

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,  
VISHNUPURI, NANDED.**

**Curriculum and scheme of Examination of M.E. program in  
Computer Networks and Internet Security  
M.E. (CNIS) First Year**

**SEMESTER - I**

Sr. No.	SUBJECT	TEACHING SCHEME				EXAMINATION SCHEME			
		L	PR	TOTAL	PAPER	TW	TEST	ORAL	TOTAL
01	Research Methodology (Audit course)	02	--	02	--	50	--	--	50
02	Mathematical Foundations of Computer Science	04	--	04	100	--	25	--	125
03	Data Structures and Algorithms	04	--	04	100	--	25	--	125
04	Advanced Computer Networks	04	--	04	100	--	25	--	125
05	Foundations of Cryptography	04	--	04	100	--	25	--	125
06	Elective - I	04	--	04	100	--	25	--	125
07	Computer lab - I	--	04	--	--	25	--	25	50
08	Computer lab – II	--	04	--	--	25	--	25	50
09	Seminar	--	02	--	--	50	--	--	50
<b>TOTAL MARKS</b>									<b>825</b>

**SEMESTER - II**

Sr. No.	SUBJECT	TEACHING SCHEME				EXAMINATION SCHEME			
		L	PR	TOTAL	PAPER	TW	TEST	ORAL	TOTAL
01	Advanced Operating Systems	04	--	04	100	--	25	--	125
02	Network and Internet Security	04	--	04	100	--	25	--	125
03	Cyber Laws and Intellectual Property Rights	04	--	04	100	--	25	--	125
04	Ethical Hacking and Cyber Forensics	04	--	04	100	--	25	--	125
05	Elective - II	04	--	04	100	--	25	--	125
06	Computer lab – III	--	04	--	--	25	--	25	50
07	Computer lab – IV	--	04	--	--	25	--	25	50
08	Mini Project	--	--	--	--	50	--	50	100
<b>TOTAL MARKS</b>									<b>825</b>

**ELECTIVE – I**

- 1) Information Systems Control & Audit
- 2) Cloud Computing
- 3) Wireless & Mobile Computing
- 4) High Performance Networks
- 5) Distributed Computing

**ELECTIVE – II**

- 1) Intrusion Detection Systems
- 2) Database Security
- 3) Elliptic Curve Cryptography
- 4) Protocol Engineering
- 5) Ad-hoc Sensor Networks

## **First Year P.G. Program in Computer Networks & Internet Security**

### **Class Tests**

The class tests are meant for continuous assessment of the students. The class tests should be evenly spread over the entire period of a term and should cover the entire syllabus. In a semester, three tests (each of one hour duration) should be conducted for each subject and average of the best two tests should be taken as class test marks in that subject.

### **Seminar-I**

The seminar should be done on any IEEE topic in Computer Science & Engineering/Computer Networks/Internet Security to be decided by the students and the teacher concerned. Seminar work shall be in the form of report to be submitted by the students at the end of the semester. The candidate will deliver the talk on the topic for half an hour and assessment will be made by two internal examiners, one of them will be guide and the other appointed by the Principal of College.

### **Mini Project**

The student should do a mini project which is implementation of IEEE papers or a prototype design. The student should submit a synopsis at the beginning of the semester for approval to the project committee in a specified format. The student will have to present the progress of the work through seminars and progress report. A report must be submitted to the project committee for evaluation purpose at the end of the semester in a specified format.

# First Year P.G. Program in Computer Networks & Internet Security

## SEMESTER I

### 1. Research Methodology

<b>Teaching Scheme</b>	<b>L: 2</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
			(Audit Course)

### Course Objectives

To familiarize the students with:

- approach to research and its design
- role of methodology
- philosophical, theoretical, ideological and originality interface with research in general and empirical research in particular.

### Course Contents

#### UNIT I

#### Concepts (5 Hrs)

Definition of Research, Characteristics of Research, Types of Research – Applications/Objectives/Enquiry mode, Paradigms of Research, Eight Step Research Procedure, Formulating Problem, Conceptualizing Design, Assumptions and Limitations of Problem Definition.

#### UNIT II

#### Problem Definition (8 Hrs)

Literature Review, Sources of Literature, Maintain Literature data using Endnote2, Determining referencing procedure, For the Problem area to be identified, study efforts of past researchers and determine the anticipated variables to be studied. Determine the approach being developed is unique. Problem Formulation, Identifying variables to be studied, determine the scope, limitations and or assumptions, Justify basis for assumption, Formulate time plan for achieving targeted problem solution.

#### UNIT III

#### Research Design: (8 Hrs)

Definition Research Design and its Functions, Research Instrumentation, Availability, Training, Theoretical Conceptualization, Setting up of experiments, understanding

instrumentation characteristics, focusing on the information processing with output results. Examples: DSC, SEM, FTIR etc., Data Collection Forms, Validity, Reliability of Data, Calibrating Instruments. Analytical Techniques associated with the problem formulations, Software tools required for analytical problem definition and obtaining solution.

#### **UNIT IV**

##### **Data Analysis : (8 Hrs)**

Representation of size Analysis Data, Mean, Mode, Median, Data Skew ness, Histograms, Frequency Polygons and Frequency Curves, Cumulative Frequency Curve, Characteristics of Frequency Curve, Functions of Random Variables, Discrete Probability Distributions, Continuous Probability Distributions, Standard Normal Distribution, Processing Data for Editing, Coding, Developing framework for quantitative analysis, Displaying Data Histogram, Bar Chart, Stacked Bar Chart, Frequency Polygon, Pie Chart, Scatter gram. Mathematical Modeling, Statistical Modeling, Data Mining to perform predictive testing of measurable parameters of research. Measurement and scaling techniques., Use of tools like Matlab, Excel, Minitab etc.

#### **UNIT V**

##### **Testing of Hypothesis (8 Hrs)**

Parametric and Non Parametric Hypothesis, Continuous Probability Distributions, Standard Normal Distribution, Confidence Intervals, Chi-Square Tests and Multivariate Analysis, Analysis of Variances. Use of Matlab, Excel or other tools for analysis and result interpretation, Bartlett's test, Cochran's test for testing Hypothesis, Regression Analysis, Experimental Design.

#### **UNIT VI**

##### **Review Research (5 Hrs)**

Presenting research outcome at conferences and submitting papers to Journals, Identifying Journal publication procedures, Compiling Reports using Latex. Presenting Research Proposal to Internal Committee Experts, Determination of shortfalls in achieving targeted objectives, Identifying Problems and re describing final objectives, Determining Time Plan.

##### **Recommended Books:**

1. Research Methodology – A Step by Step Guide for Beginners by Ranjit Kumar, Sage Publication, ISBN, 141291194X, 9781412911948
2. Research Methodology – Methods and Techniques by C. R. Kothari, New Age International, ISBN, 8122415229, 9788122415223

## First Year P.G. Program in Computer Networks & Internet Security

### 2. Mathematical Foundations of Computer Science

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

- To understand the significance of number theory
- To learn different algebraic structures
- To study various concepts of linear algebra

#### Course Contents

##### UNIT I

##### Number theory (10 Hrs)

Divisibility, gcd, prime numbers, fundamental theorem of arithmetic, Congruences, Fermat's theorem, Euler function, primality testing, solution of congruences, Chinese remainder theorem, Wilson's theorem.

##### UNIT II

##### Algebraic Structures (10 Hrs)

Groups and subgroups, homomorphism theorems, cosets and normal subgroups, Lagrange's theorem, rings, finite fields.

##### UNIT III

##### Graph theory (10 Hrs)

Graphs, Euler tours, planar graphs, graph colouring, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem.

##### UNIT IV

##### Linear Algebra (6 Hrs)

Functions; Linear transformations and their inverses; Properties of linear transformations; Orthogonality, Orthogonal transformations, Inner product spaces, Introduction to determinants

## UNIT V

### Eigenvectors and Eigen value

(6 Hrs)

Definitions and examples of eigenvectors and eigen values; Computational methods for finding eigenvectors and eigen values; Properties of eigen vectors and eigen values; Matrix representations; Change of basis; Symmetric matrices and diagonalization.

### References Books

1. Niven, H.S. Zuckerman and Montgomery, *An Introduction to the Theory of Numbers*, 3/e, John Wiley and Sons, New York, 1992, ISBN 10: 0471546003 / ISBN 13: 9780471546009
2. Kolman and R.C. Busby, *Discrete Mathematical Structures for Computer Science*, PHI, New Delhi, 1994., ISBN 0-13-215922-8
3. J. Clark and D. A. Holton, *A First Look at Graph Theory*, Allied Publishers (World Scientific), New Delhi, 1991, ISBN, 9810204906, 9789810204907
4. Richard Bronson and Gabriel B. *Linear Algebra: An Introduction, 1<sup>st</sup> or 2<sup>nd</sup> Edition*, Costa Elsevier Academic Press, ISBN-10: 0120887843 | ISBN-13: 978-0120887842
5. *Done Right*, Sheldon Axler *Linear Algebra* , ISBN-10: 0387982582 | ISBN-13: 978-0387982588

## First Year P.G. Program in Computer Networks & Internet Security

### 3. Data Structures and Algorithms

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

1. To learn various algorithm design techniques
2. To understand advanced data structures
3. To learn various algorithm analysis techniques

#### Course Contents

##### UNIT I

###### Foundations

(6 Hrs)

Overview of basic data structures, role of algorithm in computing, asymptotic notations, recurrences, substitution method, recursion tree method, the master method, proof of Master theorem.

##### UNIT II

###### Probabilistic Analysis & Randomized Algorithm

(4 Hrs)

The hiring problem, Indicator random variables, Randomized algorithm, probabilistic analysis.

##### UNIT III

###### Basic algorithm techniques

(10 Hrs)

Dynamic programming, greedy algorithm, theoretical foundation of greedy methods, matroids, task scheduling problem, graph algorithms, maximum flow, amortized analysis.

##### UNIT IV

###### Advanced Data Structures

(8 Hrs)

Red-Black trees, B-trees, Binomial heaps, Fibonacci heaps, Skip lists, universal hashing, Data structures for maintaining ranges, intervals and Data structures for disjoint sets.

##### UNIT V

###### Complexity Classes

(8 Hrs)

NP-Hard and NP-complete problems, Cook's theorem, NP completeness reductions.

## UNIT VI

### Approximation Algorithms

(4 Hrs)

Polynomial time and fully polynomial time approximation schemes.

#### Text Books:

1. T.H Cormen, C.E. Leiserson, R.L. Rivest, "Introduction to algorithms", 3<sup>rd</sup> Edition, Prentic Hall India Publication. (ISBN- 978-0262033848 )
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 3<sup>rd</sup> Edition, Pearson Education. (ISBN-10: 032144146X,ISBN-13: 9780321441461)

#### Reference Books:

1. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education, (ISBN - 978-0201000238 )
2. Donald Ervin Knuth "Art of Computer Programming", Volume 1: Fundamental Algorithms (ISBN-13: 978-0201896831)
3. Horowitz, Sahni, Rajasekaran, "Computer Algorithms", Galgotia. (ISBN: 8175152575)
4. Aho, Ullman and Hopcroft, 'Design and Analysis of Algorithms' , Pearson education. (ISBN:9788131702055)
5. G. Brassad and P. Bratley "Fundamentals of Algorithms", PHI India. (ISBN- 81-203-1131-0)
6. M. A. Weiss, Data Structures and Algorithm Analysis in Java, Pearson . (ISBN-13: 978-0-13-257627-7)

# First Year P.G. Program in Computer Networks & Internet Security

## 4. Advanced Computer Networks

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

1. To have succinct and in-depth study of IPv6 features and functions.
2. Understand and learn to plan, design and integrate IPv6 with current IPv4 infrastructure.
3. To acquaint with high speed networks such as SONET, ATM, BISDN and DWDM

### Course Contents

#### UNIT-I (8 Hrs)

**Why IPv6:** What's New in IPv6?, Why Do We Need IPv6?, When Is It Time for IPv6? **The Structure of the IPv6 Protocol:** General Header Structure, the Fields in the IPv6 Header, Extension Headers. **IPv6 Addressing:** The IPv6 Address Space, Address Types, Address Notation, Prefix Notation, Global Routing Prefixes, Global Unicast Address, Special Addresses, Link- and Site-Local Addresses, Anycast Addresses, Multicast Address, Required Addresses, Default Address Selection.

#### UNIT-II (10 Hrs)

**Interoperability:** Dual-Stack Techniques, Tunneling Techniques, Network Address and Protocol Translation, Comparison, **ICMPv6:** General Message Format, ICMP Error Messages, ICMP Informational Messages, Processing Rules, The ICMPv6 Header in a Trace File, Neighbor Discovery (ND), Autoconfiguration, Network Renumbering, Path MTU Discovery, Multicast Listener Discovery (MLD), Multicast Router Discovery (MRD).

#### UNIT-III (8 Hrs)

**Networking Aspects:** Layer 2 Support for IPv6, Detecting Network Attachment (DNA). **Routing Protocols:** The Routing Table, RIPng, OSPF for IPv6 (OSPFv3), BGP-4 Support for IPv6, Additional Routing Protocols for IPv6.

#### UNIT-IV (6 Hrs)

**Upper-Layer Protocols:** UDP/TCP, DHCP, DNS, SLP, FTP, Telnet, Web Servers  
**IPv6 Quality of Service:** QoS Basics, QoS in IPv6 Protocols, Using QoS

#### UNIT V (8 Hrs)

**Network Services and Layered Architectures:** Applications, Traffic Characterization and Quality of Service, Network Services, High -Performance Networks, Network Elements, Basic Network

Mechanisms, Network Elements, Basic Network Mechanisms, Layered Architecture, Open Data Network Model, Network Architectures.

## UNIT VI

(8 Hrs)

Performance of Circuit-Switched Networks: SONET, Dense Wave-Division Multiplexing (DWDM), Fiber to the Home, Digital Subscriber Line (DSL ), Intelligent Networks, CATV, **Asynchronous Transfer Mode**: Main Features of ATM, Addressing, Signaling , and Routing, ATM Header Structure, ATM Adaptation Layer, Management and Control, BISDN, Internetworking with ATM,

### Text Books:

1. IPv6 Essentials, 2nd Edition by Silvia Hagen, O' Reilly Publications. ISBN: 0-596-10058-2.
2. Walrand.J. Varaiya, High Performance Communication Network, Morgan Kauffman - Harcourt Asia Pvt Ltd, 2nd Edition, 2000. ISBN: 1-55860-654-8

### Reference Books:

1. William Stallings ISDN & Broadband ISDN with frame Relay & ATM, PHI 4th Edition 2000. ISBN: 978-81-7758-569-8
2. Uyles Black Emerging Communications Technologies 2/e Prentice Hall 1997. ISBN : 0-13-014248-4
3. Bates & Donald W.Gregory Voice & Data Communications Handbook, Mc-Graw Hill, Edition, 3<sup>rd</sup> edition 2000. ISBN-13: 978-0-07-064766-4
4. Silvano gai, " Internetworking IPV6 with CISCO Routers" , McGraw– Hill Computer Communication series. ISBN: 978-0-07-022836-8.

## First Year P.G. Program in Computer Networks & Internet Security

### 5. Foundations of Cryptography

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

1. To familiarize with mathematical fundamentals required for Network Security.
2. To study the encryption and ciphering techniques.
3. To explore the algorithms used for secure transactions on internet.

#### Course Contents

##### UNIT I

5 Hrs

Time estimates for doing arithmetic , Divisibility and the Euclidean algorithm , Congruences, Some applications to factoring ,Finite Fields and Quadratic Residues :- Finite fields,2 . Quadratic .Primality and Factoring, Pseudo primes , The rho method 3 . Format factorization and factor basis.

##### UNIT II

8 Hrs

One-Way Functions and the Basic Assumptions- A Notation for Probabilities, Discrete Exponential Function , Uniform Sampling Algorithms , Modular Powers , Modular Squaring, Quadratic Residuosity Property , Formal Definition of One-Way Functions .

One-Way Functions and Pseudo randomness- Computationally Perfect Pseudorandom Bit Generators, Yao's Theorem.

##### UNIT III

7 Hrs

Symmetric-Key Encryption -Stream Ciphers, Block Ciphers – DES, AES , Modes of Operation.

Public-Key Cryptography - The Concept of Public-Key Cryptography ,Modular Arithmetic , The Integers, The Integers Modulo  $n$  ; RSA-Key Generation and Encryption , Digital Signatures, Attacks Against RSA ,Probabilistic RSA Encryption .

##### UNIT IV

6 Hrs

Cryptographic Hash Functions- Security Requirements for Hash Functions , Construction of Hash Functions , Data Integrity and Message Authentication , Hash Functions as Random Functions ,Signatures with Hash Functions.

## UNIT V

8 Hrs

Cryptographic Protocols -Key Exchange and Entity Authentication-Kerberos, Deffy-Hellman Key, Key Exchange and Mutual Authentication , Station-to-Station Protocol ,Public-Key Management Techniques.

Identification Schemes - Interactive Proof Systems, Simplified Fiat-Shamir Identification Scheme Zero-Knowledge , Fiat-Shamir Identification Scheme , Fiat-Shamir Signature Scheme.

## UNIT VI

8 Hrs

Commitment Schemes- A Commitment Scheme Based on Quadratic Residues .A Commitment Scheme Based on Discrete Logarithms, Homomorphic Commitments.

Electronic Elections-Secret Sharing, A Multi-Authority Election Scheme, Proofs of Knowledge, Non-Interactive Proofs of Knowledge, Extension to Multi-Way Elections, Eliminating the Trusted Center

Digital Cash - Blindly Issued Proofs, A Fair Electronic Cash System, Underlying Problems.

### Text Books:

1. H. DelfsandH. Knebl, *Introduction to Cryptography*, Springer,2007, E.3 ISSN 1619-7100 ISBN-13 978-3-540-49243-6
2. N. Koblitz, *Number Theory and Cryptography*, Springer,2008 , ISBN 10: 0387942939 / 0-387-94293-9. ISBN 13: 978038794293

### Reference books:

1. Bruce Schneier, *Applied Cryphography*, John Wiley & Sons, 1996 , ISBN 0-471-11709-9
2. Behrouz A. Forozan , DebdeepMukhopadhyay, *Cryptography and Network Security*, ISBN: 9780070702080

# First Year P.G. Program in Computer Networks & Internet Security

## 1. ELECTIVE - I Information Systems Control & Audit

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives:

1. To study the importance of IS auditing and techniques for IS auditing.
2. To familiarize with the Information System Control frameworks.

### Course Contents

**UNIT I: Introduction** **5 Hrs**  
Overview of Information Systems Auditing, Conducting an Information Systems Audit.

**UNIT II: The Management Control Framework** **7 Hrs**  
Top Management Controls, Systems Development Management Controls, Programming Management Controls, Data Resource Management Controls, Security Management Controls, Operations Management Control, Quality Assurance Management Controls.

**UNIT III: The Application Control Framework** **7 Hrs**  
Boundary Controls, Input Controls, Communication Controls, Processing Controls, Database Controls, Output Controls.

**UNIT IV: Evidence Collection** **8 Hrs**  
Audit Software, Code Review, Test Data, and Code Comparison, Concurrent Auditing Techniques, Interviews, Questionnaires, and Control Flowcharts, Performance Measurement Tools.

**UNIT V: Evidence Evaluation** **7 Hrs**  
Evaluating Asset Safeguarding and Data Integrity, Evaluating System Effectiveness, Evaluating System Efficiency.

**UNIT VI: Information Systems Audit Management** **6 Hrs**  
Managing the Information Systems Audit Function.

### Text Books:

1. Information Systems Control & Audit, Ron Weber, 1/e, Pearson Education, ISBN 9788131704721

### Reference Books:

1. Deborah Russell, Computer Security Basics, O'Reilly & Associate, ISBN : 978-0-596-00669-3
2. Karen. A. Forcht, Computer Security Management, Boyd & Fraser Pub. Co. ISBN : 978-0878358816
3. Donald A. Watne, Peter B.B. Turney, Auditing EDP Systems, 2/e, PH. ISBN : 978-0130510044

## First Year P.G. Program in Computer Networks & Internet Security

### 2. ELECTIVE-I Cloud Computing

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

- To understand the emerging area of cloud computing, IT outsourcing, application virtualization and how it relates to traditional models of computing.
- To gain competence in Map Reduce as a programming model for distributed processing of large datasets. Specifically:
- To understand and be able to articulate key concepts behind Map Reduce, including its functional abstraction, the use of distributed storage, and the scheduling of data-local jobs.

#### Course Contents

##### Unit I: Cloud Computing Basics

8 Hrs

Cloud Computing Overview, What Is Cloud Computing?, Cloud Components, Infrastructure, Services, Applications, Storage, Database Services, Intranets and the Cloud, Components, Hypervisor Applications, First Movers in the Cloud, Amazon, Google, Microsoft, SaaS architecture, Dev 2.0 platforms, cloud models.

##### Unit II: Cloud Computing Platforms

8 Hrs

Infrastructure as a service: Amazon EC2, Platform as a service: Google App Engine, Microsoft Azure, Amazon Simple Storage Service (Amazon S3), Amazon CloudFront, Amazon Simple Queue Service (Amazon SQS), Elastic Block Store, Salesforce.com, Force.com, Salesforce.com CRM, AppExchange, IBM Services, Cloud Computing economics.

##### Unit III: Cloud Technologies

8 Hrs

SOAP and REST, SOAP versus REST, AJAX, Mashups, Virtualization, Why Virtualize?, How to Virtualize, Concerns, Security, Server Solutions, Microsoft Hyper-V, VMware, VMware Infrastructure, Virtualization Technology – VM Technology, applications, pitfalls. Multi-Tenant software. Web Application Framework, Web Hosting Service, Proprietary Methods, Web Applications, Sample Apps, Cloud APIs.

## **Unit IV: Cloud Development**

**8 Hrs**

Data in the cloud: RDBMs, GFS and HDFS, BigTable, Hbase and Dynamo, Cloud Datastore-Datastore and SimpleDB, MapReduce and extensions, Dev 2.0 Platforms. Enterprise software, Custom Enterprise Applications and Dev 2.0, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem, Roadmap for enterprise cloud Computing.

## **Unit V: Cloud Security**

**8 Hrs**

Cloud Information Security objectives, Cloud Security Services, Cloud Security Design Principles, Secure Cloud Software requirements, Threats to Infrastructure , data and access control, Cloud Service Providers risks, Identity management and access control.

### **Text Books:**

1. Anothony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing : A Practical Approach*, MGH, 2010. ISBN: 978-0-07-162695-8
2. Gautam Shroff, *Enterprise Cloud Computing*, Cambridge, 2010 , ISBN 978-0-521-76095-9
3. Ronald Krutz and Russell Dean Vines, *Cloud Security*, 1/e, Wiley, 2010 , ISBN: 978-0-470-58987-8

### **References Books:**

1. Judith Hurwitz, R Bloor, M Kanfman, F Halper, *Cloud Computing for Dummies*, 1/e, Wiley Publishers, 2009. ISBN: 978-0-470-63881-1

# First Year P.G. Program in Computer Networks & Internet Security

## 3. ELECTIVE-I Wireless and Mobile Computing

Teaching Scheme	L: 4		
Evaluation Scheme	Theory	Test	Minimum Passing Marks
	100 Marks	25 Marks	40%

### Course Objectives:

1. To explore the trends in wireless and mobile computing.
2. To study the cellular networks including 3G
3. To familiarize with the mobile device technologies.

### Course Contents

#### Unit I 4 Hrs

##### Introduction

Definition, Applications, Mobile and wireless devices, reference model, frequencies for radio transmission, Signals, Antennas, signal propagation, multiplexing, modulation, spread spectrum, cellular systems, motivation for specialized MAC, SDMA, FDMA, TDMA-fixed TDMA, classical aloha, slotted aloha, CSMA, DAMA, PRMA, reservation TDMA, MACA, polling, CDMA.

#### Unit II 6 Hrs

**Cellular System fundamentals:** Frequency reuse, handoff strategies, interference and system capacity, improving coverage and capacity.

**GSM:** services and features, system architecture, radio subsystem, channel types, frame structure, signal processing in GSM.

#### Unit III 8 Hrs

**Third Generation (3G) Cellular Systems:** Introduction, 3G Concerns, 3G Spectrum Allocation, Third Generation Service Classes and Applications, Third Generation Standards.

**Fourth Generation (4G) Systems and Beyond:** Introduction, Design Goals for 4G and Beyond and Related Research Issues, Orthogonal Frequency Division Multiplexing (OFDM), 4G Services and Applications, Challenges: Predicting the Future of Wireless Systems.

## **Unit IV**

**8 Hrs**

**WLAN:** Infra red vs radio, Infrastructure and ad-hoc, IEEE 802.11- system architecture, protocol architecture, physical layer, MAC layer, MAC management. **Mobile Network and Transport Layer:** Mobile IP, Traditional TCP and Classical TCP improvements.

## **Unit V**

**8 Hrs**

**Mobile Device Technology:** Hardware, Human-machine interface, Operating Systems-Palm OS, EPOC, Windows CE, QNX Nutrino, BeOS, Embedded Linux, Java for Pervasive devices. Introduction to Android Platform

## **Unit VI**

**6 Hrs**

**WAP:** Introduction, architecture, infrastructure, security issues, WML. Pervasive Web Application architecture, Open research topics in mobile computing.

### **Text Books:**

1. Schiller, “Mobile Communication”, Second Edition, Pearson Publication, 2009. ISBN: 978-81-317-2426-2
2. T. S. Rappaport “Wireless Communication: Principles and Practice” Second Edition, Pearson 2010. ISBN: 978-81-317-3186-4
3. P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis “WIRELESS NETWORKS”, John Wiley ISBN: 047085801X
4. J Burkhardt, H Henn, S Hepper et al, “Pervasive Computing: Technology and Architecture of Mobile Internet Applications”, Pearson 2006. ISBN: 978-0201722154

### **References:**

1. Asoke Talkukder, Roopa R Yavagal, “Mobile Computing – Technology, Applications and Service Creation”, Tata McGraw Hill, 2007 ISBN: 978-0-07-058807-3
2. Reza B’Far, “Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML”, Cambridge University press, 5th Edition, 2006. ISBN: 978-0521817332
3. Uwe Hansmann, Lothar Merk, Martin S Nicklous and Thomas Stober, Principles of Mobile Computing”, Springer International Edition, Second Edition, 2005 ISBN: 978-81-8128-073-2
4. [ProAndroid 2](#) by [Sayed Hashimi](#), [Satya Komatineni](#), ISBN: 978-1430226598

# First Year P.G. Program in Computer Networks & Internet Security

## 4.ELECTIVE-I High Performance Networks

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives:

1. To have in-depth understanding of TCP/IP performance measurements.
2. To do comparative study of network performance on different networks such as satellite networks, wireless networks, asymmetric networks.
3. To learn TCP implementation.

### Course Contents

#### Unit I Introduction

4 Hrs

TCP Applications and Services, Motivation for Performance Study of TCP/IP , What Do We Mean by TCP Performance? , **TCP/IP Fundamentals, Performance Measurement of TCP/IP Networks** Reasons for Network Measurement, Measurement Tasks, Classification of Measurement Tools, Popular measurement Tools and Their Applications ,Tcpcat , Tcpcat , Tcpcat , Tcpcat , Netperf , NetPIPE, Distributed Benchmark System.

#### Unit II : Network Simulation and Modelling

8 Hrs

**TCP/IP Simulation:** The Role of Simulation , Steps of a Systematic Simulation Study , Types of Simulations , Simulation Validation and Verification , Confidence Level of Simulation Results, Simulation with Self-Similar Traffic, Classification of Simulation Tools , 'ns' 'Network Simulator, OPNET, **TCP Modeling:** Motivation for Mathematical Modeling of TCP, Essentials of TCP Modeling , Gallery of TCP Models .

#### Unit III: Performance over High Speed Networks

8 Hrs

**Wireless Networks,** TCP Performance Issues over Wireless Links ,Improving TCP Performance over Wireless Links ,Wireless System Evolution and TCP/IP **Mobile Networks:** Cellular and Ad Hoc Networks ,TCP Performance in Cellular Networks, TCP Performance in Ad Hoc Networks

**Optical:** Evolution of Optical Networks, IP over DWDM, Multiprotocol Label Switching, Multiprotocol Lambda Switching, Optical Burst Switching, Optical Packet Switching, Performance of TCP/IP over Optical Networks.

#### Unit IV: Performance over Satellite, and Asymmetric Networks

8 Hrs

**Satellite Networks:** History of Data Satellites , Motivations for Using Satellites ,Types of Satellites ,Satellite Internet architectures , Satellite Characteristics Affecting TCP , Goals for TCP Performance Enhancement Solutions ,TCP Enhancements for Satellite Networks , Advanced Enhancements and New Versions of TCP.  
New Transport Protocols for Satellite Links, Performance Enhancing Proxy.

**Asymmetric Networks:** Types of Network Asymmetry ,Impact of Asymmetry on TCP Performance , Improving TCP Performance over Asymmetric Networks , Experimental Evaluation of Performance Improvement Techniques.

**Unit V: TCP Implementation**

**8 Hrs**

TCP Implementation Overview, Buffering and Data Movement, Accessing User Memory, TCP Data Exchange, Retransmissions, Congestion, High Performance TCP, High-Bandwidth-Delay Products, Round-Trip Estimation, Path MTU Discovery ,Reducing End-System Overhead ,Overhead, CPU Utilization, and Bandwidth The Role of Application Processing ,Sources of Overhead for TCP/IP ,Per-Packet Overhead ,Interrupts ,Checksums , Connection Management, Copy Avoidance, Page Remapping, Scatter/Gather I/O, Remote Direct Memory Access, TCP Of flood.

**Unit VI: New TCP Standards and Flavors**

**4 Hrs**

Duplicate Acknowledgments and Fast Retransmit ,Fast Recovery and TCP Reno ,TCP New Reno ,TCP with Selective Acknowledgments ,Forward Acknowledgments ,TCP Vegas ,Overview of Other Features and Options ,Performance Comparison of TCP Flavors.

**Text Books:**

1. Mahbub Hassan and Raj Jain, 'High Performance TCP/IP Networking: Concepts, Issues and solutions', PHI Learning. ISBN: 978-81-203-2812-9

**Reference Books:**

1. Larry L Peterson and Bruce S Davie, 'Computer Networks: A Systems Approach', Fourth Edition, Morgan Kaufman Publishers. ISBN: 978-012-374013-7.
2. Jean Warland and Pravin Vareya, 'High Performance Networks and Internets', Morgan Kauffman Publishers. ISBN: 1-55860-654-8
3. William Stallings, 'High Speed Networks: Performance and Quality of Service', 2nd Edition, Pearson Edu. ISBN 10: 0130322210 / ISBN 13: 9780130322210
4. Mani Subramaniam, 'Network Management: Principles and Practices', Pearson Education. ISBN-10: 8131734048. ISBN-13: 9788131734049.

## First Year P.G. Program in Computer Networks & Internet Security

<b>5. ELECTIVE-I Distributed Computing</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing</b>
<b>Marks</b>	100 Marks	25 Marks	40%

### Course Objectives

1. To understand the concepts of distributed environment and the key areas of Distributed Application Development.
2. Explore the issues involved in distributed multimedia systems and Ubiquitous Computing.
3. Familiarize with CORBA

### Course Contents

#### UNIT I

**8 Hrs**

Characterization of Distributed systems: Introduction, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges, Case Study: The World Wide Web, Summary, System Models: Introduction, Physical models, Architectural models, Fundamental models.

#### UNIT II

**8 Hrs**

Interprocess Communication: Introduction, The API for the Internet protocols, External data representation and marshalling, Multicast communication, Network virtualization: Overlay networks, Case study: MPI. Remote Invocation: Introduction, Request-reply protocols, Remote procedure call, Remote method invocation, Case study: Java RMI. Indirect Communication: Introduction, Group communication, publish-subscribe systems, Message queues, Shared memory approaches.

#### UNIT III

**8 Hrs**

Operating System Support: Introduction, The operating system layer, Protection, Processes and threads, Communication and invocation, operating system architecture, Virtualization at the operating system level. Distributed Objects and components: Introduction, Distributed objects, case study: CORBA, From objects to components, Case studies: Enterprise Javabeans and

Fractal. Web Services: Introduction, Web services, Service descriptions and IDL for web services, a directory service for use with web services, XML security, Coordination of web services, Application of web services.

#### **UNIT IV**

**8 Hrs**

Peer-to-peer Systems: Introduction, Napster and its legacy, Peer-to-peer middleware, Routing overlays, Overlay case studies: Pastry, Tapestry, Application case studies: Squirrel, OceanStore, Ivy, Security: Introduction, Overview of security techniques, Cryptographic algorithms, Digital signatures, Cryptography pragmatics, Case studies: Needham-Schroder, Keberos, TLS, 802.11 Wi-Fi, Name Services: Introduction, Name services and the Domain Name System, Directory services, Case Study: The Global Name Service, Case study: The X.500 Directory Service

#### **UNIT V**

**8 Hrs**

Mobile and Ubiquitous Computing: Introduction, Association, Interoperation, Sensing and context awareness, Security and privacy, Adaptation, Case study: Cooltown. Distributed multimedia Systems: Introduction, Characteristics of multimedia data, Quality of service management, Resource management, Stream adaptation, Case studies: Tiger, BitTorrent and End System multicast, Designing Distributed Systems: Google Case study: Introduction, Introducing the case study: Google, Overall architecture and design philosophy, Underlying communication paradigms, Data storage and coordination services, distributed computation services

#### **Textbook:**

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Pearson Education, 5th Edition, 2012 ISBN 13: 978-0-13-214301-1

#### **Reference Books:**

1. P.K.Sinha, "Distributed Operating System" Addison Wesley, 2003, ISBN 6321117891
2. Tanenbaum & Steen, "Distributed System" PHI, 2002, ISBN 0-13-148521-0
3. Sape Mullender, "Distributed Systems", Addison Wesley, 2nd Edition, 1993, ISBN 0-201-62427-3.
4. Liu M.L., "Distributed Computing Principles and Applications", Pearson Education, 2004. ISBN 0-201-79644-9
5. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill Publication, 1996, ISBN 0-7803-1119-1.

## First Year P.G. Program in Computer Networks & Internet Security

### 7. COMPUTER LAB-I

<b>Teaching Scheme</b>	<b>PR: 4</b>		
<b>Evaluation Scheme</b>	<b>Practical</b>	<b>Termwork</b>	<b>Minimum Passing Marks</b>
	25 Marks	25 Marks	40%

Computer Lab –I shall be based on the subjects Advanced Computer Networks and Foundations of Cryptography.

#### **Term Work:**

The Term Work shall consists of at least 8 programs/assignments or one small project for each subject. The experiments shall be evenly distributed over the entire syllabus.

## First Year P.G. Program in Computer Science & Engineering

### 8. COMPUTER LAB-II

<b>Teaching Scheme</b>	<b>PR: 4</b>		
<b>Evaluation Scheme</b>	<b>Practical</b>	<b>Termwork</b>	<b>Minimum Passing Marks</b>
	25 Marks	25 Marks	40%

Computer Lab – II shall be based on the subjects Data Structure & Algorithms and Elective – I.

#### **Term Work:**

The Term Work shall consists of at least 8 programs/assignments or one small project for each subject. The experiments shall be evenly distributed over the entire syllabus.

## SEMESTER – II

### First Year P.G. Program in Computer Networks & Internet Security

1. Advanced Operating System
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

- To familiarize with the goals, components and architecture of operating systems.
- To study process, thread, memory and disk management techniques.
- To do comparative study between Linux and windows kernels.

#### Course Contents

#### UNIT I 4 Hrs

**Introduction:** Computers and Software, Operating System Strategies, The Programmer's Abstract Machine, Resources, Processes and Threads, Writing Concurrent Programming, Objects,

#### UNIT II 5 Hrs

**Operating System Organization:** Basic Functions, General Implementation Considerations, Contemporary OS Kernels. **Device Management:** The I/O System, I/O Strategies, Device Manager Design, Buffering, Device Class Characteristics.

#### UNIT III 8 Hrs

**Implementing Processes, Threads, and Resources:** The Task at Hand, The Hardware Process, The Abstract Machine Interface, The Process Abstraction, The Thread Abstraction, State Diagrams, Resource Managers, Generalizing Process Management Policies.

**Scheduling:** Overview, Scheduling Mechanisms, Strategy Selection, Non-Preemptive Strategies, Preemptive Strategies, Implementing the Scheduler.

#### UNIT IV 8 Hrs

**Basic Synchronization Principles:** Cooperating Processes, Evolving from the Classic Solution, Semaphores: The Basis of Modern Solutions, Synchronization in Shared Memory Multiprocessors.

**High-Level Synchronization and Interprocess Communication:** Alternative Synchronization Primitives, Monitors, Interprocess Communication.

**Deadlock:** Background, A System Deadlock Model, Prevention, Avoidance, Detection and Recovery.

## UNIT V

8 Hrs

**Memory Management:** The Basics, The Address Space Abstraction, Memory Allocation, Dynamic Address Space Binding, Modern Memory Manager Strategies.

**Virtual Memory:** The Task at Hand, Address Translation, Paging, Static Paging Algorithms, Dynamic Paging Algorithms, Segmentation, Memory-Mapped Files.

**File Management:** The Task at Hand, Files, Low-Level File Implementations, Supporting High-Level File Abstractions, Directories, Implementing Directories, File Systems.

## UNIT VI

6 Hrs

**Design Strategies:** Design Considerations, Monolithic Kernels, Modular Organization, Extensive Nucleus or Microkernel Organization, Layered Organizations, Operating Systems for Distributed Systems.

**The LINUX Kernel:** The LINUX Kernel, Kernel Organization.

**The Windows NT/2000XP Kernel:** The NT Kernel, The NT Executive.

### Text Books:

1. Gary Nutt “Operating Systems”, 3/e, Pearson Education, ISBN: 9788131723593.

### Reference Books:

- 1 Silberschatz and Galvin, Operating system concepts, Addison Wesley. ISBN: 0471694665 / ISBN-13: 978047169466
- 2 Tanenbaum Andrew S., Modern Operating system, Eaglewood Cliffs, NJ: Prentice Hall. ISBN: 9780136006633
- 3 Stallings W, Operating system- Internals and design principles, 4<sup>th</sup> Edition, PHI. ISBN:9788131725283
- 4 Charles Crowley, Operating system- a design oriented approach, Tata McGraw-Hill New Delhi. ISBN: 9780074635513, 978-0074635513
- 5 H M Dietel, P J Dietel, and D R Choffnes, Operating Systems, 3<sup>rd</sup> Edition, Pearson Edu. ISBN:81-317-1289-3.

# First Year P.G. Program in Computer Networks & Internet Security

## 2. Network and Internet Security

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

- To know the network security tools and applications.
- To understand the system level security.
- To learn concepts in Internet security

### Course Contents

#### Unit I: Introduction

6 Hrs

Overview of ISO's OSI model and TCP/IP model, Key Management, X.509 certificates, Public-Key Infrastructure (PKI), Remote user authentication using symmetric key encryption, Kerberos, Remote user authentication using asymmetric key encryption Federated Identity management, Biometrics

#### Unit II: Wireless Network Security

5Hrs

IEEE 802.11 Wireless LAN Overview: The Wi-Fi Alliance, IEEE 802 Protocol Architecture, IEEE 802.11 Network Components and Architectural Model ,IEEE 802.11 Services, IEEE 802.11i Wireless LAN Security: IEEE 802.11i Services, IEEE 802.11i Phases of Operation, Discovery Phase, Authentication Phase, Key Management Phase, Protected Data Transfer Phase, The IEEE 802.11i Pseudorandom Function,

#### Unit III: WAP Security

5 Hrs

Wireless Application Protocol Overview: Operational Overview, WAP Architecture, Wireless Application Environment, WAP Protocol Architecture, Wireless Transport Layer Security: WTLS Sessions and Connections, WTLS Protocol Architecture, Cryptographic Algorithms, WAP End-to-End Security

#### Unit IV: Electronic Mail Security

8Hrs

Pretty Good Privacy: Notation, Operational Description, Cryptographic Keys and Key Rings, Public-Key Management, S/MIME: RFC 5322, Multipurpose Internet Mail Extensions, S/MIME Functionality, S/MIME Messages, S/MIME Certificate Processing, Enhanced Security Services, Domain Keys Identified Mail: Internet Mail Architecture, E-mail Threats, DKIM Strategy, DKIM Functional Flow

**Unit- V: Web and IP Security****8 Hrs**

Web security: Web security requirements, Secure Sockets Layer (SSL), Transport Layer Security (TLS), and Secure Electronic Transaction (SET), HTTPS, Secure Shell (SSH), IP Security: IP Security overview, Architecture, Authentication, Encapsulating security payload, Combining security associations, Key management.

**Unit –VI: System Security****8 Hrs**

Intruders, Intrusion detection, Password management, malicious software, Viruses and related threats, Virus countermeasures, Distributed denial of service attacks, Firewalls: Firewall design principles, trusted systems.

**Text books:**

1. William Stallings “Cryptography and Network Security: Principles and Practice”, 5<sup>th</sup> Edition, Pearson Education. (ISBN:978-81-317-6166-3)
2. Behrouz A. Forouzan, “Cryptography and Network Security”, Tata McGraw-Hill. 2007, (ISBN: 978-00-706-6046-5)

**Reference Books:**

1. Bernard Menezes, “Network Security And Cryptography”, Cengage Learning, 2010 (ISBN : 978-81-315-1349)
2. Schneier B., “Applied Cryptography”, 2<sup>nd</sup> Edition, Wiley & Sons. 2002, (ISBN: 0-471-11709-9)
3. Kaufman C., Perlman R. and Speciner M., “Network Security: Private communication in Public World”, 2<sup>nd</sup> Edition, Prentice-Hall, 2002, (ISBN: 978-01-304-6019-6)

## First Year P.G. Program in Computer Networks & Internet Security

### 3. Cyber Laws and Intellectual Property Rights

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

#### Course Objectives

1. To study the issues and laws of intellectual property rights such as patent laws, etc.
2. To familiarize with the cyber crimes and to learn how to avoid it.
3. To explore IT Act 2000.

#### Course Contents

##### UNIT I 6 Hrs

Intellectual property rights, computer software copyrights, copyright in databases and electronic publishing, law of confidence, patent laws, trademarks, product designs, international law.

##### UNIT II 10 Hrs

Computer contracts, liability for defective hardware and software, software contracts, web and hardware contracts, electronic contracts and torts, liabilities.

##### UNIT III 10 Hrs

Computer crime, computer fraud, hacking, unauthorized modification of information, piracy.

##### UNIT IV 14 Hrs

Cyber laws in India, IT Act 2000, data subjects' rights, ethical issues in computer security, case studies.

#### Text Books:

1. D. Bainbridge, *Introduction to Computer Law*, 5/e, Pearson Education, 2004.
2. P. Duggal, *Cyber law: the Indian Perspective*, 2005.
3. C. P. Fleeger and S. L. Fleeger, *Security in Computing*, 3/e, Pearson Education, 2003.

#### Reference Books:

1. D. Bainbridge, *Introduction to Information Technology Law*, 6<sup>TH</sup> ED., Pearson Education.

# First Year P.G. Program in Computer Networks & Internet Security

## 4. Ethical Hacking and Cyber Forensics

<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives:

1. To understand the fundamentals of ethical hacking.
2. To learn network, web and router forensics.

### Course Contents

#### Unit I 5 Hrs

Hacking windows , Network hacking , Web hacking, Password hacking. A study on various attacks –Input validation attacks, SQL injection attacks, Buffer overflow attacks , Privacy attacks.

#### Unit II 5 Hrs

TCP / IP, Checksums, IP Spoofing port scanning, DNS Spoofing. Dos attacks, SYN attacks, Smurf attacks, UDP flooding, DDOS, Models. Firewalls, Packet filter firewalls, Packet Inspection firewalls – Application Proxy Firewalls. Batch File Programming.

#### Unit III 7 Hrs

**Network Forensics and Investigating logs**-Introduction, Network forensics, log files as evidence, tools for log files, why synchronize computer times. **Investigating network traffic**-introduction of network protocols, types of network attacks, why investigate network traffic, evidence gathering at physical layer and data link layer, DNS poisoning techniques, evidence gathering from, ARP table, DHCP database, IDS. Different tools , documenting the evidence gathered on a network, evidence reconstruction for investigation.

#### Unit IV 8 Hrs

**Investigating web attacks**- introduction, indications, types, overview of web logs, Investigating , web attack, FTP servers, IIS logs, apache logs, windows,based servers, static and dynamic ip addresses. Web page defacement, ID, security strategies for web apps, checklist for web security, statistics, Tools for web , attack investigations, locating ip addresses and other tools.

#### Unit V 8 Hrs

**Router forensics**-introduction, functions, vulnerabilities, attacks, router forensics vs. traditional forensics, investigating router attacks, tools. **Investigating DoS attacks**-introduction, indications of DoS/DDoS attack, types of DoS attacks, DDoS attack, DoS attack modes, techniques to detect DoS attacks, investigating DoS attacks, challenges and tools. **Investigating internet crime**-,objectives, introduction, internet crimes, internet forensics, goals of investigation, steps for investigating internet crime and tools.

## **Unit VI**

**7 Hrs**

**Tracking emails and investigating email crimes**-objectives, introduction, email systems, email crime, identity theft, chain emails, phishing, email spoofing, investigating email crimes and violations, using specialized email forensic tools. **Investigating corporate espionage**-introduction, motives, insider/outsider threat, threats due to aggregation of information, spying techniques, defense against corporate spying, steps to prevent corporate espionage, tools.

### **Text Books:**

1. Ankit Fadia “ Ethical Hacking” second edition Macmillan India Ltd, 2006
2. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series:Computer Forensics) EC-Council, Cengage Learning.

### **References:**

1. Understanding Cryptography: A Textbook for Students and Practitioners :Christof paar, Jan Pelzl.
2. Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts Ali Jahangiri
3. Handbook of Digital and Multimedia Forensic Evidence [Paperback] John J. Barbara
4. CyberForensics: Understanding Information Security Investigations (Springer's Forensic Laboratory Science Series) by Jennifer Bayuk

## First Year P.G. Program in Computer Networks & Internet Security

<b>1. ELECTIVE-II</b> <b>Intrusion Detection System</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objective

1. To learn the Intrusion detection and prevention techniques used on networks.
2. To familiarize with Snort.

### Course Contents

#### **UNIT I:** **8 Hrs**

History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, need and types of IDS, Information sources Host based information sources, Network based information sources

#### **UNIT II** **8 Hrs**

Intrusion Prevention Systems, Network IDs protocol based IDs ,Hybrid IDs, Analysis schemes, thinking about intrusion, A model for intrusion analysis , techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis

#### **UNIT III** **10 Hrs**

Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces , Snort Command Line Options , Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

#### **UNIT IV** **8 Hrs**

Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc Plugins, Preprocessors and Output Modules, Using Snort with MySQL

#### **UNIT V** **6 Hrs**

Using ACID and SnortSnarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs, future needs

### Reference Books

1. Rebecca Gurley Base “ Intrusion Detection” MacMillan Technology Series( MTP Series) ISBN 1578701856, 9781578701858
2. Rafeeq Rehman “ Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID” Prentice Hall PTR ,2003 ISBN 0-13-140733-3

## First Year P.G. Program in Computer Networks & Internet Security

<b>2.ELECTIVE-II</b> <b>Database Security</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

- To familiarize with the techniques for hardening of database environment.
- To learn the secure database transaction algorithms
- To study the security methods of different database servers.

### Course Contents

#### UNIT-I

Getting Started : Harden your database environment, Patch your database, Track security bulletins, Audit the database, Define an access policy as the center of your database security and auditing initiative, Resources.

Database Security within the General Security Landscape and a Defense-in-Depth Strategy : Defense-in-depth, The security software landscape, Perimeter security, firewalls, intrusion detection, and intrusion prevention, Securing the core, Application security, Public key infrastructure (PKI), Vulnerability management,, Patch management, Incident management.

**08hrs.**

#### UNIT -II

The Database as a Networked Server : Leave your database in the core, Understand the network access map for your database environment, Track tools and applications, Remove unnecessary network libraries, Use port scanners—so will the hackers, Secure services from known network attacks, Use firewalls.

Authentication and Password Security: Choose an appropriate authentication option, Understand who gets system administration privileges, Choose strong passwords Implement account lockout after failed login attempts, Create and enforce password profiles, Use passwords for all database components, Understand and secure authentication back doors

**06hrs**

#### UNIT-III

Application Security: Reviewing where and how database users and passwords, Obfuscate application code, Secure the database from SQL injection attacks, Beware of double whammies: Combination of SQL injection and buffer overflow vulnerability, Don't consider eliminating the application server layer, Address packaged application suites, Work toward alignment between the application user model and the database user model.

Using Granular Access Control : Align user models by communicating application user information, Use row-level security (fine-grained privileges/access control), Use label security,

Integrate with enterprise user repositories for multitiered authentication, Integrate with existing identity management and provisioning solutions.

Using the Database To Do Too Much: Don't use external procedures,, Don't make the database a Web server and don't promote, Don't generate HTML from within your stored procedures, Understand Web services security before exposing Web services endpoints

**07hrs**

#### **UNIT-IV**

Securing database-to-database communications : Monitor and limit outbound communications ,Secure database links and watch for link-based elevated privileges, Protect link usernames and passwords, Monitor usage of database links, Secure replication mechanisms ,Map and secure all data sources and sinks

Trojans : The four types of database Trojans, Baseline calls to stored procedures and take action on Divergence, Control creation of and changes to procedures and triggers, Watch for changes to run-as privileges, Closely monitor developer activity on production environments, Monitor creation of traces and event monitors, Monitor and audit job creation and scheduling, Be wary of SQL attachments in e-mails.

Encryption: Encrypting data-in-transit, Encrypt data-at-rest.

**08hrs**

#### **UNIT-V**

Regulations and Compliance: The alphabet soup of regulations: What does each one mean to you? , Understand business needs and map to technical requirements, The role of auditing, The importance of segregation of duties, Implement a sustainable solution.

Auditing Categories : Audit logon/logoff into the database, Audit sources of database usage, Audit database usage outside normal operating hours , Audit DDL activity, Audit database errors, Audit changes to sources of stored procedures and triggers , Audit changes to privileges, user/login definitions, and other security attributes, Audit creations, changes, and usage of database links and of replication, Audit changes to sensitive data, Audit SELECT statements for privacy sets, Audit any changes made to the definition of what to audit.

**06hrs**

#### **UNIT-VI**

Auditing Architectures : Don't create a false sense of security , Opt for an independent/backup audit trail, Architectures for external audit systems , Archive auditing information, Secure auditing information, Audit the audit system, Sustainable automation and oversight for audit activities, Think in terms of a data warehouse , Implement good mining tools and security applications, Support changing audit requirements, Prefer an auditing architecture that is also able to support remediation.

**05hrs**

#### **Text book:**

1. Ron Ben Natan, *Implementing Database Security and Auditing*, Elsevier, Indian reprint, ISBN: 9781555583347

#### **Reference books:**

1. S. Castano, M. Fugini, G. Martella, P. Samarati (eds.), *Database Security*, Addison-Wesley,  
2. Michael Gertz, Sushil Jajodia, *Handbook*, ISBN-10: 0387485325 , ISBN-13: 978-0387485324

## First Year P.G. Program in Computer Networks & Internet Security

<b>3.ELECTIVE-II</b> <b>Elliptic Curve Cryptography</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

- To learn the mathematics of Elliptic curve cryptography.
- To understand Elliptic curve cryptography
- To know applications of Elliptic curve cryptography.

### Course Contents

#### UNIT – I 6 Hrs

Introduction , Weierstrass Equations ,The Group Law, Projective Space and the Point at Infinity, Proof of Associativity, Equations for Elliptic Curves, Coordinate Systems, The  $j$ -invariant, Elliptic Curves in Characteristic 2 , Endomorphisms Singular Curves, Elliptic Curves mod  $n$ , Torsion Points, Division Polynomials ,The Weil Pairing, The Tate-Lichtenbaum Pairing

#### UNIT – II 8 Hrs

Elliptic Curves over Finite Fields, The Frobenius Endomorphism, Determining the Group Order, A Family of Curves, Schoof's Algorithm, Supersingular Curves, The Discrete Logarithm Problem, The Index Calculus ,General Attacks on Discrete Logs, Attacks with Pairings, Anomalous Curves, Other Attacks

#### UNIT – III 8 Hrs

Elliptic Curve Cryptography, The Basic Setup, Diffie-Hellman Key Exchange, Massey-Omura Encryption, ElGamal Public Key Encryption, ElGamal Digital Signatures, The Digital Signature Algorithm, ECIES ,A Public Key Scheme Based on Factoring, A Cryptosystem Based on the Weil Pairing, Factoring Using Elliptic Curves ,Primality Testing

#### UNIT – IV 6 Hrs

Elliptic Curves over  $Q$ , The Torsion Subgroup. The Lutz-Nagell Theorem, Descent and the Weak Mordell-Weil Theorem, Heights and the Mordell-Weil Theorem, The Height Pairing,

Fermat's Infinite Descent, 2-Selmer Groups, Shafarevich-Tate Groups, A Nontrivial Shafarevich-Tate Group, Galois Cohomology, Elliptic Curves over  $\mathbb{C}$ , Doubly Periodic Functions, Tori are Elliptic Curves, Computing Periods, Division Polynomials, The Torsion Subgroup: Doud's Method

#### **UNIT – V**

**8 Hrs**

Divisors, Definitions and Examples, The Weil Pairing, The Tate-Lichtenbaum Pairing, Computation of the Pairings, Genus One Curves and Elliptic Curves, Equivalence of the Definitions of the Pairings, The Weil Pairing, The Tate-Lichtenbaum Pairing, Nondegeneracy of the Tate-Lichtenbaum Pairing

#### **UNIT – VI**

**4 Hrs**

Hyperelliptic Curves, Basic Definitions, Divisors, Cantor's Algorithm, The Discrete Logarithm Problem, Zeta Functions, Elliptic Curves over Finite Fields, Elliptic Curves over  $\mathbb{Q}$ , Fermat's Last Theorem

#### **Reference Books:**

- 1) Lawrence C. Washington, "Elliptic Curves: Number Theory and Cryptography", 2<sup>nd</sup> Edition, CRC Press 2008, (ISBN: 978-142007-1467)
- 2) Darrel Hankerson, Alfred J. Menzes, Scott Vanstone, "Guide to Elliptic curve Cryptography", Springer Professional computing, (ISBN: 978-038795-2734)
- 3) H.Cohen and G.Frey, "Handbook of Elliptic and Hyperelliptic Curve Cryptography", CRC Press, 2006, (ISBN: 978-158488-5184)

## First Year P.G. Program in Computer Networks & Internet Security

<b>4.ELECTIVE-II</b> <b>Protocol Engineering</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

1. Understand network protocols verification and validation concept.
2. To provide thorough understanding of network protocols specifications and their performance testing's.
3. To learn how protocols are synthesized.

### Course Contents

#### UNIT-I

**Introduction:** Communication Model, Communication Software, Communication Subsystems, Communication Protocol, Communication Protocol Development Methods, Protocol Engineering Process. Layered Architecture, Network Services and Interfaces, Protocol Function, OSI Model, TCP/IP Protocol Suite, Application Protocols. **05 Hours**

#### UNIT-II

**Protocol Specification:** Components of Protocol to be Specified, Communication Service Specification, Protocol Entity Specification, Interface Specifications, Multimedia Protocol Specifications, Internet Protocol Specifications: Examples. **SDL:** Examples of SDL Based Protocol Specifications Introduction to Other Protocol Specification Languages. **08 Hours**

#### UNIT-III

**Protocol Verification/Validation:** Protocol Verification, Verification of a Protocol Using Finite State Machines, Protocol Validation, Protocol Design Errors, Protocol Validation Approaches, and SDL based Protocol Verification, SDL based Protocol Validation. **Protocol Conformance Testing:** Conformance Testing, Conformance Testing Methodology and Framework, Conformance Test Architectures, Test Sequence Generation Methods, Distributed Architecture by Local Methods, Conformance Testing with TTCN, Conformance Testing in Systems with Semi-controllable Interfaces, Conformance Testing of RIP, Multimedia Applications Testing, SDL Based Tools for Conformance Testing, SDL Based Conformance Testing of MPLS. **12 Hours**

#### UNIT-IV

**Protocol Performance Testing:** Performance Testing Methods, SDL Based Performance Testing of TCP, SDL based Performance Testing of OSPF, Interoperability Testing, SDL Based Interoperability Testing of CSMA/CD and CSMA/CA Protocol Using Bridge, Scalability Testing. **05 Hours**

#### UNIT V

**Protocol Synthesis:** Protocol Synthesis, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis. **Protocol Implementation:** Requirements of Protocol Implementation, Object based approach to Protocol Implementation, Protocol Compilers, and Tools for Protocol Engineering. **10 Hours**

**Text Books:**

1. Venkataram & Manvi, Pallapa Venkataram Sunilkumar S. Manvi, “Communication Protocol Engineering”, PHI Learning Pvt. Ltd., 2004, ISBN – 81-203-2603-9
2. Miroslav Popovic, “Communication Protocol Engineering”, CRC Press, 2006, ISBN - 978-0-8493-9814-8.

**Reference Books:**

1. Konig, Hartmut, “Protocol Engineering”, Springer, 2012, ISBN – 978-3-642-29144-9

## First Year P.G. Program in Computer Networks & Internet Security

<b>5.ELECTIVE-II</b> <b>Ad hoc and Sensor Networks</b>
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<b>Teaching Scheme</b>	<b>L: 4</b>		
<b>Evaluation Scheme</b>	<b>Theory</b>	<b>Test</b>	<b>Minimum Passing Marks</b>
	100 Marks	25 Marks	40%

### Course Objectives

1. To study the basics of Wireless Sensor Networks (WSN)..
2. To learn the protocols and routing algorithms in WSN.
3. To explore the OS and other WSN technologies.

### Course Contents

**UNIT I** **8 Hrs**  
**Introduction to Ad Hoc Networks:** Characteristics of MANETs, Applications of MANETs and challenges of MANETs. **Routing in MANETs:** Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms, Position based routing algorithms, other routing algorithms.

**UNIT II:** **7 Hrs**  
**Data Transmission:** Broadcast storm problem, Broadcasting, Multicasting and Geo-casting  
**TCP over Ad Hoc:** TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

**UNIT III:** **8 Hrs**  
**Basics of Wireless, Sensors and Applications:** Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer.  
**Data Retrieval in Sensor Networks:** Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, Sensor Networks and mobile robots

**UNIT IV:** **6 Hrs**  
**Security:** Security in Ad Hoc networks, Key management, Secure routing, Cooperation in MANETs, Intrusion Detection systems.

**UNIT V:** **6 Hrs**  
**Sensor Network Platforms and Tools:** Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms

**UNIT VI :** **5 Hrs**  
**Operating System:** TinyOS - **Imperative Language:** nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor network extension, TOSSIM

### TEXT BOOKS:

1. Ad Hoc and Sensor Networks , Theory and Applications, Carlos Corderio Dharma P. Aggarwal, World Scientific Publications, March 2006, ISBN,981-256-681-3

2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN,978-1-55860-914-3 ( Morgan Kauffman)

### **REFERNCE BOOKS**

1. AD Hoc Wireless networks , Architectures and protocols, Murthy, Manoj, Pearson
2. Ad-hoc Networks: Fundamental Properties and Network Topologies, Hekmat, Ramin, Springer.
3. AD HOC NETWORKS: Technologies and Protocols, Prasant Mohapatra, Srikanth Krishnamurthy, Springer.
4. Ad-Hoc Wireless Networks: Architecture and Protocols , Siva Ram Murthy, B S Manaj, PH2004 ISBN 013147023X, 9780131470231

## First Year P.G. Program in Computer Networks & Internet Security

### 6. COMPUTER LAB-III

<b>Teaching Scheme</b>	<b>PR: 4</b>		
<b>Evaluation Scheme</b>	<b>Practical</b>	<b>Termwork</b>	<b>Minimum Passing Marks</b>
	25 Marks	25 Marks	40%

Computer Lab – III shall be based on the subjects Advanced Operating Systems and Network and Internet Security.

#### **Term Work:**

The Term Work shall consists of at least 8 programs/assignments or one small project for each subject. The experiments shall be evenly distributed over the entire syllabus.

### 7. COMPUTER LAB-IV

<b>Teaching Scheme</b>	<b>PR: 4</b>		
<b>Evaluation Scheme</b>	<b>Practical</b>	<b>Termwork</b>	<b>Minimum Passing Marks</b>
	25 Marks	25 Marks	40%

Computer Lab – IV shall be based on the subjects Ethical Hacking & Digital Forensics and Elective – II.

#### **Term Work:**

The Term Work shall consists of at least 8 programs/assignments or one small project for each subject. The experiments shall be evenly distributed over the entire syllabus.

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,  
VISHNUPURI, NANDED.**

**Curriculum and scheme of Examination of M.E. program in  
Computer Networks and Internet Security  
M.E. (CNIS) Second Year**

**SEMESTER - III**

Sr. No	Subject	Teaching Scheme			Examination Scheme			
		Theory	Practical	Total	Paper	Term Work	Oral/Presentation	Total
01	Dissertation Part - I	-	20*	20	-	100	100	200

\* This is the minimum number of hours student should work for his/her dissertation; however the teaching load for guide is 4Hrs / student / week.

**SEMESTER - IV**

Sr. No	Subject	Teaching Scheme			Examination Scheme			
		Theory	Practical	Total	Paper	Term Work	Oral/Presentation	Total
01	Dissertation Part - II	-	20*	20	-	100	200	300

\* This is the minimum number of hours student should work for his/her dissertation; however the teaching load for guide is 2Hrs / student / week.

**Dissertation shall consist of research work done by the candidates in the areas related to Computer Science & Engineering.**

**OR**

**Design and/or development of a software (product) related to Computer Science & Engineering.**

Following shall be the guidelines for the evaluation of dissertation part – I

### **Dissertation Part – I**

1. Dissertation part – I shall consist of the following components(whichever applicable)
2. Extensive literature survey.
3. Data collection from R & D organizations, Industries, etc.
4. Study of viability, applicability and scope of the dissertation.
5. Detailed design (H/W and S/W as applicable).
6. Partial Implementation, etc.

A candidate should prepare the following documents for the examination

1. A term paper in the IEEE format based on the work.
2. A detailed report of the work done by the candidate related to dissertation.  
Every candidate should present himself (for about 30 min) before the panel of examiners (which will evaluate the dissertation-I for term work and oral marks) consisting of
  1. Head of the Department.
  2. M.E.Coordinator.
  3. All guides.
  4. At least one examiner from outside the Department.

### **Dissertation Part – II**

The dissertation shall be assessed internally by a panel of examiners before submission to the University. The candidate shall submit the dissertation in triplicate to the Head of the Institution, duly certified that the work has been satisfactorily completed. The practical examination (viva-voce) shall consists of a defense presented by the candidate in the presence of Examiners appointed by the University one of whom will be the guide and the other an External Examiner.