Punjab Technical University  
Syllabus for M.Tech (e-SECURITY) Batch 2010 onwards

**SEMESTER-I**

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<td>CS-501</td>
<td>Advance Software Engineering</td>
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<td>CS-503</td>
<td>Network Security</td>
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<td>CS-505</td>
<td>Advanced Computer Architecture</td>
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<td>Advanced Database Management System</td>
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<td>Advanced Programming Language</td>
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<td>Advanced Database Management System Lab</td>
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**SEMESTER-II**

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<td>Digital image Processing</td>
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<td>CS-504</td>
<td>Distributed Systems</td>
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<td>CS-506</td>
<td>Compiler Design</td>
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**SEMESTER-III**

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**SEMESTER-IV**

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<td>CS-500</td>
<td>Dissertation</td>
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LIST OF ELECTIVES

ELECTIVE-I

527- Mathematical Models for Internet
528- Financial Mathematics
529- Digital Defense

ELECTIVE-II

530- Cryptography
531- Public Key Infrastructure and Trust Management
532- Biometric Security

ELECTIVE-III

533- Game theory and its applications
534- Intrusion Detection
535- Security Engineering

ELECTIVE-IV

536- Information Security Risk Management
537- Cyber laws and rights in today's digital age
538- Computer Security Audit and Assurance
539- Decision Support Systems and Methods
CS-501 Advance Software Engineering

L T P 3 1 -
Unit testing. Black box and white box testing. Integration and system testing. Software quality and reliability.
SEI CMM and ISO 9001. PSP and Six Sigma. Clean room technique.
Software maintenance issues and techniques. Software reuse. Client-Server software development.

Reference:
CS-503 Network Security

L T P 3 1 -

Introduction:
Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols, etc.
MAC protocols for high-speed LANS, MANS and wireless LANs. (For Example, FDDI, DQDB, HIPPI, Gigabit Ethernet, Wireless Ethernet, etc.)
Fast access technologies (For Example, ADSL, Cable Modem, etc.)

IP Multicasting, Multicast routing protocols, address assignments, session discovery, etc.
TCP extension for high-speed networks, transaction-oriented applications. Other new options in TCP.

Network security at various layers. Secure-HTTP, SSL, ESP, Authentication header, key distribution protocols, Digital signatures, digital certificates.

References:
CS- 505 Advance Computer Architecture
L T P 3 - -
1. Computational model
2. The concept of Computer Architecture
3. Introduction to Parallel Processing
4. Introduction to ILP Processors
5. Pipelined Processors
6. VLIW Architecture
7. Super Scalar Processors
8. Processing of Control transfer instruction
9. Code Scheduling for ILP-processors
10. Introduction to Data Parallel Architecture, SIMD Architecture, MIMD Architecture
12. Multi threaded Architecture
13. Distributed Memory MIMD Architecture

Reference:
2. Computer Architecture by Stone
CS-507 Advance Database Management Systems

L T P 3 1 -
Introduction of DBMS, Types of DBMS and their advantages and disadvantages
Introduction of RDBMS, Types of relational query language, Normalization, Query optimization
Database protection in RDBMS – Integrity, Concurrency control, Recovery
Distributed Databases :- concepts, structure, trade-offs
Methods of data distribution – fragmentation, replication, design & advance concepts of DDBMS
Introduction to object oriented databases, Deductive databases
Data warehousing Concepts: Architecture, Dataflows, Tools & Technologies, Data Marts Data Mining & Online Analytical Processing
Spatial & Multimedia databases
Mobile Computing & Mobile Databases Textbooks:-
3) Thomas Conolly, Carolyn Begg, ” Database Systems”, Pearson Education.
4) Alexis Leon, Mathews Leon, ”Database Management Systems”.
5) C.J.Date ,”An Introduction to DBMS”, Narosa Publishing House.
Introduction: Brief history of Programming Language, Characteristics of programming language.

**Programming Language Processors:** The structure and operation of a computer, Hardware and firmware computers, Translator and simulator computers, Syntax, semantics and virtual computers, hierarchies of computers, binding and binding time.

**Elementary Data Types:** Data object, variable and constants, data types, specification of elementary data types, declarations, type checking and type conversion, assignment and initialization, numeric data types, enumerations, Boolean, characters.

**Structured Data Types:** Structured data object and data types, specification of data structure types, implementation of data structure types, declarations and type checking for data structures, vector and arrays, record, character strings, variable sized data structures, pointers and programmer-constructed data objects, sets, file and input/output.

**Subprogram And Programmer-Defined Data Types:** Evolution of the data type concept, Abstraction, encapsulation, and information hiding, subprogram, type definitions, abstract data types.

**Sequence Control:** Implicit and explicit sequence control, sequence control within expression, sequence control between statements, subprogram sequence control, recursive subprogram, exceptions and exception handlers, Co-routines, scheduled subprograms, tasks and concurrent execution, data structures and sequence control.

**Data Control:** Names and referencing environments, static and dynamic scope, block structure, local data and local referencing environments, shared data, task and shared data.

**Storage Management:** Major Runtime elements requiring storage, programmer and system controlled storage management, storage management phases, static storage management, stack based storage management, heap storage management.

**Syntax And Translation:** General syntactic criteria, syntactic elements of language, stages in translation, formal definition of syntax.

**Operating And Programming Environment:** Batch processing environment, interactive environments, embedded system environments, programming environments.

**Theoretical Models:** Problem in syntax and translation, problem in semantics.

**References:**
Programming Languages, design and implementation second edition by Terrence W. Pratt Prentice Hall of India pvt.ltd. New Delhi.
CS-511 & CS-513 Project Lab (DBMS & Software Engineering)
L T P - - 4
The Students are required to implement the applications based on
1. Fuzzy databases
2. Expert databases
3. Object-oriented Databases
4. Distributed databases
5. Library management system
6. Crop management system
7. On-line sharing of computer systems
8. Highway systems
9. Hospital management system
10. Hotel management system
11. University management system
12. Inventory control
13. Railway management system
14. Any other similar database system
CS-502 Digital Image Processing

L T P 3 1 -  
**Fundamentals:** Introduction, Origin, Areas of Image Processing, steps in Digital Image Processing, Components of Image Processing System, Image Sensing, Sampling and Quantisation, Neighbouring of Pixels  

**Wavelets:** Wavelet functions, Wavelet transformations in one and two dimensions, fast wavelet transform.  
**Image Compression:** Image compression models, Error free compression, Lossy compression. **Image segmentation:** Line detection, edge detection, Edge linking and boundary detection, region based segmentation.  
**Representation and Description:** Representation, Boundary and Regional Descriptors, Relational Descriptors.  
**Object Recognition:** Pattern and pattern classes, recognition based on Decision Theoretic Methods, Structural Methods.  
**References:**  
**Digital Image Processing** by Rafael C. Gonzalez, Richard E. Woods
CS-504 DISTRIBUTED SYSTEMS L T P
3 1 -
2. Interprocess communication: API for internet protocol, Marshalling. Client server communication, group communication case study: unix
3. Distributed objects and remote invocation: communication between Distributed objects, RPC, events and notification case study: Java RMI
4. Operating System Support: Operating System layer. Protection, processes and threads, operating system architecture
5. Distributed File System: File service architecture, network file system, Sun network file system, Andrew file system Case Study: unix
6. Name services: Name services and domain name system. directory and discovery services Case Study: Global Name service
7. Transaction and concurrency control: transactions, nested transactions, Locks, optimistic concurrency control, time stamp ordering. Comparison of methods for concurrency control
8. Distributed transaction: Flat and nested distributed transactions. Atomic Commit protocol, Distributed dead locks
10. Distributed shared memory: design and implementation issues, sequential consistency and Ivy and Release Consistency by Munin
Case Study of distributed systems: CORBA Books:
2. A.S. Tanenbaum, Modern operating Systems, Prentice Hall
3. www.cdk3.net/refs
4. www.ietf.org/rfc
CS-506 Compiler Design

L T P 3 1 -
Course Contents:
Compiler structure: analysis-synthesis model of compilation, various phases of a compiler, tool based approach to compiler construction.
Lexical analysis: interface with input, parser and symbol table, token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation. Regular definition, Transition diagrams, LEX.

Syntax analysis: CFGs, 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.
Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions.
Type checking: type system, type expressions, structural and name equivalence of types, type conversion, overloaded functions and operators, polymorphic functions.
Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.

Books and References:
C.Fischer and R. LeBlanc. Crafting a Compiler in C, Benjamin Cummings.
Fraser and Hanson. A Retargetable C Compiler: Design and Implementation, Addison-Wesley.
Electives

CS -527 Mathematical Models for Internet

L T P 3 1 -

1) MATHEMATICAL BACKGROUND
a) Introduction to Probability and Distributions
b) Graph Theory and Graphical Models
c) Singular Value Decompositions and Markov Chains
d) Classification, Clustering
e) Information Theory and Power Law Distributions

2) MATHEMATICAL MODELS FOR INTERNET
a) Design and control of communication networks that respond to randomly fluctuating demands and failures
b) Stability and Fairness of rate control algorithms
c) Simulation of such networks

3) BASIC WWW TECHNOLOGIES
a) Web Documents and Resource Identifiers
b) Protocols
c) Search Engines

4) WEB GRAPHS
a) Internet and Web Graphs
b) Generative Models
c) Applications

5) TEXT ANALYSIS
a) Indexing
b) Lexical Processing
c) Content Based Ranking
d) Latent Semantic Indexing
e) Clustering and Extraction

6) LINK ANALYSIS AND ADVANCED CRAWLING TECHNIQUES
a) Page Ranking
b) Stability and Link Analysis
c) Types of Crawling
d) Web Dynamic

TEXT BOOKS:
1) Modeling Internet and Web by P. Baldi, P. Fracon, and P. Smyth, John Wiley and Sons
2) The Mathematics of Internet Congestion Control by Rayadurgam Srikant
CS-528 Financial Mathematics

L T P 3 1 -

Fundamentals of Mathematical Finance

Computation and Simulation in Finance
Monte Carlo, finite difference, tree, and transform methods for the numerical solution of partial differential equations in finance. Emphasis is on derivative security pricing. Prerequisite: 238 or equivalent.

Statistical Methods in Finance

Financial Modeling Methodology and Applications

Algorithmic Trading and Quantitative Strategies
An introduction to financial trading strategies based on methods of statistical arbitrage that can be automated. Methodologies related to high frequency data and stylized facts on asset returns; models of order book dynamics and order placement, dynamic trade planning with feedback; momentum strategies, pairs trading. Emphasis on developing and implementing models that reflect the market and behavioral patterns.

Statistical Models and Methods for Risk Management and Surveillance

Data Mining as Modern Applied Statistics
Two-part sequence. New techniques for predictive and descriptive learning using ideas that bridge gaps among statistics, computer science, and artificial intelligence. Emphasis is on statistical aspects of their application and integration with more standard statistical methodology. Predictive learning refers to estimating models from data with the goal of predicting future outcomes, in particular, regression and classification models. Descriptive learning is used to discover general patterns and relationships in data without a predictive goal, viewed from a statistical perspective as computer automated exploratory analysis of large complex data sets.

Monte Carlo
Carlo. Examples, problems and motivation from Bayesian statistics, machine learning, computational finance and graphics.

**Credit Risk: Modeling and Management**

**References**
Sasha Cyganowski, Peter Kloeden and Jerzy Ombach, From Elementary Probability to Stochastic Differential Equations with MAPLE, Springer, 2001
CS -529 Digital Defense

L T P 3 1 -

**Viruses, worms, malicious codes, Trojan Horses etc.:** History, Threats, Components, models of propagation and their epidemic spread, defense against worms viruses and malicious codes

**DOS attacks, DDoS:** Introduction, History, Effects, Evolution, Semantic Levels of ddos, IP Spoofing, ddos defense approaches.

**Design of Testbeds for simulation of attacks against critical infrastructures:** Attack vectors, Attack simulation their analysis and modeling.

**Architectures for Internet:** Design Principles, Architectural Constraints, Principles of avoiding failures.

**Information Security and Data Management:** Information Security, Information Management Technologies, Issues, Discretionary and Mandatory policies for information security, secure distributed and heterogeneous database systems

Introduction to secure data warehousing and data mining for security applications

**Books:-**


2) Internet Denial of Service: Attack and Defense Mechanisms, Jelena Mirkovic, Sven Dietrich, David Dittrich, Peter Reiher, Prentice Hall.


4) Internet Architecture and Innovations, Barbara van Schewick, July 2010, MIT press

5) Scalable Internet Architecture, Thoe Schlossnagel, 2007

CS-530 Cryptography

Unit 1:

Unit 2:

Unit 3:
**Pseudorandom Generators**: Computational Approaches to Randomness, A Rigorous Approach to Pseudorandom Generators, Definitions of Pseudorandom Generators, The Applicability of Pseudorandom Generators, Pseudo randomness and unpredictability.

Unit 4:

Unit 5:

Unit 6:
**Digital Signatures and Message Authentication**: The two types of schemes, The unified treatment, Attacks and security, Length-restricted signature scheme, Constructing collision-freehashing functions, Constructions of Message Authentication Schemes, Constructions of Signature Schemes.

Unit 7:

References:
- Oded Goldreich: Foundation of Cryptography, volume2 basic applications
- Jonathan Katz and Yehuda Lindell: Introduction to Modern Cryptography Principles and Protocols
CS -531 Public Key Infrastructure and Trust Management

1. **Describe PKI and the major components of a PKI:** What Is PKI, Components of PKI, Digital signatures, Digital Certificates., Key Management.

2. **Design a certification authority (CA) hierarchy to meet business requirements:** Certifying Authority, Different trust Model, Hierarchical /Mesh/Bridge, Certification, authorities/Parameters/Certificate chain, Certificate management, Registration & Initialization, Certification, Expiration and Revocations – CRL (Certification Revocation List)

3. **Certificate services:** Install Certificate Services to create a CA hierarchy, Perform certificate management tasks, CA management tasks, and plan for disaster recovery of Certificate Services., Create and publish a certificate template, and replace an existing certificate template, Enroll a certificate manually, auto-enroll a certificate, and enroll a smart card certificate, Configure trust between organizations by configuring and implementing qualified subordination.

4. **Directory services such as X.500 and LDAP:** X.500 for publication of PKC & CRL, X.509 version 3 certificates, Certificate Validation methods, Time Stamps, Certificate Lifecycle Management, Cross certification, PKI Architecture and its working.

5. **Impact on E-commerce and E business.**

**References:**
1) An INTRODUCTION to CRYPTOGRAPHY, Second Edition, Author: RICHARD A. MOLLIN
3) Internet Security Cryptographic Principles, Algorithms and Protocols, Author: Man Young Rhee
CS -532 Biometric Security

L T P 3 1 -

UNIT – I
Biometrics technology evolution, verification and identification, introduction to Biometrics, Fingerprint Recognition, Face Recognition, Iris Recognition, Hand Geometry Recognition, Gait Recognition, Voice Biometrics, On-Line Signature Verification, Face Recognition, comparison of various biometrics, biometric system errors, biometric deformations.

UNIT – II
False match rate, false non-match rate, biometric applications, biometric sensor interoperability, user psychology in biometric enrollment, Multi-biometrics and multimodal biometrics, Multispectral Face Recognition.

UNIT – III
Attacks against Biometric Systems, Biometric Cryptography, Fusion in biometrics, Liveness detection in biometrics, Fingerprint identification technology, scope of fingerprint biometric systems, how to improve the privacy and security of fingerprint biometric system. SFING (synthetic fingerprint generator).

UNIT – IV

Text Books:

Reference Books:
CS -533 Game theory and its applications

L T P 3 1 -

Basics of Game theory
Introduction to Game theory, Different types of games: two party, multi party games, coalition games. Applications of Game Theory in the context of Computer Science, in particular, decision making in multi-agent systems.

Introduction to Non-cooperative Game Theory: Games in Normal Form
Definition and Examples of Games in Normal Form, in particular the TCP user’s game, Analyzing games: from optimality to equilibrium, Pareto optimality, Defining best response and Nash equilibrium, Finding Nash equilibrium Nash’s theorem: proving the existence of Nash equilibrium, Strategies in normal-form games, Maxmin and minmax strategies, Minimax regret, Removal of dominated strategies, Rationalizability, Correlated equilibrium, Trembling-hand perfect equilibrium and Q-Nash equilibrium.

Computing Solution Concepts of Normal-Form Games

Games with Sequential Actions: Reasoning and Computing with the Extensive Form

Richer Representations: Beyond the Normal and Extensive Forms

Learning and Teaching
The interaction between learning and teaching, Rational learning, Reinforcement learning, Targeted learning, Evolutionary learning and other large-population models.

**Mechanism Design**
Introduction, Mechanism design with unrestricted preferences, Mechanism design in the quasi-linear setting Groves mechanisms, VCG mechanism, AGV mechanism, Tractable Groves mechanisms, Computational applications of mechanism design: Task scheduling, Bandwidth allocation in computer networks, Multicast cost sharing and Two-sided matching; Constrained mechanism design.

**Introduction to Coalitional Game Theory**

**BOOKS**

CS -534 Intrusion Detection

Introduction to data and methodologies of computer intrusion detection.: Intrusion detection principles, Approaches to intrusion detection, Models Architecture Organization Intrusion response.


Techniques for studying the Internet: TCP dump filters, Common attacks: network based attacks; probes, DOS., Techniques for visualizing network data. Activity Profiling.

Host Monitoring: Common attacks: host based attacks; buffer overflow and race conditions, malicious code. Computer Immunology, User profiling

Computer virus and worms: How viruses replicate, How viruses scanners work, Virus phylogenies, Computer worms, Covert channels, Back doors, Detecting Trojans

Statistical pattern recognition for detection of attacks: Designing a Statistical Pattern Recognition System., Multi-Class Pattern Classification, One-Class Pattern Classification, Multiple Classifier Systems

References
3. Network Intrusion Detection by Stephen Northcutt Judy, PEARSON EDUCATION LIMITED
CS -535 Security Engineering

L T P 3 1 -

**Security Engineering:** Introduction, Framework and definition

**Usability and Psychology:** Attacks Based on Psychology: Pretexting; Passwords; and System Issues

**Access Control:** Operating System Access Controls; Hardware Protection

**Distributed Systems:** Introduction; Concurrency; Fault Tolerance and Failure Recovery; Naming and Types of Name

**Multilevel Security:** Introduction; The Bell-LaPadula Security Policy Model; Historical Examples of MLS Systems; Future MLS Systems; Broader Implications of MLS

**Multilateral Security:** Introduction; Compartmentation, the ChineseWall and the BMA Model; Inference Control; Residual Problem

**Physical Protection:** Introduction; Threats and Barriers; Alarms

**Monitoring and Metering:** Introduction; Prepayment Meters; Taxi Meters, Tachographs and Truck Speed Limiters; Postage Meters

**Telecom System Security:** Introduction; Phone Phreaking; Mobile Phones; Security Economics of Telecomms

**Managing the Development of Secure Systems:** Introduction; Managing a Security Project; Methodology; Security Requirements Engineering; Risk Management; Managing the Team

**Reference:**


CS – 536 Information Security Risk Management

LTP 31 -

RISK MANAGEMENT:
Definition of Risk, Risk Management, Importance Of Risk Management, Integration Of Risk Management Into SDLC

RISK ASSESSMENT:

RISK MITIGATION:
Risk Mitigation Options, Risk Mitigation Strategy, Approach for Control Implementation, Control Categories, Cost-Benefit Analysis, Residual Risk

RISK ANALYSIS:
Effective Risk Analysis, Qualitative risk Analysis, Value Analysis, Facilitated Risk Analysis Process, Case Studies of Risk Analysis.

VULNERABILITY IN INFORMATION SYSTEM:

THREATS AND ATTACKS:
Principles of Security, Understanding the Attackers, Reducing the Risk of attack, Tools used for the attack, Respond to an Attack.

POST ASSESSMENT ACTIVITIES:

References:
1. Risk management guide for Information technology systems, Special Publication National institute of Standard and technology, Gaithersburg, MD
CS -537 Cyber laws and rights in today's digital age

L T P 3 1 -

1 )Introduction to Cyber Crime and IT ACT,2000: Crimes of the millennium, Section 80,Arrest without warrant, Checks and Balances against Arbitrary Arrests, Arrest for about to commit offence, Concept of cyber crime, Hacking, Web Vandals, Cyber fraud and cheating, E-mail Abuse, Virus, Cyber Pornography

2 ) Jurisdictional Issues and Disputes : Civil Law of Jurisdiction in India, Cause of Action, Jurisdiction and IT Act, Foreign judgements in India, Place of Cause of Action in contractual and IPR disputes, Exclusion clauses and their abuse, Misuse of the law of jurisdiction

3 ) Copyright Protection in Cyber World : Concept of Domain name, Squatters, legislative moves against squatting, meta tagging, Meaning of copyright, Copyright ownership and assignment, Licence, Term and respect for foreign works, Infringement remedies and Offences, Protection of content on the internet, Downloading for viewing content, Liability of ISPs for Copyright violations, Napster, Software piracy.

4 ) Digital Signatures, Certifying Authorities and E- Governance : Digital signatures, digital signature certificate, certifying authorities and their liability, E- Governance in India

5 ) Protection of Cyber Consumers in India : Consumer Protection Act, Goods and Services, Consumer Complaint, Defect in Goods and deficiency in Services, Restrictive and unfair trade practices, Reliefs under CPA, Consumer foras, jurisdiction and implications

6) IT Acts of USA and UK should be discussed.

Recommended Books :

CS -538 Computer Security Audit and Assurance

L T P 3 1 -

**Security Policy frameworks:** Practices and Procedures, Policy authority and practices, Policy elements, Information security policy framework, Organizational security policies & procedures, Asset classification and control policies & procedures, Personnel security policies & procedures, Physical and environmental security policies & procedures, Communications and operations management policies & procedures, business practice disclosures. [35%]

**PKIs:** Public Key Infrastructure, Various PKIs, Core PKI services, Issues of revocation, Anonymity and Privacy issues. [20%]

**Key Management:** Key generation, key distribution, key storage, key backup and recovery, key management schemes , Threats to key management and protection against those threats, key management Principles and Issues


References


2. Security policies and procedures *principles and practices* By Sari Stern Greene Published by Pearson Prentice Hall in Upper Saddle River, N.J.


CS -539 Decision Support Systems and Methods

UNIT- I

UNIT II
Business Intelligence, Special Introductory Section: The Essentials of Business Intelligence, Business Analytics and Data Visualization.

UNIT III
Advanced Querying & Information Retrieval, data analysis and OLAP, Data mining, data-warehousing, Information retrieval systems, Data, Text, and Web Mining, Neural Networks for Data Mining.

UNIT IV

UNIT V

BOOKS
1. Decision Support and Business Intelligence Systems (8th Edition) by Efraim Turban, Jay E
2. Decision Support and Business Intelligence Systems ; Aronson, Ting-Peng Liang, and Ramesh Sharda, PHI, 2006.

REFERENCES: