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

**SEMESTER I**

|  |  |  |  |  |  |  |  |  |  |  |
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| **S.No** | **Course Type** | **Paper** | **Course Title** | **L** | | **T** | **P** | **Cr** | **Total Marks** |  |
| **Code** |  |
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|  |  |  |  |  | |  |  |  |  |  |
|  |  |  | Research Methodology  and Statistics |  | |  |  |  |  |  |
| 1 |  | CBS.501 | 3 | | 1 | - | 4 | 100 |  |
|  | Foundation |  |  | |  |  |  |  |  |
| 2 | Core | CBS.503 | Secure Coding | 3 | | 1 | - | 4 | 100 |  |
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|  |  |  |  | |  |  |  |  |  |
| 3 | Core | CBS.505 | Network Technologies and Protocols | 3 | | 1 | - | 4 | 100 |  |
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| 4 | Core | CBS.507 | Python Programming | 3 | | 1 | - | 4 | 100 |  |
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| 5 | Core | CBS.553 | Programming Methodologies - Lab | - | | - | 4 | 2 | 50 |  |
| 6 | Core | CBS.557 | Python - Lab | - | | - | 4 | 2 | 50 |  |
| 7 | Elective | XXX.YYY | Inter-Disciplinary Elective -1 (From Other Departments) | 2 | | **-** | **-** | 2 | 50 |  |
|  |  |  |  | | **14** | **4** | **8** | **22** | 550 |

**SEMESTER II**

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| **S.No** | **Course**  **Type** | **Paper** | **Course Title** | **L** | **T** | **P** | **Cr** | **Total Marks** |  | |
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| 1 | Core | CBS.502 | Information & Network Security | 3 | 1 | - | 4 | 100 |  | |
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| 2 | Core | CBS.504 | Ethical Hacking and Forensics | 3 | 1 | - | 4 | 100 |  | |
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| 3 | Core | CBS.506 | IT Act & Cyber Laws | 4 | - | - | 4 | 100 |  | |
|  |  | Opt any one subject from following | | | | | | |  | |
| 4 | Elective | CBS.508 | Image Processing & Biometric Security | 3 | 1 | - | 4 | 100 |  |
| CBS.510 | Software Testing and Maintenance |  |
| CBS.512 | Data Warehouse and Mining |  |
| CBS.514 | Data Structures and Programing Methodology |  |
|  | CBS-516 | Advanced Web Technologies |  |
| 5 | Core | CBS.552 | Information & Network Security - Lab | - | - | 4 | 2 | 50 |  |
| 6 | Core | CBS.554 | Ethical Hacking and Forensics - Lab | - | - | 4 | 2 | 50 |  |
| 8 | Elective | XXX.YYY | Inter-Disciplinary Elective-2 (From Other Departments) | 2 | **-** | **-** | 2 | 50 |  |
|  |  |  |  | **15** | **3** | **8** | **22** | 550 |

**SEMESTER III**

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| **S.No** | **Course Type** | **Paper** | **Course Title** | **L** | **T** | **P** | **Cr** | **Total Marks** |  |
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|  | Elective |  |  |  |  |  |  |  |  |
| 1 |  | CBS.601 | Project Lab-I | - | - | 8 | 4 | 100 |  |
|  |  |  |  |  |  |  |  |  |  |
| 5 | Elective | CBS.603 | Pre-Dissertation | - | - | - | 20 |  |  |
|  |  |  |  |  |  | **8** | **24** | 100 |

**SEMESTER IV**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **Course Type** | **Paper** | **Course Title** | **L** | **T** | **P** | **Cr** | **Total Marks** |  |
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| 1 | Elective | CBS.602 | Project Lab-II | - | - | 8 | 4 | 100 |  |
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| 2 | Elective | CBS.604 | Dissertation | - | - | - | 20 |  |  |
|  |  |  |  |  |  | **8** | **24** | 100 |

1. Continuous Assessment: Based on Objective Type Tests, Term paper and Assignments
2. Pre-Scheduled Test-1: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
3. Pre-Scheduled Test-2: Based on Objective Type & Subjective Type Test (By Enlarged Subjective Type)
4. End-Term Exam (Final): Based on Objective Type Tests
5. Total Marks

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

**Semester-I**

**CBS.501 Research Methodology and Statistics Credits: 3-1-0**

**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.

**Course 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

**Unit I**

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.

Measures of central tendency and dispersal, Histograms, Sampling distribution, Kurtosis and skewness.

**Unit II**

Probability distributions (Binomial, Poisson and Normal), General Statistics: Hypothesis testing, parametric tests: z test, Student's t-test, Chi-square test.

**Unit III**

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 IV**

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

**Text books:**

1. Theil, D.V. (2014). David Research Methods for Engineers, Cambridge University Press.

2. Kothari, C.R. (2013). Research Methodology: Methods and Techniques. New Age International.

3. 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.503 Secure Coding Credits: 3-1-0**

**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.

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

* Identify the elements of secure coding
* Describe various possible security attacks
* Classify various errors that lead to vulnerabilities

**Unit I**

**Software Security:** Security Concepts, Security Policy, Security Flaws, Vulnerabilities, Exploitation and Mitigations. Software Security problems, 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 II**

**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 III**

**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

**Unit IV**

**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 recent trends.

**Text Books:**

1. Seacord, R. C. (2013). Secure Coding in C and C++. 2nd edition. Addison Wisley for Software Engineering Institute,
2. Chess, B., and West, J. (2007). Secure Programming with static Analysis. Addison Wisley Software Security Series.

**Suggested Readings:**

1. Seacord, R. C. (2009). The CERT C Secure Coding Standard. Pearson Education.
2. Howard, M., LeBlanc, D. (2002). Writing Secure Code. 2ndEdition. Pearson Education.

**CBS.505 Network Technologies & Protocols Credit Hours: 3-1-0**

**Objective:** This course aims to provide background on relevant computer networking protocols to have a comprehensive and deep knowledge in computer networks.

**Course Outcomes:** After successfully completing this course, students will be able to

* Describe functioning of protocol stacks related to different networks.
* Understand functioning of various networking protocols.
* Discover state of communication from values mentioned in header structure of protocols.

**Unit I** Introduction: Overview of Computer Networks, ISO-OSI and TCP/IP reference models, Gigabit Ethernet, Wireless LAN, MAC protocols for LANs: Aloha, Pure Aloha, CSMA/CD, CSMA/CA, Layer 2 headers.

**Unit II**

IPv4: Header, Class-full and Classless addresses, Subnets and supernets, IPv6: Basic protocol, Header, 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.

Internet Control Message Protocol, Address Resolution Protocol, Reverse Address Resolution Protocol

**Unit III**

TCP header, TCP Three way handshake, TCP for Wired networks, TCP extensions for wireless networks, UDP header. Commonly used TCP and UDP ports. Remote Procedure Call, RTP Control Protocol, Secure Shell. Application Protocols: File Transfer Protocol, Domain Name System, Bittorrent: peer-to-peer file sharing protocol, Hypertext Transfer Protocol, Hypertext Transfer Protocol Secure, Internet Relay Chat, Network Time Protocol, Post Office Protocol Version 3, Simple Mail Transfer Protocol, Simple Network Management Protocol, Telnet.

**Unit IV** Wireless Networks: WLAN, Bluetooth. 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,4G and 5G.

**Text books:**

1.Behrouz A. Forouzan, (2012), Data Communications and Networking, McGraw-Hill.

2. Andrew S. Tanenbaum, David J. Wetherall, 2013, Computer Networks, Pearson.

3. Hesham Soliman, (2014), Mobile IPv6 Mobility in Wireless Internet, Pearson Education.

**Suggested Books**

1. Ashok K. Talukdar, (2007), Mobile Computing Technology, Applications and Service Creation, 2nd Edition, McGraw-Hill.

2.Theodore S. Rappaport: Wireless Communications Principles and Practice, Prentice Hall.

**CBS.507 Python Programming Credits: 3-1-0**

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

**Course 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.

**Unit I**

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 II**

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 III**

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.

**Unit IV**

**Data Structure in Python:** Search and Sorting Algorithms, Divide and Conquer Algorithm, Dynamic Programing 0/1 knapsack Algorithms, Security Trends with Python Programing.

**Text Books:**

1. Lutz Mark, (2009). Learning Python, Latest Edition., O’REILLY Media, Inc.

2. Seitz Justin , (2009). Gray Hat Python: Python Programming with Hackers and Reverse Engineers, Latest Edition, No Starch Press, Inc.

**Suggested Readings:**

1. Berry Paul, (2011). Head First Python. Latest Edition, O’REILLY Media, Inc.

2. Jose Jeeva & Lal P. Sojan, (2016). Introduction to Computing & Problem Solving With Python, Latest Edition, Tata-Mcgraw hills New Delhi

**CBS.553 Programming Methodologies - Lab Credits: 0-0-2**

Students will implement the lab practical as per the syllabus of the subject

**CBS.557 Python Programming- Lab Credits: 0-0-2**

Students will implement the lab practical as per the syllabus of the subject.

**Semester-II**

**CBS .502 Information and Network Security Credits: 3-1-0**

**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.

**Course Outcomes:** 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 and filtering rules

**Unit I**

**History of Information Systems:** Importance of Information Systems, Basics of Information Systems,Need for Security, Three Pillars of Security.

**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 Vigenere, Vernam Cipher, Stream & Block Ciphers.

**Unit II**

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

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

**Unit III**

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

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

**Unit IV**

**Network Perimeter Security Fundamentals:** Introduction to Network Perimeter, Multiple layers of Network Security, Security by Router.

**Firewalls:** Firewall Basics, Types of Firewalls, Network Address Translation Issues, Linux IP Chains. **Access Control Lists:** Ingress and Egress Filtering, Types of Access Control Lists, ACL types: standard and extended, ACL commands.

**Virtual Private Networks:** VPN Basics, Types of VPN, IPSecTunneling, IPSec Protocols. VLAN: introduction to VLAN, VLAN Links, VLAN Tagging, VLAN Trunk Protocol (VTP).

**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. 1st Ed. John Wiley & Sons India.
4. Riggs,C.(2005).Network Perimeter Security: Building Defence In-Depth, AUERBACH, USA.
5. NorthcuttS. (2005) Inside Network Perimeter Security, 2ndEd.,Pearson Education.

**Suggested Readings:**

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

**CBS.504 Ethical Hacking & Forensics Credit Hours: 3-1-0**

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

**Course Outcomes:** After successfully completing this course, students will be able to

* Describe phases of ethical hacking
* Identification and Evaluation of tools and techniques to perform ethical hacking.
* Investigation of cyber crimes and preservation of cyber evidences.

**Unit I**

Ethical hacking process, Hackers behaviour & mind set, Maintaining Anonymity, Hacking Methodology, Information Gathering, Active and Passive Sniffing, Physical security vulnerabilities and countermeasures. Phases of Penetration Testing, Types of Penetration Tests, Internal and External penetration testing. Preparation of Ethical Hacking and Penetration Test Reports and Documents. Social Engineering attacks and countermeasures.

**Unit II**

Password attacks, Privilege Escalation and Executing Applications,

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

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

**Unit III**

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

Cyber Forensics: Incident- Response Methodology, Evidence – Search, Seizure, Identification, Preservation and Analysis, Image Capturing, Hidden Data Extraction: Recovery of deleted files, Cracking Passwords

**Unit IV**

Network Forensics and Investigating Logs, Document Forensics: Information in Metadata ,Web Attack Investigations, Internet Crime Investigations, Email Crime Investigations: Email Structure, Email Addressing, Email Headers Analysis, Mobile forensics

**Text books:**

1. Baloch, R. (2015). Ethical Hacking and Penetration Testing Guide, CRC Press.

2. Beaver, K. (2013). Hacking for Dummies, 3rded. John Wiley & sons.

3. [Council, E](http://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Ec-Council%22&source=gbs_metadata_r&cad=6)c. (2009). Computer Forensics: Investigating Network Intrusions and Cybercrime,

Cengage Learning.

**Suggested readings:**

1. McClure S., Scambray J., and Kurtz G, (2009), Hacking Exposed. Tata McGraw-Hill Education.

2. International Council of E-Commerce Consultants by Learning, Penetration Testing Network and Perimeter Testing Ec-Council/ Certified Security Analyst Vol. 3 of Penetration Testing .

3. Davidoff, S. and Ham, J. (2012). Network Forensics Tracking Hackers through Cyberspace, Prentice Hall.

1. Michael G. Solomon , K Rudolph, Ed Tittel, Broom N., and Barrett, D. (2011),Computer Forensics Jump Start, Willey Publishing, Inc.

**CBS.506 IT Act & Cyber Law Credits: 3-1-0**

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

**Course 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.

**Unit I**

Concept of Cyberspace, Issues of Jurisdiction in Cyberspace: Jurisdiction Principles under International law, Jurisdiction in different states, Position in India. Conflict of Laws in Cyberspace, International Efforts for harmonization Privacy in Cyberspace

**Unit II**

Electronic Commerce, Cyber contract, Intellectual Property Rights and Cyber Laws

UNCITRAL Model Law, Digital Signature and Digital Signature Certificates, E-Governance and Records.

**UnitIII** Define Crime, *Mens Rea*, Crime in Context of Internet, Types of Cyber Crime, Computing Damage in Internet Crime, Offences under IPC (Indian Panel Code, 1860), Offences & Penalties under IT Act 2000, IT Act (Amendment) 2008, Investigation & adjudication issues, Digital Evidence

**Unit IV**

Obscenity and pornography, Internet and potential of obscenity, Indian law on obscenity & pornography, International efforts, Some Important Case Studies

**Text books:**

1. Cyber Law in India – Dr. Farooq Ahmad
2. Cyber Laws – J.P. Sharma, Sunaina Kanojia
3. Cyber Laws and IT Protection – Harish Chander

**Suggested readings:**

1. Cyber Laws – Justice Yatindra Singh
2. An Introduction to cyber crime and cyber law – Prof. R.K. Chaubey
3. Understanding Laws – Garima Tiwari
4. Computers Internet and New Technology Laws – Karnika Seth, Justice Altamas Kabir

**CBS.508 Digital Image Processing and Biometric Security Credits: 3-1-0**

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

**Course 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**

**Introduction:** Fundamental steps in Image Processing System, Image Sensing and acquisition, Image sampling & Quantization, Basic Relationship between pixels.

**Image Enhancement Techniques:** Spatial Domain Methods: Basic grey level transformation, Histogram equalization, Image subtraction, image averaging, Spatial filtering: Smoothing, sharpening filters, Laplacian filters, Frequency domain filters, Smoothing and sharpening filters.

**Unit II**

**Image Restoration & Reconstruction:** Model of Image Degradation/restoration process, Noise models, Spatial filtering, Inverse filtering, Minimum mean square Error filtering, constrained least square filtering.

**Image edge detection:** Introduction to edge detection, types of edge detectors.

**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 III**

**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

**Unit IV**

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

**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. Gonzalez, R.C. and Woods, R.E. (2009). Digital Image Processing. 2nd ed. India: Person Education.
3. 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.510 Software Testing and Maintenance Credit Hours: 3-1-0**

**Objective:** This course is designed to enable a clear understanding and knowledge of the foundations, techniques, and tools in the area of software testing and its practice in the industry. The course will prepare students to be leaders in software testing.

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

* Able to apply software testing knowledge, verification & validation and engineering methods.
* Design and conduct a software test process for a quality software test.
* Understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.

**Unit I**

**Overview of Software Engineering:** Phases in development of Software, Software Engineering Ethics, Life cycle Revisited(Incremental Development, Agile Methods, RAD), Model-Driven Architecture, Software Product Line, Process Modelling**.**

**Project Management:** Project Planning, Project Control (Work Break Down Structure, GANTT Charts, PERT Charts) Project Team Organisation, Risk Management, CMM

**Unit II**

**Testing of OO systems:** Objects and Classes, OO Testing, Class Testing, Regression Testing, Non-Functional Testing, Acceptance Testing

**Software Testing**: Levels of testing, Module, Integration, System, Regression, Testing techniques and their Applicability, Functional testing and Analysis Structural testing and Analysis, Error Oriented testing and Analysis, Hybrid Approaches, Integration Strategies, Transaction Flow Analysis, Stress Analysis, Failure Analysis, Concurrency Analysis

**Unit III**

**Overview of Software Metrics:** Measurement in Software Engineering, Scope of Software Metrics, Measurement and Models Meaningfulness in measurement, Measurement quality, Measurement process, Scale, Measurement validation, Object-oriented measurements.

**Measuring Internal External Product Attributes:** Measuring size, aspects of software size, length, functionality and complexity, measuring structure, types of structural measures,

Modeling software quality, measuring aspects of software quality, software reliability, basics of software reliability

**Unit IV**

**Software Maintenance:** Maintenance Categories, Major causes of Maintenance Problems, Reverse Engineering, Software Evolutions, Organizational and Managerial Issues of Maintenance activities, Maintenance Measurements

**Software Refactoring:** Principles of Refactoring, Bad Smells in code, Composing Methods of Refactoring, Moving features between objects.

Text book:

1. Pressman Roger S. (2014). Software Engineering a Practitioners Approach, Latest Edition, McGraw-Hill Singapore
2. Peters, James S. Witold Pedrycz, (2011). Software engineering an engineering approach, Wiley India,.
3. Anirban Basu, (2015). Software Quality Assurance, Testing and Metrics, Latest Edition, PHI India.

Reference Book:

1. Vliet Hans Van, (2015). Software Engineering Principles and Practice, Latest Edition, John Wiley & Sons
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandriolo,(2003). Fundamental of Software Engineering. Latest Edition, Printice Hall India

**CBS.512 Data Warehousing and Data Mining Credits: 3-1-0**

**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.

**Course Outcomes:** 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**

**Fundamentals of Data Mining, 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**

**Data warehouse:** Basic Concepts, Multi-tier Architecture, Data Warehousing Modeling: Multidimensional Data Model, Schemas for multidimensional data models, OLAP, Data Warehouse Implementation. Further Development of Data Cube Technology, From Data Warehousing to Data Mining Data Cube Computation and Data Generalization

**Unit III**

**Association Rules:** Association rules mining, Mining Association rules from single level, multilevel transaction databases, multidimensional 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 IV**

**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.

Case studies based on 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.
2. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition

**CBS.514 Data Structures and Programing Methodology Credits: 3-1-0**

**Objective:** This course will provide knowledge related to various data structures and algorithms.

**Course Outcomes:** 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.

**Graph Algorithms:** Elementary graph algorithms, Minimum spanning trees, shortest path algorithms.

**Unit IV**

**Programming Paradigms:** Problem solving, define Programming Language, Software design, Role of Programming Languages**.**

**Sequence Control:** Implicit and Explicit Sequence Control, Sequencing with Arithmetic Expressions, Sequence Control Between Statements, Sequencing with Nonarithmetic Expressions. Storage Management.

**Text books:**

1. Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C. (2010). Introduction to Algorithms.3rded. Mit Press.
2. Sridhar, S. (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: 516 Advanced Web Technologies Credits: 3-1-0**

**Unit I**

Introduction: Introduction to Java, Difference between C/C++ and Java, Applets and Applications, Java Development Kit, Advantages of Java, Data types, modifiers, expressions, operators in Java, Control Statements in Java, Classes statements in Java, Classes, Inheritance (single, multilevel, hierarchical), Multiple Inheritance using Interfaces, Arrays, Strings and Vectors, Java packages, Exception handling, Multithreading, Applets, Graphics and AWT.

**Unit II**

Name services and configuration: DNS, DHCP, X500 Directory Services, LDAP, Internet Security, Authentication and Encryption, Watermarks, Firewall, SSL, Digital Signatures.

Web Services: Web services, Evolution and differences with Distributed computing, XML, WSDL, SOAP, UDDI, Transactions, Business Process Execution Language for Web Services, WS-Security and the Web services security specifications, WS-Reliable Messaging, WS-Policy, WS-Attachments. Web 2.0 technologies: Introduction to Ajax, Ajax Design Basics, JavaScript, Blogs, Wikis, RSS feeds.

**Unit III**

Content delivery and preparation: Introduction to WWW, TCP/IP, HTTP, FTP, UDP, NTier, Markup Languages VRML– HTML, DHTML, DNS, URL, Browsers, Platform for Web Services Development, MVC Design Pattern, .NET, J2EE Architecture, J2EE Components & Containers, Specification, Application servers, Struts.

**Unit IV**

Dynamic web programming: Java Applets, Java script, JSP, JSTL, ASP, PHP, Servlets, Servlet Life cycle, C#, Component Technologies, Java beans, CORBA, Introduction to EJBs, JDBC, Secure Electronic Transactions over Web. Introduction to cloud computing: Cloud Computing- History of Cloud Computing, Cloud Architecture, Cloud Storage, Why Cloud Computing Matters, Pros and Cons of Cloud Computing, Companies in the Cloud Today, Cloud Services.

**Text Books:**

1. Balagurusamy, E. (2009). Programming With Java. 4th ed. Tata McGraw-Hill Education.

2. Ladd, E. and O'Donnell, J. (2001). Platinum Edition Using Xhtml, Xml and Java 2. 4th ed.

Que Publishing.

3. Deitel, P.J., Deitel, H. and Deitel, A. (2011). Internet and World Wide Web How to

Program. 5th ed. India: Pearson Education, Limited.

**Suggested Readings:**

1. Miller, M. August. (2008). Cloud Computing: Web-Based Applications That Change the

Way You Work and Collaborate Online. Que Publishing.

**CBS.552 Information and Network Security** - Lab **Credits: 0-0-2**

Students will implement the lab practical as per the syllabus of the subject.

**CBS.554 Ethical Hacking & Forensics** - Lab **Credits: 0-0-2**

Students will implement the lab practical as per the syllabus of the subject.

**SEMESTER- III**

**CBS.601 Project Lab-I Credits: 0-0-4**

The students should be required to implement an application for the Industrial/Scientific/Research Community.

**CBS.603 Pre-Dissertation Credits: 20**

**Objectives:**

* + - 1. The student shall have to write his/ her 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:

|  |  |
| --- | --- |
| **Evaluation Parameter** | **Grade** |
| Review of literature | Satisfactory/Un-Satisfactory |
| Identification of gaps in knowledge and Problem Statement | Satisfactory/Un-Satisfactory |
| Objective formulation & Methodology | Satisfactory/Un-Satisfactory |
| Presentation | Satisfactory/Un-Satisfactory |
| **Total** | Satisfactory/Un-Satisfactory |

* + - 1. 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:

|  |  |  |
| --- | --- | --- |
| **Evaluation Parameter** | **Maximum Marks** | **Evaluated By** |
| Mid Term Review and Presentation | Satisfactory/Un-Satisfactory | Evaluation Committee |
| Continuous evaluation | Satisfactory/Un-Satisfactory | Supervisor |
| **Total** | Satisfactory/Un-Satisfactory |  |
| **Total Objective 1 + Objective 2** | Satisfactory/Un-Satisfactory |  |

**SEMESTER IV**

**CBS.602 Project Lab-II Credits: 0-0-4**

The students should be required to implement an application for the Industrial/Scientific/Research Community

**CBS.604 Dissertation Credits: 20**

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). One research paper (either accepted or published) out of the dissertation research work is compulsory before pre-submission evaluation of dissertation. The Evaluation criteria shall be as detailed below:

|  |  |  |
| --- | --- | --- |
| **Evaluation Parameter** | **Maximum Marks** | **Evaluated By** |
| Parameters by External Expert (As per University Criteria) | Satisfactory/Un-Satisfactory | External Expert |
| Presentation and defence of research work | Satisfactory/Un-Satisfactory | Evaluation Committee |
| Total | Satisfactory/Un-Satisfactory |  |