: Mathematical Statistics (1996), New Central Book Agency, Calcutta, Introduction to Mathematical Statistics, Ed. 4 (1989), MacMillan Publishing Co. New York.

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IS 583 Big Data Analytics

Overview of Big Data: Introduction, history, elements, related knowledge, big Data in Businesses, and types of big data analytics. Technologies for Handling Big Data: Understanding Hadoop Ecosystem: HDFS, Map Reduce YARN, HBase, Hive, Pig, Sqoop, Zookeeper, Flume, Oozie etc. Understanding of Apache Spark: Programming in Scala, Spark Core, Interactive Data Analysis with Spark Shell, Writing a Spark Application, Spark Streaming, Spark SQL, Machine Learning with Spark Graph Processing with Spark. Understanding of Apache storm :Introduction to Apache Storm, Use Cases of Apache Storm, Key features and Architecture of a Storm cluster, Storm Programming.
Big Data Privacy and Ethics: Big data privacy, Risk in big data, Big data ethics, Transparency and Identity.

COs

- This Course provides an insight to big data processing requirement and processing mechanism.
- It provides a scalable and speedy solution to handle huge data processing.
- It helps to analyze new business opportunities and next generation computations.
- It helps to give the knowledge about big data batch processing using apache hadoop tool.
- It helps to give the knowledge about real time, interactive and iterative bigdata processing using apache spark tool.
- It helps to give knowledge about streaming data processing using apache storm.
- This course note that the gains in performance of No SQL versus RDBMS's due to differences in how the data is persisted and managed in memory and on disk.

Textbook

- Hadoop: The Defiantive Guide, By Tom White O’Rielly Publications 4thedition 2015.
- High Performance Spark, By Holden Karau, Rachel WarrenO’ Rielly Publications 2014.
- Getting Started with Storm, By Jonathan Leibiusky, Gabriel Eisbruch, Dario SimonassiO’ Rielly Publications 2014.

Reference books

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- Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and GraphBy David Loshin
- Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data: Analytics for Enterprise Class Hadoop and Streaming Data By Paul Zikopoulos, Chris Eaton.
- Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, By Michael Minelli, Michele Chambers, Ambiga Dhira.

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IS 584 Technical Foundation for e-Commerce

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, ecommerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda. E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, FRAMERELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications, security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce.

COs

- To understand the issues, problems and prospects of internet and intranet based e-commerce.
- Study of mobile commerce and electronic payment systems.
- Learn methods of securing business on network.

Textbook

- No text book is recommended, subject will be taught using the material available on internet and research papers.

Reference books

- E- Commerce Strategies, Technology and applications (David) Tata McGrawHill
- E-Business Organizational and technical foundation (Michael P) Wiley Publication
- John Benamati ,William S. Davis, E-Commerce Basics Technology Foundations and E-Business Applications, Prentice Hall
- Essentials of E-commerce technology, V Rajaraman, Prentice Hall.

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IS 585 Integer Programming

Introduction; Model Building and Enhancements; Relaxation and Bounds, Introduction to Computational Complexity, Branch-and-Bound Frameworks, Branch and cut, and Dantzig-Wolfe decomposition. Strong Valid Inequalities; Lifting Procedures, Decomposition/Partitioning; Column Generation; Lagrangian Relaxation, Implicit Enumeration, Advanced modeling; Reformulation-Linearization Technique. Fundamentals of integer Programming, complexity, computation, and polyhedral theory.

COs

The goals of this course are for students to:

- Understand how integer variables are used for formulating complex mathematical models.
- Be able to assess the difficulty of integer programming problems using the tools of complexity theory.
- Understand and be able to use common methodology for the solution of integer programs.
- Understand the basic concepts of polyhedral theory and how they apply to integer programming.
- Understand the theory of valid inequalities and how it applies to the solution of integer programs.

Textbook

- Nemhauser, G.L. and Wolsey, L.A., Integer and Combinatorial Optimization John Wiley & Sons, 1999.

Reference book

- M. Conforti, G. Cornuejols, and G.Zambelli, Integer Programming, Springer (2015).

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IS 524 Laboratory-III

Database Security & Digital Forensics

Database Vulnerabilities: Excessive Privileges Attack, Privilege Abuse, Unauthorized Privilege, Blind SQL, Understand the Weak Authentication, ExPOure of Data Backup Evidence Handling - Registry, Slack Space, windows log file Analyzing Data from Networked Systems :- Log Files: Access Log, Security Log, Firewall Log, Server log E-mail Investigations Cell Phone and Mobile Device Forensics Tools & Techniques: SNORT, Wireshark, TCP Dump, Nexus, RegEdit, Process Monitor Practically implement tools and techniques for database security and digital forensics.

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IS 525 Laboratory-IV

This lab is based on electives that the student chooses from departmental elective 3 and departmental elective 4.

IS 526 Seminar-II

Seminars are conducted throughout the semester as per the schedule given in the time-table. Students can choose any recent topic for their presentation. Minimum two presentations are given by each student consisting of one credit each. Topics are decided with the mutual concern/ discussion with the mentor.