

**Centre for Computer Science & Technology**

**Course Structure and Syllabus**

**For**

**M.Tech in Computer Science & Technology  
(Cyber Security)**

**(2016-17 Onwards)**

**Eligibility Criteria:** B.Tech/B.E. in Computer Science and Engineering / Information Technology /Electronics / Electronics & Communication from a recognized Indian or Foreign University/ Graduates (AMIETE/AMIE) from Institution of Electronics and Telecommunication Engineers (IETE) in Computer Science & Engineering with minimum 55% marks. Preference will be given to candidates having valid GATE score.

## Centre for Computer Science & Technology

Scheme of Programme: M.Tech. in Computer Science & Technology (Cyber Security)

### SEMESTER - I

S.No	Course Type	Paper	Course Title	L	T	P	Cr	% Weightage				E
		Code						A	B	C	D	
1	Foundation	CBS.6101	Research Methodology and Statistics	4	-	-	4	25	25	25	25	100
2	Core	CBS.6102	Advanced Data Structures and Algorithms	4	-	-	4	25	25	25	25	100
3	Core	CBS.6103	Advanced Computer Networks	4	-	-	4	25	25	25	25	100
4	Core	CBS.6104	Advanced Operating Systems	4	-	-	4	25	25	25	25	100
5	Elective-1	CBS.6111	Data mining	4	1	-	4	25	25	25	25	100
		CBS.6112	Wireless Networks and Mobile Computing									
		CBS.6113	Cloud Computing and Security									
6	Foundation	CBS.6150	Programming in C++	-	-	4	2	-	-	-	-	50
8	Core	CBS.6153	Advanced Computer Networks -Lab	-	-	4	2	-	-	-	-	50
9	Elective	XXX.XXX X	Inter-Disciplinary Elective -2 (From Other Departments)	2	-	-	2	10	15	15	10	50
				<b>22</b>	<b>-</b>	<b>8</b>	<b>26</b>					<b>650</b>

**SEMESTER- II**

S.No	Course Type	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
								A	B	C	D	
1	Core	CBS.6201	Information Security	4	-	-	4	25	25	25	25	100
2	Core	CBS.6202	Ethical Hacking & Penetration Testing	4	-	-	4	25	25	25	25	100
3	Core	CBS.6203	Python Programming	4	-	-	4	25	25	25	25	100
4	Core	CBS.6204	IT Act & Cyber Laws	4	-	-	4	25	25	25	25	100
5	Elective-1	CBS.6211	Computer and Cyber Forensics	4	1	-	4	25	25	25	25	100
		CBS.6212	Secure Coding									
		CBS.6213	Advanced Database Management System									
		CBS.6214	Biometric Security									
6	Core	CBS.6252	Ethical Hacking & Penetration Testing-Lab			2	1	-	-	-	-	25
7	Core	CBS.6253	Python Programming - Lab	-	-	2	1	-	-	-	-	25
8	Elective	XXX.XX XX	Inter-Disciplinary Elective-2 (From Other Departments)	2	-	-	2	10	15	15	10	50
				<b>22</b>	-	4	<b>24</b>					600

**SEMESTER III**

S.No	Course Type	Paper	Course Title	L	T	P	Cr	% Weightage				E
		Code						A	B	C	D	
	Elective	CBS.6199	Research Seminar	-	-	4	2	-	-	-	-	50
4	Elective	CBS.6300	Pre-Dissertation	-	-	-	16					400
				-	-	-	<b>18</b>					450

**SEMESTER IV**

S.No	Course Type	Paper	Course Title	L	T	P	Cr	% Weightage				E
		Code						A	B	C	D	
1	Elective	CBS.6400	Dissertation	-	-	-	16					400
				-	-	-	<b>16</b>					400

A: Continuous Assessment: Based on Objective Type Tests

B: Pre-Scheduled Test-1: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)

C: Pre-Scheduled Test-2: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)

D: End-Term Exam (Final): Based on Objective Type Tests

E: Total Marks

**L: Lectures T: Tutorial P: Practical Cr: Credits**

**Total Lectures for 4 Credit Course: 50-55**

## SEMESTER - I

### CBS.6101                      Research Methodology and Statistics

Credits: 4

**Objective:** The objective of this course is to ensure that a student learns basis of scientific research and statistical methods to arrive at and verify the conclusions drawn.

**Learning Outcomes:** Upon completion of this course, the students will be able to:

- Prepare research proposal and plan
- Explain how to interpret data using hypothesis testing
- Describe the concept of multivariate analysis

#### Unit1

General principles of research: Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. Technical writing: Scientific writing, writing synopsis, Research paper, Poster preparation and Presentations and Dissertation.

#### Unit 2

Measures of central tendency and dispersal, Histograms, Sampling distribution, Kurtosis and skewness. Probability distributions (Binomial, Poisson and Normal), General Statistics: Hypothesis testing, parametric tests: z test, Student's t-test, Chi-square test.

#### Unit 3

One-way and two-way analysis of variance (ANOVA), Critical difference (CD), Fisher's LSD (Least significant difference), Non parametric tests: Kruskal-Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks, Chi-square test.

#### Unit 4

Regression and correlation: Standard errors of regression coefficients, Comparing two regression lines, Pearson Product ó Moment Correlation Coefficient, Spearman Rank correlation coefficient, Power and sampling size in correlation and regression.

#### Text books:

1. Kothari, C.R. (2013). Research Methodology: Methods and Techniques. New Age International.
2. S.C. Gupta (2014), Fundamentals of Statistics, Himalaya Publishing House

#### Suggested readings::

1. David J. Sheskin (2011), Handbook of Parametric and Nonparametric Statistical Procedures, Chapman and Hall/CRC.2.
2. Best J. W. (1999). Research in Education, New Delhi: Prentice Hall of India Pvt. Ltd.

### CBS.6102                      Advanced Data Structures and Algorithms

Credits: 4

**Objective:** This course will provide knowledge related to various data structures and algorithms. The course will also introduce techniques for analysing the efficiency of computer algorithms

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Identify the properties, strengths, and weaknesses of different data structures
- Examine various existing algorithms
- Distinguish among various data structures

#### Unit I

**Introduction to Basic Data Structures:** Importance and need of good data structures and algorithms, Linked lists, Queues, Heaps, Hash tables, Binary search trees.

### Unit II

**Advanced Data Structures:** Red-Black Trees, B-trees, Fibonacci heaps, Data Structures for Disjoint Sets.

**Design Strategies:** Divide-and-conquer, Dynamic Programming, Greedy Method.

### Unit III

**Internal and External Sorting algorithms:** Linear Search, Binary Search, Bubble Sort, Insertion Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort, Counting Sort, Radix Sort.

**Advanced String Matching Algorithms:** The naive string-matching algorithm, Rabin-Karp, String matching with finite automaton, Knuth-Morris-Pratt algorithm.

### Unit IV

**Graph Algorithms:** Elementary graph algorithms, Minimum spanning trees, shortest path algorithms: single source and all pair, Max flow problem and its solutions, Graph coloring problem and its solutions, Bio-inspired algorithms: Swarm Intelligence, Ant Colony Optimization, and Current Trends in Data Structures.

#### Text books:

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C. 2010. Introduction to Algorithms. 3<sup>rd</sup> ed. MIT Press.
2. S. Sridhar 2014. Design and Analysis of Algorithms. Oxford University Press India

#### Suggested readings:

1. Aho, A.V., Hopcroft, J.E. and Ullman, J. D. 2009. Data Structures and Algorithms. India: Pearson Education.
2. Horowitz, E., Sahni, S. and Rajasekaran, S. 2010. Fundamentals of Computer Algorithms. Galgotia Publications.
3. Weiss, M.A. 2009. Data Structures and Algorithm Analysis in C++. India: Pearson Education.

**CBS.6103**

**Advanced Computer Networks**

**Credits: 4**

**Objective:** This course is designed to discuss recent developments in various fields of networking, including but not limited to, routing, flow control, performance evaluation, transport protocols, application protocols, real-time protocols, and network architectures.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Define various networks and their applications
- Identify issues in wired as well as wireless networks
- Explain the properties, strengths, and weaknesses of different computer networks and routing protocols

### Unit I

#### Introduction:

Overview of Computer Networks, ISO-OSI and TCP/IP reference models, MAC protocols for LANs, Gigabit Ethernet, Wireless LAN

**IPv6:** Overview of IP and IPv4, IPv6: Basic protocol, Extensions and options, Tunneling, Addressing, Neighbor Discovery, Auto-configuration, IPv6 in an IPv4 Internet Migration and Coexistence, **Mobile IPv6:** Overview, Route Optimization, Handover and its impacts on TCP and UDP, Security requirements.

### Unit II

#### Transport Layer:

Conventional TCP, TCP extensions for wireless networks

#### Software Defined Networks:

Introduction, Evolution and Importance of SDN, Control and Data Planes, Role of SDN Controllers, Application areas of SDN.

### Unit III

#### Mobile Computing:

Introduction, Mobile Computing Architecture, Technologies: Bluetooth, RFID, WiMAX, Security Issues in Mobile Computing.

### **Cellular Technologies:**

Cellular Concept: Introduction, Frequency Reuse, Channel Assignment, Handoff Strategies, Interference, Cell Splitting and Sectoring. **GSM:** GSM-services, features, system architecture, **GPRS:** Introduction, network architecture, data services, applications and limitations, 3G and 4G.

### **Unit IV**

**Ad Hoc Networks:** Introduction to Adhoc networks, Issues in Adhoc networks and Pro-active and Reactive routing protocols. **VANETS:** Introduction, architecture, applications and challenges **WSNs:** Introduction, architecture, applications, challenges, and Current Trends.

### **Text books:**

1. Behrouz A. Forouzan: Data Communications and Networking, 2<sup>nd</sup> Edition, McGraw-Hill.
2. Andrew S. Tanenbaum, David J. Wetherall: Computer Networks, Pearson.
3. HeshamSoliman: Mobile IPv6 Mobility in Wireless Internet, Pearson Education.

### **Suggested Books**

1. Ashok K. Talukdar: Mobile Computing- Technology, Applications and Service Creation, 2<sup>nd</sup> Edition, McGraw-Hill.
2. Theodore S. Rappaport: Wireless Communications Principles and Practice, Prentice Hall.
3. KazemSohraby, Daniel Minoli, TaiebZnati: Wireless Sensor Networks- Technology, Protocols and Applications, Wiley.

**CBS.6104**

**Advanced Operating System**

**Credits: 4**

**Objective:** This course is designed to provide the students with a basic understanding and experiential learning of operating system.

**Learning Outcomes:** Upon completing the course the students should be able to

- explain the basic structure and functioning of operating system.
- define the problems related to process, file and memory management.
- Compare the working of windows and linux based operating systems

### **Unit1**

**Fundamentals of Operating System:** Operating System Functions, OS structures, Processes: Process control, Process states, Interacting processes, Process Control Block. Job Scheduling Algorithms.

### **Unit 2**

**Deadlocks:** handling deadlocks, deadlock detection and resolution, deadlock avoidance.

Memory Management: contiguous memory allocation, non-contiguous memory allocation, Memory partitioning: fixed and dynamic, paging, segmentation.

### **Unit 3**

**Virtual memory:** Demand Paging, Page replacement algorithms. Disk Scheduling Algorithms, Directory Structure, Distributed Operating Systems & its types.

**Windows System:** Concepts and tools, System Architecture, Process Threads, and Jobs, Windows Management Mechanisms - The registry, Registry usage, Registry data types, Local structure, Services, Applications.

### **Unit4**

**Linux Systems :**History, design principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output, Inter-process Communication, Network Structure, Security.

**Smartphones:** Case Studies: OS for smartphones. **Internet of Things:** Introduction, Architecture, Challenges, Importance, and Recent Trends in Operating Systems.

**Text books:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons ,Inc., 9th Edition,2012,.
2. Mark E. Russinovich and David A. Solomon, "Microsoft® Windows® Internals- Part 1", 6th Edition, Microsoft Press, 2012.
3. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2012.

**Suggested readings:**

3. Mark E. Russinovich and David A. Solomon, "Microsoft® Windows® Internals- Part 2", 6th Edition, Microsoft Press, 2012.
4. Christopher Negus and Christine Breshnahan, "Linux Bible ", 8th Edition, John Willey & Sons, Inc., 2012.

## Elective-1

**CBS.6111**

**Data Mining**

**Credits: 4**

**Objective:** The objective of this course is to ensure that a student learns to understand and implement basic models and algorithms in data warehousing and data mining. The students will learn how to analyze the data and identify the related issues.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Describe the concepts related to data warehousing and data mining
- Summarize the dominant data warehousing architectures
- Use information from a variety of different sources and extract knowledge from large data repositories

### Unit I

**Data Mining Architecture:** Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Basic Statistical Descriptions of Data, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons, Measuring Data Similarity and Dissimilarity

### Unit II

**Association Rules:** Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlational analysis, Constraint based association mining

**Advanced Pattern Mining:** Pattern Mining in Multilevel, Multidimensional space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns.

### Unit III

**Classification and Clustering:** Classification and prediction, Decision tree induction, Bayesian classification, Rule based Classification, Classification by Support Vector Machine Cluster analysis, Types of data in clustering, Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density-based methods, Grid-based methods, Model based clustering methods, clustering high dimensional data, clustering with constraints.

### Unit IV

**Introduction of Mining Complex Data:** Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web, Data Mining Applications, Data Mining and Society and Recent Trends in Data Mining.

**Text Book:**

1. Han, J., Kamber, M. and Pei, J. 2011. Data Mining: Concepts and Techniques. Elsevier.
2. Berson, A. and Smith S.J. 2008. Data Warehousing, Data Mining, &Olap. Tata McGraw-Hill Education

**Suggested Readings:**

1. Dunham, M.H. 2008. Data Mining: Introductory and Advanced Topics. India: Pearson Education.

**CBS.6112****Wireless Networks and Mobile Computing****Credits: 4**

**Objective:** The main objective of this course is to provide the students with basic knowledge and concepts of Wireless Data Transmissions.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Identify the basic problems, limitations, strengths and current trends of mobile computing;
- Explain the current wireless networking mechanisms
- Discuss the issues related to developing mobile computing systems and applications;

**Unit I**

**Introduction:** History of Wireless Communications, Advantages of Wireless Communication, Disadvantages of Wireless communication, Wireless Network Generations, Comparison of Wireless Systems, Applications of Wireless Communications

**Wireless Communication Technology:** Signal Encoding Techniques, Overview of Modulation Techniques, Multiple Access Techniques.

**Unit II**

**Wireless Networks:** Cellular Wireless Networks, Cordless Systems, Paging and Wireless Systems, Wi-Fi, Wi Max, Hyper LAN and Zig bee.

**Wireless Internet:** Mobile IP components, process of agent discovery, registration and de-registration, care-of-address, concept of tunnelling, Limitations of Mobile IP, Wireless Application Protocol: WAP Introduction, Protocol Architecture, Components of WAP.

**Unit III**

**Mobile Computing:** Mobile communication, Mobile computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Mobility Management.

**Mobile Network Layer:** Mobile IP: Goals, Assumptions, Entities and Terminology, IP Packet Delivery, Agent Discovery, Registration, Tunneling and Encapsulation, Optimizations, Dynamic Host Configuration Protocol (DHCP)

**Unit IV****Wireless Ad hoc Networks (MANETs)**

Introduction to Ad hoc wireless networks, applications of Ad hoc networks, **MANETs:** Introduction, secure routing protocols. **VANETs:** Introduction and routing protocols, Wireless sensor Networks, WPAN, Body Area Network, and recent trends in MANETs .

**Text books:**

1. Schiller, J. 2008. Mobile Communications. 2nd ed. India: Pearson Education.
2. Kumar, S., et al. Wireless and Mobile Networks: Concepts and Protocols. Wiley India.
3. Kamal, R. 2009. Mobile Computing. Oxford University Press.

**Suggested readings:**

1. Talukder, K A., et al. 2008. Mobile Computing, Tata McGraw Hill.
2. Gast S.M.,802.11 Wireless Networks, SPD O'REILLY.
3. Stojmenovic I.2007, Handbook of Wireless Networks and Mobile Computing, Wiley.

4. Rappaport, T.S. 2009. Wireless Communications. 2nded. India: Pearson Education.
  5. Stalling, W. 2009. Wireless Communications & Networks. India: Pearson Education.
- Singhal, T L. 2010 Wireless Communication Tata McGraw-Hill Education

**CBS.6113**

**Cloud Computing and Security**

**Credits: 4**

**Objective:** This course will introduce cloud computing concepts in detail. This course will also explain the concept of virtualization and its role in cloud computing. Storage related issues of cloud computing will also be discussed.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Identify the key concepts and challenge in cloud computing
- Describe the role of virtualization in cloud computing
- Classify the storage related issues in cloud computing

**Unit I**

**Introduction to cloud computing:** Definition, architecture, deployment models, characteristics and cloud Storage. Evolution of cloud, services, projects and challenges, Companies in the Cloud Today. Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Comparison among SAAS, PAAS, IAAS.

**Unit II**

**Virtualization:** Introduction to virtualization, concept and properties of virtualization, CPU virtualization, memory virtualization, I/O virtualization, Forms of CPU virtualization, Role of Virtualization in cloud computing, Hypervisors, Virtualization Security concerns.

**Scheduling in Cloud:** Overview of Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling.

**Unit III**

**Cloud Storage**

Overview; Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3

**Role of Grid in Implementing Cloud Computing:** Basics of Grid Computing, Grid Architecture, Distributed computing in Grid and cloud, Interoperability in Grid and cloud.

**Unit IV**

**Cloud Security**

Infrastructure Security: Network Level Security, Host Level Security and Application Level Security;

**Data Security:** Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing, and Recent Trends in Cloud Computing.

**Text Books:**

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi. 2013. Mastering Cloud Computing: Foundations and Applications Programming. Elsevier Science & Technology.
2. Jamsa, Kris, Cloud computing : Saas, paas, laas, virtualization, business models, mobile, security, and more, Jones & Bartlett Learning (2013)

**Suggested Readings:**

1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill (2010)
2. Magoules, Frederic, Cloud computing : Data-intensive computing and scheduling, CRC Press (2012)
3. Schulz, Greg, Cloud and virtual data storage networking : Your journey to efficient and effective information services, Auerbach Publications (2011)

4. Velte, Anthony T. Cloud computing, McGraw-Hill Osborne; 1 edition (2009)  
Hurwitz J., Bloor R., Kanfman M., Halper F.,2010 Cloud Computing for Dummies, Wiley India.

**CBS- 6150**

**Programming in C++**

**Credits: 2**

Students should be asked to implement the object oriented programming using C++ on the following topics:

Tokens, Expressions and Control Structures, Functions in C++, Classes and Objects, Constructors and destructor, Operator Overloading and Type Conversions, Inheritance: Extending Classes, Pointers, Virtual Functions and Polymorphism, Managing Console I/O Operations, Working with Files, Templates, Exception Handling

**CBS.6153**

**Advanced Computer Networks-Lab**

**Credits: 2**

In this practical class students should be asked to implement scenarios in (Opnet/NS-2/ NS-3) network simulator on the following topics.

Installation of Network Simulator, Introduction to Syntax, looping, conditional check, functions, execution of Mathematical Operations and Execution, Nodes Creation, traffic flows, queuing disciplines and result analysis, Wired and Wireless topology of multiple nodes.

## SEMESTER - II

CBS.6201

Information Security

Credits: 4

**Objective:** The main objective of this course is to provide students with an overall understanding of the main concepts of information systems, cryptographic techniques and network security tools and to highlight the importance in modern organizations.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Explain the principles of information security and its significance
- Identify the domain specific security issues
- Describe the design and working of different cryptographic methods

### Unit I

**History of Information Systems:** Importance of Information Systems, Basics of Information Systems, Changing Nature of Information Systems, Global Information Systems.

**Essential Security Terminologies:** Hardware, Software, Defining Security, Need for Security, Cyber-Crimes, Three Pillars of Security.

### Unit II

**Encryption and Decryption:** Attackers and Types of Threats, Encryption Techniques, Classical Cryptographic Algorithms: Monoalphabetic Substitutions such as the Caesar Cipher, Cryptanalysis of Monoalphabetic ciphers, Polyalphabetic Ciphers such as Vigenere, Vernam Cipher, Stream and Block Ciphers.

**Symmetric Key Systems:** Data encryption Standard (DES), DES Structure, DES Analysis, Multiple DES, Advance Encryption Standard (AES).

### Unit III

**Key Management Protocols:** Solving Key Distribution Problem, Diffie-Hellman Key Exchange Algorithm.

**Public Key Encryption Systems:** Concept and Characteristics of Public Key Encryption System, Rivest-Shamir-Adleman (RSA) Encryption.

### Unit IV

**Hash Algorithms:** Hash concept, Description of Hash Algorithms (MD5 and SHA-1), Digital Signature/Certificate.

**Trojans:** Working of Trojans, Different Types of Trojans, Different ways a Trojan can get into a system, Indications of a Trojan Attack.

**Recent Trends:** Firewall, DMZs, Web Security, Web application Security Auditing.

#### Text Books:

1. Forouzan, B.A. 2010. Cryptography & Network Security. Tata McGraw-Hill Education.
2. Kahate, A. 2009. Cryptography and Network Security. McGraw-Hill Higher Ed.
3. Godbole, N. 2009. Information Systems Security: Security Management, Metrics, Frameworks and Best Practices. 1<sup>st</sup> Ed. John Wiley & Sons India.

#### Suggested Readings:

1. Stallings, W. 2007. Network Security Essentials: applications and standards. 3<sup>rd</sup> ed. Pearson Education India.
2. Stallings, W. 2014. Cryptography and Network Security: Principles and Practice. 6<sup>th</sup> ed. Pearson.
3. Kim, D., and Solomon, M. G. 2010. Fundamentals of Information Systems Security. Jones & Bartlett Learning.
4. Elsevier Journal of Information Security and Applications.

**CBS.6202**

**Ethical Hacking & Penetration Testing**

**Credits: 4**

**Objective:** This course will introduce basics of ethical hacking and penetration testing.

**Learning Outcomes:** By the end of this Course, students should be able to:

- Identify the stages an ethical hacker requires to take in order to compromise a target system.
- Classify tools and techniques to carry out a penetration testing.
- Evaluate security techniques used to protect system and user data.

**Unit1**

Ethical hacking process, Hackers behaviour & mindset, Maintaining Anonymity, Hacking Methodology, Information Gathering: Footprinting, Scanning & Enumeration. Active and Passive Sniffing, Evasion: Intrusion Detection System & Firewall, Physical security vulnerabilities and countermeasures.

**Unit 2**

Password attacks, Privilege Escalation and Executing Applications, Social Engineering attacks and countermeasures.

Network Infrastructure Vulnerabilities, IP spoofing, DNS spoofing, DoS attacks. Web server and application vulnerabilities, SQL injection attacks, Buffer overflow attacks.

**Unit 3**

Wireless Hacking: Wireless footprint, Wireless scanning and enumeration, Wireless network defence and counter measures, Gaining access (hacking 802.11), WEP, WPA, WPA2.

Introduction to Metasploit: Metasploit framework, Metasploit Console, Payloads, Metpreter, Introduction to Armitage.

**Unit 4**

**Introduction to Penetration Testing:** Phases of Penetration Testing, Types of Penetration Tests, Penetration Testing Checklist, Internal and External penetration testing, Conducting a Denial of Service Penetration Test, Routers and Switches Penetration Testing, Firewall Penetration Testing, Email Security Penetration Testing, Penetration Testing Tools, Preparation of Penetration Test Report and Documents, and Recent Trends in Ethical Hacking & Penetration Testing

**Text books:**

1. McClure S., Scambray J., and Kurtz G, 2009, Hacking Exposed. Tata McGraw-Hill Education.
2. Kevin Beaver, 2013, Hacking for Dummies, 3<sup>rd</sup>ed. John Wiley & sons.

**Suggested readings:**

1. Matt Walker., All in One Certified Ethical Hacker Exam Guide, 2<sup>nd</sup>ed. Tata McGraw Hill Education.
2. International Council of E-Commerce Consultants by Learning, Penetration Testing Network and Perimeter Testing Ec-Council/ Certified Security Analyst Volume 3 of Penetration Testing, 2009

**CBS.6203**

**Python Programming**

**Credits: 4**

**Objective:** The objective of this course is to introduce students to the Python programming language.

**Learning Outcomes:** On completion of the course the students should be able to

- Define python environment and constructs of Python language.
- Explain the various data structures

- construct scripts in Python language.

### Unit1

Python Introduction, Installing and setting Python environment in Windows and Linux, basics of Python interpreter, Execution of python program, Editor for Python code, syntax, variable, types. Flow control: if, ifelse, for, while, range() function, continue, pass, break. Strings: Sequence operations, String Methods, Pattern Matching.

### Unit 2

Lists: Basic Operations, Iteration, Indexing, Slicing and Matrixes; Dictionaries: Basic dictionary operations; Tuples and Files; Functions: Definition, Call, Arguments, Scope rules and Name resolution; Modules: Module Coding Basics, Importing Programs as Modules, Executing Modules as Scripts, Compiled Python files(.pyc), Standard Modules: OS and SYS, The dir() Function, Packages.

### Unit 3

Input output and file handling, Object Oriented Programming features in Python: Classes, Objects, Inheritance, Operator Overloading, Errors and Exceptions: try, except and else statements, Exception Objects, Regular expressions, Multithreading, Networking: Socket module.

### Unit4.

Role of Python in Hacking and Cyber Forensics, Debugging in python: introduction to PyDBG and immunity debugger; Hooking: Soft Hooking with PyDbg, Hard Hooking with Immunity Debugger, DLL and code injection: Remote Thread Creation, DLL Injection, Code Injection.

#### Text books:

1. Mark Lutz.,2009, ðLearning Pythonö,4<sup>th</sup> ed., OøREILLY Media, Inc..
2. Justin Seitz,2009, ðGray Hat Python: Python Programming with Hackers and Reverse Engineersö, No Starch Press, Inc.

#### Suggestedreadings:

1. Paul Berry,2011,ðHead First Pythonö. OøREILLY Media, Inc.
2. Jeeva Jose & P. Sojan Lal. 2016. Introduction to Computing & Problem Solving With Python.

**CBS.6204**

**IT Act & Cyber Law**

**Credits: 4**

**Objective:**The objective of this course is to provide knowledge about the basic information on IT Act and cyber law.

**Learning Outcomes:** By the end of this Course, students should be able to:

- Analyze fundamentals of Cyber Law
- Discuss IT act & its amendments
- Relate Cyber laws with security incidents.

### Unit1

Introduction: Fundamentals of Cyber Space, Understanding Cyber Space, Interface of Technology and Law Defining Cyber Laws, Jurisdiction in Cyber Space, Concept of Internet Jurisdiction, Indian Context of Jurisdiction, International position of Internet Jurisdiction Cases in Cyber Jurisdiction.

## Unit 2

Specific issues: E-commerce- Legal issues, Legal Issues in Cyber Contracts, Cyber Contract and IT Act 2000, The UNCITRAL Model law on Electronic Commerce, Intellectual Property Issues and Cyberspace.

The Indian Perspective Overview of Intellectual, Property related Legislation in India Copyright law & Cyberspace, Trademark law & Cyberspace, Law relating to Semiconductor Layout & Design.

## Unit 3

Understanding Cyber Crimes: Defining Crime, Crime in context of Internet óActus Rea/Mens Rea, Types of crime in Internet, Computing damage in Internet crime, Frauds: Hacking, Mischief, Trespass, Defamation, Stalking, Spam

## Unit4

Obscenity and Pornography: Internet and Potential of Obscenity, Indian Law on Obscenity & Pornography, International efforts, Changes in Indian Law.

Penalties & Offences: IT Act 2001, Offences under the Indian Penal Code, Investigation & adjudication issues Digital evidence, and Recent amendments in laws.

### Text books:

1. Singh Y.,2012.Cyber Laws, 5<sup>th</sup>ed.,UniversallawPublishingCompany.
2. GuptaA., 2011,Commentaryon InformationTechnologyAct, 2ndEd.

### Suggested readings:

1. ViswanathanA, 2012, Cyber Laws: Indian and International Perspectives on Key topics including Data Security, E-commerce, Cloud Computing and Cyber Crimes 1st Edition,LexisNexis

## Elective-1

**CBS.6211**

**Computer and Cyber Forensics**

**Credits: 4**

**Objective:** This course offers a good understanding of Cyber Forensic Investigation, web attacks and DOS investigation and will prepare students to be in a position to perform network forensics. This course also helps to provide understanding of email system and tracking.

**Learning Outcome:** After studying this course, students should be able to:

- Identify some of the current techniques and tools for forensic examinations.
- Describe and identify basic principles of good professional practice for a forensic computing practitioner.
- Apply forensic tools in different situations.

## Unit1

**Introduction:** Need of Cyber Forensics. Cyber Evidence: Incidents and Evident, Examining Investigative Methods, Revealing Investigations Results. Search and Seizure: Getting Authority, Criminal cases and Civil Cases of Cyber Forensics. Documentation and Management of Crime Scene: Obsessing over documents, Recording the scene and sound, Managing Evidence, Stepping and Securing through Scene.

<b>Unit</b>	<b>2</b>
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**Hidden Data Extraction:** Encryption and Compression, Data Hiding Techniques, Defeating Algorithms, Hashes and Keys. Recovery of deleted files, Cracking Passwords, Decrypting and Encrypting the data. Document Forensics: Viewing and Extracting Metadata, Discovering Documents.

<b>Unit</b>	<b>3</b>
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**Network Forensics:** Network Forensics and Investigating Logs as evidence. Investigating Network Traffic: Overview of network protocol for OSI layers, Types of Network Attacks, Evidence gathering at Physical layer, Data Link layer, ARP table and From an IDS. Internet Crime Investigations: Introduction to Investigating Internet Crimes, Internet Forensics, Steps for Investigating Internet Crime.

<b>Unit4</b>
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**Web Attack Investigations:** Introduction to Web Attacks, Indication of a Web Attacks, Types of Web Attacks. DoS Attacks Investigation: Types of DoS Attacks, DoS Attack Modes, Techniques to detect and Investigate DoS Attacks. **Email Crime Investigations:** Email Architecture, Forensic Perspective, E-mail Crime, E-mail Phishing and Spoofing, Investigating E-Mail Crime and Violations. Malware Forensics: Botnets, Automatic Self Updates, Fast Flux DNS and Recent trends in forensics.

**Text books:**

1. Council, Ec. *Computer Forensics: Investigating Network Intrusions and Cybercrime*, Cengage Learning. 2009.
2. Linda Volonino, *Computer Forensics for Dummies*, Willey Publishing, Inc., 2012
3. Nina Godbole & Sunit Belapure, *Cyber security - Understanding cybercrimes, computer forensics & Legal perspectives*, Wiley India, 2013.

**Suggested readings:**

1. Michael G. Solomon , K Rudolph, Ed Tittel, Neil Broom and Diane Barrett, *Computer Forensics Jump Start* 2<sup>nd</sup> Edition, Willey Publishing, Inc., 2011
2. Casey E., 2009. *Handbook of Digital Forensics and Investigation*, Academic Press.
3. Sherri Davidoff and Jonathan Ham, *Network Forensics Tracking Hackers through Cyberspace*, Prentice Hall, 2012.

**CBS.6212**

**Secure Coding**

**Credits: 4**

**Objective:** This course aims to provide an understanding of the various security measure required for the source code of software and major coding errors that lead to vulnerabilities.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- identify the elements of secure coding
- describe various security attacks possible
- classify various errors that lead to vulnerabilities

<b>Unit1</b>
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**Software Security:** Security Concepts, Security Policy, Security Flaws, Vulnerabilities, Exploitation and Mitigations. Software Security problems, Defensive program is not enough, Quality Fallacy, Classification of Vulnerabilities.

**Security Analysis:** Problem Solving with static analysis: Type Checking, Style Checking, Program understanding, verifications and property checking, Bug finding and Security Review. Analysing Source versus Analyzing Compiled code.

## Unit

2

**Strings:** Common String manipulating Errors, String Vulnerabilities and Exploits, Mitigation Strategies for strings, String handling functions, Runtime protecting strategies, Notable Vulnerabilities.

**Integer Security:** Integer data Type, Integer Conversions, Integer Operations, Integer Vulnerabilities, Mitigation Strategies.

## Unit 3

**Handling Inputs:** What to validate, How to validate, Preventing metadata Vulnerabilities, Buffer Overflow: Introduction, Exploiting buffer overflow vulnerabilities, Buffer allocation strategies, Tracking buffer sizes, buffer overflow in strings, Buffer overflow in Integers Runtime protections

**Errors and Exceptions:** Handling Error with return code, Managing exceptions, Preventing Resource leaks, Logging and debugging

## Unit4

**Privacy and Secrecy:** Privacy and regulations, outbound passwords, Random Numbers, Cryptography, Secrets in memory

**Recommended Practices for Secure Coding:** Security development Life cycle, Security Training, Practices of secure code for Requirement, design, implementation, Verification of source code, and new trends in secure coding.

### Text books:

1. Robert C. Seacord, Secure Coding in C and C++, published by Addison Wisley for Software Engineering Institute, 2<sup>nd</sup> edition, 2013.
2. Brian Chess & Jacob West, Secure Programming with static Analysis, published by Addison Wisley Software Security Series, 2007

### Suggested Readings:

1. Seacord, Robert C. The CERT C Secure Coding Standard Pearson Education, 2009
2. LeBlanc, D. and Howard, M. 2002. Writing Secure Code. 2<sup>nd</sup> Edition. Pearson Education.
3. Android Secure Coding:  
<https://www.securecoding.cert.org/confluence/display/seccode/SEI+CERT+Coding+Standards>

**CBS.6213**

**Advanced Database Management System**

**Credits: 4**

**Objective:** provides the theory and practice of advanced database management systems, and will build upon the student's existing knowledge of Database Systems.

**Learning Outcome:** Upon completion of this course, the students will be able to:

- Explain and evaluate the fundamental theories and requirements that influence the design of modern database systems.
- Discuss the theory, methods and technologies of relational databases.
- Classify application issues and current trends in database technologies.

## Unit I

**Introduction:** File-Systems, database Approach, Database Environment, Database Languages, Data Models and Conceptual Modelling, Multi-user DBMS architecture, Relational Model and Languages: Relational Algebra and Calculus, SQL, Query-by-Example; Entity-Relationship Modeling, Enhanced Entity-Relationship Modeling, Normalization, Advanced Normalization.

## Unit II

**Database Issues:** Database Security: Threats, Countermeasures, DBMS and Web Security; Transaction Management, Concurrency Control: Serializability & Recoverability, Locking Methods, Timestamping Methods; Database Recovery: Recovery Facilities and Techniques; Query Processing, Query Decomposition, Query Optimization.

### Unit III

**Distributed and Parallel DBMS:** Distributed Database Concepts: Distributed Relational Database Design, Transparencies, Date's Twelve Rules, Distributed Transaction Management, Distributed Concurrency Control, Distributed Database Recovery, Distributed Query Optimization, Database Replication; Parallel DBMS Concepts: Inter-query and Intra-query Parallelism, Interoperation and Intra-operation Parallelism.

### Unit IV

**Object DBMS:** Object-oriented Concepts, Object-oriented Database Design, Object-oriented Data Models, Object-oriented DBMSs, Issues in OODBMSs, NoSQL Databases: case study.

**Data warehouse:** Basic Concepts, Multi-tier Architecture, Data Warehousing Modeling: Multidimensional Data Model, Schemas for multidimensional data models, OLAP, Data Warehouse Implementation, recent trends in ADBMS.

#### Text books:

1. Connolly, T. and Begg, C. 2012. Database Systems, 4<sup>th</sup> Ed. India: Pearson Education.
2. Silberschatz, A. and Korth, H. F. and Sudarshan, S. 2011. Database System Concepts, 6<sup>th</sup> Ed. McGraw Hill.
3. Desai, B. C. 2010. An Introduction to Database Systems. Galgotia Publications.

#### Suggested readings:

1. Date, C. J., Kannan, A. and Swamynathan, S. 2012. An Introduction to Database Systems, 8<sup>th</sup> Ed. India: Pearson Education.
2. Elmasri, R. and Navathe, S. B. 2013. Fundamentals of Database Systems, 5<sup>th</sup> Ed. India: Pearson Education.

**CBS.6214**

**Biometric Security**

**Credits: 4**

**Objective:** The main objective is to make the students understand the problems with traditional security systems and introduce the concept of biometric security systems.

**Learning Outcomes:** Upon completion of this course, the students will be able to:

- Describe the theory of biometric security
- Classify algorithms related to various biometrics
- Evaluate the performance of various biometric systems

### Unit I

**Biometrics Introduction:** Benefits of biometrics over traditional authentication systems, Benefits of biometrics in identification systems, Comparison of various biometric traits, Applications. Key biometric terms and processes: biometric verification and identification, how biometric matching works.

### Unit II

**Physiological Biometric Technologies:** Fingerprints: Working, characteristics, Competing technologies, strengths, weaknesses and deployment.

**Facial scan:** Working, Strengths, weaknesses and deployment. Advanced Topics: Handling pose, illumination, and expression variations, Heterogeneous face recognition, Face modelling.

**Iris Scan:** working, strengths, weaknesses and deployment.

**Voice Scan:** Working, characteristics, strengths, weaknesses and deployment, GAIT Pattern.

### Unit III

**Behavioral Biometric Technologies:** Handprint Biometrics, Signature technology: Technical description, classification, keystroke-scan.

**Repositories for Database and Template Storage:** Features and Capabilities of a DBMS, Biometric data and databases, database issues, Biometric databases.

### Unit IV

**Security of Biometric Systems:** Adversary Attacks, Attack on biometric processing, Attacks on the template database, Database security, Template security techniques.

**Advanced Topics in Biometrics:** Biometrics in Internet-Ecommerce, Integrated Biometrics, VLSI Biometrics.

#### Text books:

1. Jain, A. K., Ross, A. A. 2011. Introduction to Biometrics. Springer Science & Business Media.
2. G.R. Sinha, Sandeep B. Patil. 2013. Biometrics: Concepts and Applications. Wiley India.

#### Suggested readings:

1. Chirillo, J. and Blaul, S. 2003. Implementing Biometric Security. Wiley.
2. Wang, P. S. P. 2012. Pattern Recognition, Machine Intelligence and Biometrics. Springer Science & Business Media.
3. Nanavati, S., Thieme, M. and Nanavati, R. 2002. Biometrics: Identity Verification in a Networked World. John Wiley & Sons.

**CBS.6252**

**Ethical Hacking & Penetration Testing-Lab**

**Credits: 1**

In this practical session students should be asked to perform experiments related to the following topics:

Footprint and collection of information about the system one need to hack, network scanning tools, vulnerability assessment tools such as openVAS, Man-In óThe ó Middle-Attack using ARP poisoning, perform password cracking using tools such as Ophcrack etc, Scan vulnerabilities in wireless networks, bypass MAC filtering in Wireless LAN, break WPA/WPA2 passwords, Perform wireless Miss-association attack.

**CBS.6253**

**Python Programming Lab**

**Credits: 1**

In this practical session students should be asked to write programs in python using following concepts: Basic arithmetic operators, Flow Control and Iteration statements, Storing and processing data with strings, List and Dictionary: Creation and Manipulations, Tuples and Files, Inheritance, Operator Overloading, Python scripts for performing various hacks: DLL Injection and Code Injection.

### Semester – III

**CBS.6399**

**Research Seminar**

**Credits: 2**

The students should be guided to prepare and deliver the content effectively to the audience. The students will choose the topic in consultation with the Supervisor.

**CBS.6300**

**Pre-Dissertation**

**Credits: 16**

**Objectives:**

1. The student shall have to write his synopsis including an extensive review of literature with simultaneous identification of scientifically sound (and achievable) objectives backed by a comprehensive and detailed methodology. The students shall also present their synopsis to the synopsis approval committee. The Evaluation criteria will be as detailed below:

<b>Evaluation Parameter</b>	<b>Maximum Marks</b>
Review of literature	40
Identification of gaps in knowledge and Problem Statement	60
Objective formulation & Methodology	60
Presentation	40
<b>Total</b>	<b>200</b>

2. The second objective of Pre-Dissertation would be to ensure that the student learns the nuances of the scientific research. Herein the student shall have to carry out the activities/experiments to be completed during Pre-Dissertation (as mentioned in the synopsis).

The students would present their work to the Evaluation Committee (constituted as per the university rules). The evaluation criteria shall be as detailed below:

<b>Evaluation Parameter</b>	<b>Maximum Marks</b>	<b>Evaluated By</b>
Mid Term Review and Presentation	100	Evaluation Committee
Continuous evaluation	100	Supervisor
<b>Total</b>	<b>200</b>	
<b>Total Objective 1 + Objective 2</b>	<b>400</b>	

## SEMESTER IV

**CBS.6400**

**Dissertation**

**Credits: 16**

In Dissertation the student shall have to carry out the activities/experiments to be completed during Dissertation (as mentioned in the synopsis). The students would present their work to the evaluation Committee (constituted as per the university rules). The Evaluation criteria shall be as detailed below:

<b>Evaluation Parameter</b>	<b>Maximum Marks</b>	<b>Evaluated By</b>
Parameters by External Expert	100	External Expert
Presentation and defence of research work	150	Evaluation Committee (DAA, Dean SET, CoC, Supervisor)
*Research Publication out of the research work (50) Continuous evaluation (100)	150	Supervisor
Total	400	

\*Instructions to award marks/grades for Research Publication:

S. No.	Grade	Condition
1	50	Publication from Dissertation in SCI indexed journal.
2	45	Publication from Dissertation in Scopus indexed journal.
3	35	Publication from Dissertation in Proceedings of Conference which is Scopus indexed. Publication from Dissertation in ACM/Springer/Elsevier/Inderscience/IEEE portal.
4	30	Presented paper in International Conference.
5	25	Presented paper in National Conference.

### Certificate

The Board of Studies for Computer Science & Technology certifies that the syllabus of M.Tech in Computer Science & Technology (Cyber Security) has been designed in alignment with the Choice Based Credit System (CBCS) of UGC.

The percentage of foundation, core, and elective courses for this programme are given below:

Course Type	Percentage of course type in the Programme	Percentage of course type required under CBCS
Foundation Courses	10	10% - 15%
Core Courses	55	50%-65%
Elective Courses	35	25%-35%

Dr.AmandeepKaur  
Chairperson (Ex-officio)

Dr. Rama Krishna Challa  
(Member)

Dr. Anil Kumar Verma  
(Member)

Er. Meenakshi  
(Member)

Er. Surinder Singh Khurana  
(Member)