Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 Batch
B.Tech in Cyber Security

Semester-Vth

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
		PROGRAMME CORE COURSES (PCC)										
01		PCC-I (Network Security & Cryptography)	3	0	0		3					
02		PCC-II (IOT & Embedded System Security)	3	0	0		3					
		***PROGRAMME ELECTIVES I & II**										
03		PE-I (Any One From The Given Basket Of PE-I & II)										
04		PE-II(Any One From The Given Basket Of PE-I & II)										
05		Entrepreneurship Management										
Total												
Practical			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
06		Seminar & Report Writing –I (UN Sustainable Development Goals)				6						
07		Business Communications										
08		**Lab-I** (Network Security LAB)	**0**	**0**	**3**		1					
09		**Lab-II** (IOT & Embedded System Security LAB)	**0**	**0**	**3**		1					
Total												

Audit Course			L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
10		**REGIONAL LANGUAGE (ANY ONE THROUGH NPTEL/SWAYAM)** 1. MARATHI 2. KANNAD 3. TAMIL 4. TELUGU										
11		Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance										
Total												
Grand Total												

Basket of Professional Elective-I

S. No.	Course Code	Subject
01		Information Security
02		Cyber Law
03		Forensics And Incident Response
04		Network Protocols and Programming
05		Security Management
06		Security Governance, Risk and compliance
07		Security Audit and Risk Assessment
08		Advanced Malware Analysis
09		Penetration Testing and Vulnerability Assessment
10		Hacker Techniques, Tools, and Incident Handling

Basket of Professional Elective-II

S. No.	Course Code	Subject
01		Database Security
02		Operation System Security
03		Ethical Hacking
04		Malware Analysis
05		Social Network Security
06		Modern Cryptography
07		Digital and Mobile Forensics
08		Cryptocurrency and Blockchain Technologies
09		Security and Privacy in Cloud
10		Web Application Security

Abbreviations:-*AU- Audit Course; L: Lecture, T: Tutorial, P: Practice.
J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.
***Passing in Audit Course shall be mandatory.**
Note:- Student may choose their two Professional Electives (PE-I & PE-II) from NPTEL/SWAYAM also on the advice of departmental academic council if the subject is not mentioned in the above basket.
Students will complete the Elective Papers(Professional) of 12 weeks duration from NPTEL/SWAYAM. Student may register on NPTEL/SWAYAM at any time from 1st to 5th semester but the passing marks and credits will be reflected only in the 5th semester.
The secured percentage of marks and passing certificate of the subject shall be forwarded by the institute to Controller of Examination (CoE), JUT, Ranchi timely.

Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch
B.Tech in Cyber Security

Semester- VIth

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
		PROGRAMME CORE COURSES (PCC)										
01		PCC-I (AI & ML)	3	0	0		3					
02		PCC-II (Application & Web security)	3	0	0		3					
		PROGRAMME ELECTIVES III & IV										
03		PE-III (Any One From The Given Basket of PE-III & IV)										
04		PE-IV (Any One From The Given Basket of PE-III & IV)										
		OPEN ELECTIVE-I										
05		OE-I (Any one From The Given Basket of OE-I)										
Total												
Practical			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
06		**Lab-I** (AI & ML LAB)	**0**	**0**	**3**		**1**					
07		**Lab-II** (Application & Web security LAB)	**0**	**0**	**3**		**1**					
08		**Lab-III** (Mobile Applications Development Lab(Android & iOS)	**0**	**0**	**3**		**1**					
Total												

Audit Course			L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
09		**FOREIGN LANGUAGE (ANY ONE THROUGH NPTEL / SWAYAM)** 1. GERMAN 2. JAPANESE 3. CHINESE 4. KOREAN 5. SPAINISH 6. RUSSIAN 7. FRENCH										
10		Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance										
Internship			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
11		Industrial Internship	08 weeks									
Minor Project (For Exit Option)												
Total												
Grand Total												

Basket of Professional Elective- III

S. No.	Course Code	Subject
01		**Cyber warfare**
02		**Hacker Mind: Profiling the IT Criminal**
03		**Mobile and Wireless Security**
04		**Windows and Linux Internals**

Basket of Professional Elective- IV

S. No.	Course Code	Subject
01		**Blockchain Technology**
02		**Formal Methods for Security**
03		**Hardware Security**
04		**Biometrics and Security**

05		Data Networks		05		Quantum Cryptography
06		Cyber Crimes and Cyber Security		06		Cyber Analytics
07		Wireless Sensor Network Security		07		Zero-Trust Architecture
08		Network Routing Algorithms		08		Image Processing
09		Internet of Things		09		Digital Signal Processing
10		Program Obfuscation		10		Data Mining

Basket of Open Elective I

S. No.	Course Code	Subject	S. No.	Course Code	Subject
01		Web Programming	11		Graph Theory
02		Python Programming	12		Mechatronics
03		Mobile Application Development	13		Foundation of Robotics
04		Data Analytics	14		Fundamentals of Aeronautical Engineering
05		Space Science	15		Remote Sensing Concepts
06		Introduction to Industrial Engineering	16		Urban Agriculture
07		Food, Nutrition and Health	17		Drinking Water Supply and Treatment
08		Environmental and Social Impact Assessment	18		Electric Vehicle technology
09		Renewable Energy System	19		Introduction to PLC Programming
10		Introduction to Industrial Instrumentation and Control	20		Nano Technology

Abbreviations:- *AU- Audit Course; L: Lecture, T: Tutorial, P: Practice.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

***Passing in Audit Course shall be mandatory.**

Note:- Student may choose their two Professional Electives (PE-III & PE-IV)& Open Elective-I from NPTEL/SWAYAM also on the advice of departmental academic council if the subject is not mentioned in the above basket.

Students will complete the Elective Papers (Professional or Open) of 12 weeks duration from NPTEL/SWAYAM. Student may register on NPTEL/SWAYAM at any time from 1st to 6th semester but the passing marks and credits will be reflected only in the 6th semester.

The secured percentage of marks and passing certificate of the subject shall be forwarded by the institute to Controller of Examination (CoE), JUT, Ranchi timely.

Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch
B.Tech in Cyber Security

Semester- VIIth

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
		PROGRAMME CORE COURSES (PCC)										
01		PCC-I (Cyber laws & Digital Forensics)	3	0	0		3					
		PROGRAMME ELECTIVES V, VI & VII										
02		PE-V (Any One From The Given Basket of PE-V, VI &VII)										
03		PE-VI (Any One From The Given Basket of PE-V, VI &VII)										
04		PE-VII (Any One From The Given Basket of PE-V, VI &VII)										
		OPEN ELECTIVE-II& III										
05		OE-II (Any one From The Given Basket of OE-II& III)										
06		OE-III (Any one From The Given Basket of OE-II& III)										
Total												
Practical			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
06		**Lab-I** (Ethical Hacking & Digital Forensic LAB)	**0**	**0**	**3**		**1**					
07		**Lab-II** (Advanced Network Security LAB)	**0**	**1**	**2**		**2**					
Total												

Audit Course			L	T	P		Cr	FM	Overall Pass Marks	Internal	External	Categorization
10		**(THROUGH NPTEL/SWAYAM)** Exploring Human Values: Visions of Happiness and Perfect Society										
11		Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance										
Project			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**	**Categorization**
12		Minor Research Project										
Total												
Grand Total												

Basket of Professional Elective-V

S. No.	Course Code	Subject
01		**Object Oriented Programming**
02		**Data Structures and Algorithms**
03		**Operating Systems**
04		**Advanced Programming Practice**
05		**Design and Analysis of Algorithms**
06		**Database Management Systems**
07		**Formal Language and Automata**
08		**Computer Networks**
09		**Software Engineering and Project Management**
10		**Security Risk Management Principles**

Basket of Professional Elective-VI

S. No.	Course Code	Subject
01		**Pattern Recognition Techniques**
02		**Information Retrieval**
03		**Information Storage and Management**
04		**Cyber Crime and Digital Forensics**
05		**Computational Logic**
06		**Quantum Computing**
07		**Deep Learning**
08		**Robotic Process Automation**
09		**Neuro Fuzzy and Genetic Programming**
10		**BioInformatics**

Basket of Professional Elective-VII

S. No.	Course Code	Subject		S. No.	Course Code	Subject
01		Artificial Intelligence		06		Natural Language Processing
02		Design of Secure Protocols		07		Program Analysis and Verification
03		Intrusion Detection Systems		08		Software Metrics and Software Project Management
04		Real Time Systems		09		Distributed Computing
05		Secure Software Engineering		10		Multimedia Technology

Basket of Open Elective-II

Basket of Open Elective-III

S. No.	Course Code	Subject		S. No.	Course Code	Subject
01		Resource Management Techniques		01		Renewable Energy Technologies
02		Fintech Regulation		02		Applied Design Thinking
03		Holistic Nutrition		03		Reverse Engineering
04		IT in Agricultural System		04		Sustainable Manufacturing
05		Introduction to Control Engineering		05		Electric and Hybrid Vehicles
06		Pharmaceutical Nanotechnology		06		Space Engineering
07		Aviation Management		07		Industrial Management
08		English for Competitive Examinations		08		Quality Engineering
09		NGOs and Sustainable Development		09		Fire Safety Engineering
10		Democracy and Good Governance		10		Introduction to Non-Destructive Testing

Abbreviations:- *AU- Audit Course; L: Lecture, T: Tutorial, P: Practice.

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

***Passing in Audit Course shall be mandatory.**

Note:- Student may choose their two Professional Electives (PE-V, VI& PE-VII) & Open Elective-II & III from NPTEL/SWAYAM also on the advice of departmental academic council if the subject is not mentioned in the above basket.

Students will complete the Elective Papers (Professional or Open) of 12 weeks duration from NPTEL/SWAYAM. Student may register on NPTEL/SWAYAM at any time from 1st to 7th semester but the passing marks and credits will be reflected only in the 7th semester.

The secured percentage of marks and passing certificate of the subject shall be forwarded by the institute to Controller of Examination (CoE), JUT, Ranchi timely.

Jharkhand University of Technology, Ranchi
NEP-2020 based Syllabus w.e.f – 2025-26 batch
B.Tech, Branch- Cyber Security

VIIIth –Semester

S.No.	Course Code	Course Title	L	T	P	J	Cr	FM	Overall Pass Marks	Internal	External	Categorization
			Contact Hours per week									
01		Major Project/ Research Project	36 Hours per week / week Total 12-16 Weeks			6	20					
02		Industrial Internship										
Total												
Grand Total												

L: Lecture, T: Tutorial, P: Practical.
J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

Semester-Vth

PCC-I

Network Security & Cryptography

Unit-I

Introduction to Security Concepts **(9 Hours)**

The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security, substitution techniques, transposition techniques, steganography.

Unit-II

Symmetric Key Cryptography **(9 Hours)**

Algebraic structures, Divisibility and division algorithm, Euclidean algorithm, Modular arithmetic, Prime numbers, Fermat's and Euler's theorem, Congruence and matrices, Block Ciphers and operations, Simplified Data Encryption Standard, Data Encryption Standard, Advanced Encryption Standard.

Unit-III

Asymmetric Key Cryptography **(9 Hours)**

Groups, Rings, Fields, Finite fields, Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography.

Unit-IV

Message Authentication Algorithms and Hash Functions **(9 Hours)**

Message Authentication, Secure Hash Algorithm (SHA-3), Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme, Kerberos, X.509 Authentication Service, Public–Key Infrastructure.

Unit-V

Security in Networks **(9 Hours)**

Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Email security (PGP, S/MIME), Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls, Case Studies on Cryptography and security: Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual Elections.

Learning Resources

1. Cryptography and Network Security Principles and Practice, Seventh Edition, William Stallings, Pearson, 2017.

2. Cryptography and Network Security, Atul Kahate, McGraw Hill, 3rd Edition, 2013.

3. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw Hill, 2010.

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PCC-II

Embedded system and IOT

Unit-I

8-BIT embedded Processor (9)

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.

Unit-II

Embedded C Programming (9)

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.

Unit-III

IOT and ARDUINO Programming (9)

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.

Unit-IV

IOT communication and open platforms (9)

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

Unit- V

Applications Development (9)

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare.

Textbooks

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, Pearson Education, Second Edition, 2014.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, CISCO Press, 2017.

References

1. Michael J. Pont, “Embedded C”, Pearson Education, 2007.
2. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, “Arm System Developer's Guide”, Morgan Kauffman/Elsevier, 2006.
4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.

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Basket of Professional Elective-I

Information Security

Unit-I

Introduction **9Hour**

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

Unit-II

Security Investigation **9Hour**

Security for Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues, an Overview of Computer Security, Access Control Matrix, Policy-Security Policies, Confidentiality Policies, Integrity Policies, Hybrid Policies

Unit-III

Security Analysis **9Hour**

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk, Systems: Access Control Mechanisms, Information Flow and Confinement Problem

Unit-IV

Logical Design **9Hour**

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

Unit-V

Physical Design **9 Hour**

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

Learning Resources

1. Michael E Whitman and Herbert J Mattord, Principles of Information Security, Vikas Publishing House, New Delhi, 2021
2. Matt Bishop, Computer Security Art and Science, Pearson/PHI, 2021
3. Micki Krause, Harold F. Tipton, Handbook of Information Security Management, Vol 1-3 CRC Press LLC, 2019
4. Stuart McClure, Joel Scrambray, George Kurtz, Hacking Exposed, Tata McGraw- Hill, 2019

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Cyber Law

Unit-I

Introduction **(9 Hours)**

History of Internet and World Wide Web - Need for cyber law - Cyber-crime on the rise - Important

terms related to cyber law - Cyber law in India - Need for cyber law in India - History of cyber law in India - Information Technology Act, 2000 - Overview of other laws amended by the IT Act, 2000 - National Policy on Information Technology 2012

Unit-II

Overview of the Information Technology Act, 2000 (9 Hours)

Applicability of the Act - Scheme of the Act - Important provisions of the Act - Digital Signature under the IT Act, 2000 - E-Governance - Attribution, Acknowledgement and Dispatch of Electronic Records - Certifying Authorities - Controller of Certifying Authorities (CCA) - Security Guidelines for Certifying Authorities - Electronic Signature Certificates - Duties of Subscribers - Penalties and Offences Intermediaries - RULES ISSUED UNDER THE IT ACT, 2000

Unit-III

Cyber-Crimes / Cyber Frauds (9 Hours)

Definition of cybercrime - First Cyber-crime - Types of cyber frauds - Cyber frauds in India - Preventive measures - Cyber-crimes - Who commits cyber crimes? - Penalties and offences under the IT Act, 2000 - Offences under other legislations - Investigation of cyber-crimes in India - Regulatory Authorities

Unit-IV

Cyber Crimes and Legal Framework (9Hours)

Cyber Crimes against Individuals, Institution and State – Hacking - Digital Forgery - Cyber Stalking/Harassment - Cyber Pornography - Identity Theft & Fraud - Cyber Terrorism - Cyber Defamation - Right to Privacy and Data Protection on Internet - Concept of privacy - Self-regulation approach to privacy - Ingredients to decide confidentiality of information - Intellectual Property Issues in Cyber Space - Interface with Copyright Law - Interface with Patent Law - Trademarks & Domain Names Related issues - Dispute Resolution in Cyberspace

Unit-V

Cyber Security (9 Hours)

Network and website Security Risks – Hacking - E-business Risk management issues – Firewall - Security framework – Cryptocurrency - Blockchain – Technology Stack: Protocol, Currency - Crowd Funding - Bitcoin - Prediction Markets - Smart Property - Smart Contract - Decentralized Governance Services - E Payments - Digital Token based E payment systems - E Wallet - Online financial services in India - Law to Protect online financial service fraud.

Learning Resources

1. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
2. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
3. S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).
4. Blockchain, Blueprint for a new Economy, Melanie Swan, 2017 –O'Reilly
5. SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)
6. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007
7. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003).
8. Essential CyberSecurity Science, Josiah Dykstra, 2017 –O'Reilly

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Forensics And Incident Response

Unit-I

Introduction to Incident **9 Hour**

Goals of Incident Response, Introduction to Incident Response Methodology (IRM), Steps in Incident Response Methodology, IRM: Pre-incident preparation, IRM: Detection of incidents, IRM: Initial Response, IRM: Formulate a Response Strategy, IRM: Investigate the Incident, IRM: Reporting, Creating response toolkit – Windows, Volatile Data Collection – Windows, In-depth data collection – Windows, Storing collected data – Windows, Creating response toolkit – Unix, Volatile Data Collection – Unix, In-depth data collection – Unix, Storing collected data – Unix

Unit-II

ACPO Principles **9Hour**

Introduction to ACPO Principles, ACPO Principles of Computer Based Evidence, Introduction to computer Storage Formats, Understanding Storage Formats for Digital Evidence, Forensic Duplication, Forensic Duplication tools, Forensic Duplicate creation of HDD, Qualified Forensic Duplicate creation, Restored Image, Mirror Image, Forensic Duplication Tool Requirements, Creating a Forensic Duplicate of a Hard Drive, Evidence Handling, Types of Evidence, Challenges in Evidence Handling, Overview of Evidence Handling Procedure, Evidence Handling Procedure, Evidence Handling reports

Unit-III

File System Analysis **9Hour**

Introduction to File System Analysis, What is a File System?, Five Data Categories, FAT Concepts, FAT Analysis, FAT - The Big Picture, Introduction to NTFS, Files in NTFS, MFT Concepts, MFT Attribute Concepts, Other MFT Attribute Concepts, Indexes in NTFS, NTFS Analysis - File System Category, NTFS Analysis - Content Category, NTFS Analysis - Metadata Category, NTFS Analysis - File Name Category, NTFS Analysis - Application Category, NTFS - The Big Picture

Unit-IV

Investigating Systems **9 Hour**

Introduction to Investigating Systems, Investigating Windows Systems, Where Evidence resides on Windows Systems, Conducting a Windows Investigation I, Conducting a Windows Investigation II, File Auditing, Theft of Information, Handling the departing employee, Investigating Unix Systems, Overview of steps - Unix Investigation, Reviewing pertinent logs, Performing keyword searches, Reviewing relevant files, Identifying unauthorized user accounts/groups, Identifying rogue processes, Checking for unauthorized access points, Analysing trust relationships, Detecting loadable kernel modules

Unit-V

Investigating Hacker Tools **9 Hour**

Investigating Hacker Tools, What are the goals of tool analysis?, How are files compiled?, Static Analysis of Hacker Tools I, Static Analysis of Hacker Tools II, Dynamic Analysis of Hacker Tools I, Dynamic Analysis of Hacker Tools II, Evaluating Computer Forensics Tools, Types of Forensic Tools, Tasks performed by Forensic Tools, Tool comparisons, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Computer Forensics Software, Introduction to Forensic Report Writing, Understanding the Importance of Reports, Guidelines for Writing Reports, A Template for Computer Forensics Reports

Learning Resources

1. Kevin Mandia, Chris Prosise, Incident Response and Computer Forensics, Tata McGraw Hill, 2006
2. Bill Nelson, Amelia Philips, and Christopher Steuart, Guide to Computer Forensics and Investigations, Course Technology, Cengage Learning, 4th edition, ISBN: 1-435-49883-6, 2009
3. Eoghan Casey, Handbook of Computer Crime Investigation's Forensic Tools and Technology, Academic Press, 1st Edition, 2001
4. Brian Carrier, File System Forensic Analysis, Addison-Wesley Professional, 1st edition, 2005, ISBN13: 978-0321268174

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Network Protocols and Programming

Unit-I

Network and Transport Layer Protocols **9 Hour**

OSI Model, IP Header, ARP, RARP, ICMP, UDP Data gram and its characteristics, TCP Header & Connection Establishment Process, IP Fragmentation, ARP, RARP, ICMP, UDP Data gram and its characteristics, TCP Header & Connection Establishment Process

Unit-II

Socket Programming **9 Hour**

Byte Ordering Conversion Functions, man page, System Calls used with sockets, Iterative and Concurrent Server, Socket Interface, Remote Procedure Call, TCP Client Server Program, UDP Client Server Program

Unit-III

Application Layer Protocols **9 Hour**

DNS, TELNET, FTP, HTTP, WWW, DHCP, SMTP, POP3 Multicasting Protocols BGMP, IGMP, MBGP, MOSPF, PGM, PIM-DM PIM-SM

Unit-IV

Ipv6 Protocol **9 Hour**

IPV6 Features, Ipv6 Header, Ipv6 Address Types, Ipv6 Routing Protocols, Ipv4 to Ipv6 Tunneling and Translation Techniques

Unit-V

WAN Protocols **9 Hour**

DSL and Cable technology, Frame Relay, ATM, PPP, HDLC, MPLS, CR-LDP, LDP, RSVP-TE

Textbooks

1. Forouzan, Behrouz A. TCP/IP Protocol Suite. McGraw-Hill Higher Education, 2002.
2. Stevens, W. Richard, Andrew M. Rudoff, and Bill Fenner. Unix Network Programming Volume 1: The Sockets Networking API. Vol. 3. Boston: Addison-Wesley Professional, 2003.
3. Dong, Jielin. Network Protocol Handbook. 2007.

References

1. Beej's Guide to Network Programming Using Internet Sockets. Brian "Beej Jorgensen" Hall, v3.1.9, Copyright © November 16, 2022.
2. https://people.scs.carleton.ca/~lanthier/teaching/COMP1406/Notes/COMP1406_Ch12_NetworkProgramming.pdf

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Security Management

Unit-I

Introduction to Security Management **9 Hour**

Overview of security policies, models and mechanisms, Security Management Principles, Models and Practices, Security Planning and Asset Protection, Developing Security Programs and Disaster Recovery Plans

Unit-II

Principles of Risk and Risk Management **9 Hour**

Introduction and identification, risk analysis and evaluation, Practice of Risk Management, Risk Assessment - Types and sources of risk information, Risk identification techniques, Risk Treatment - Evaluating and selecting risk control mechanisms, Identifying, allocating, and resourcing risk controls

Unit-III

Security Analysis and Safeguards **9 Hour**

Vulnerability analysis, Penetration testing, Protection Mechanisms, Incident handling, Access Control and Authentication architecture, Auditing systems and audit trail analysis, Configuration Management

Unit-IV

Network Defense and Countermeasures **9 Hour**

Intrusion Detection Systems (SNORT), Architectural configurations and survivability issues, Firewall configurations and network design, Virtual private networks, Dial-up security, Computer and network forensic, Privacy Protection, Case studies on OS and application software (e.g., SELinux, Unix and Windows)

Unit-V

Standards and Security Certification Issues **9 Hour**

Rainbow Series, Common Criteria, Security Certification Process, Case studies, National and International Security Laws and Ethical Issues

Learning Resources

1. Management of Information Security, M. E. Whitman, H. J. Mattord, Cengage Learning, 2016
2. Guide to Disaster Recovery, 1st Edition, Michael Erbschloe
3. Guide to Network Defense and Countermeasures, Greg Holden, 2003
4. Security in Computing, 2nd Edition, Charles P. Pfleeger, Prentice Hall, 2005
5. Security Engineering: A Guide to Building Dependable Distributed Systems, Ross Anderson, Wiley, 2001
6. Software Security: Building Security In, Gary McGraw
7. The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities, Mark Dowd, John McDonald, Justin Schuh)

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Security Governance, Risk and compliance

Unit-I

Introduction to IT Governance **9 Hour**

Introduction to IT Governance, IT Risk Management Life Cycle, IT Risk framework, IT Risk identification, IT Risk Security Governance, IT Risk assessment, IT Risk evaluation, IT Risk response, IT Risk monitoring and reporting

Unit-II

Standards **9 Hour**

Overview of Industry Best Practice Standards, Model and Guidelines covering some aspect of IT governance, Principles of Business/IT Alignment Excellence, Principles of Program/Project Management Excellence, Principles of IT Service Management and Delivery Excellence, Principles of Vendor Management, Outsourcing Excellence, Critical success factors, Case Study

Unit-III

Security Design Principles **9 Hour**

Security mind-set, Design principles, System/security life-cycle, Security implementation mechanisms, Information assurance analysis model, Disaster recovery, Forensics, Threats, Vulnerabilities, Attacks, Countermeasures

Unit-IV

Security Trends and Audit **9 Hour**

Trends, Auditing, Cost/benefit analysis, Asset management, Standards, Enforcement, Legal issues, Disaster recovery, Security related issues and incidents

Unit-V

Security Policies **9 Hour**

Creation of policies, Maintenance of policies, Prevention, Avoidance, Incident response, Domain integration, Social engineering, Protocol attacks, Security awareness

Learning Resources

1. Iannarelli, J. G., & O'Shaughnessy, M. O. (2015). Information Governance and Security: Protecting and Managing Your Company's Proprietary Information. Waltham, MA: Butterworth Heinemann, Elsevier
2. Van Wyk, K. R., Graff, M. G., Peters, D. S., & Burley, D. L. (2015). Enterprise Software Security: A Confluence of Disciplines. Upper Saddle River, NJ: Pearson Education
3. Joanna Lyn Grama (2015). Legal Issues in Information Security. Jones & Bartlett Learning, Second Edition, ISBN: 978-1-284-05474-3
4. Kord Davis (2012). Ethics of Big Data. O'Reilly Media, ISBN: 978-1449311797

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Security Audit and Risk Assessment

Unit-I

Basics of Information Security **12 Hour**

Security Metrics and Reporting, Common Issues and Variances of Performance Metrics, Introduction

to Security Audit, Need, Steps in Security Audit, Auditable resources in an organization, Servers and Storage devices, Infrastructure and Networks, Communication Routes, Lab1: Working with Trojans, Backdoors and sniffer for monitoring network communication System, Information Security Methodologies (Black-box, White-box, Grey-box), Phases of Information Security Audit and Strategies, Ethics of an Information Security Auditor, Lab2: Understanding Data Packet Sniffers, Security Audit Part I - Auditing PC-based Accounting System, Auditing Operating Systems, Auditing Networks, Auditing Electronic Data Interchange, Controlling and Auditing Database Management Systems, Lab3: Windows Hacking – NT LAN Manager, Secure 1 password recovery

Unit-II

Security Audit **12 Hour**

Pre-audit checklist, Information Gathering, Vulnerability Analysis, Lab1: UDP Scan Using nmap, TCP Connect Scan Using nmap, TCP SYN Scan Using nmap, External Security Audit, Internal Network Security Audit, Firewall Security Audit, Lab2: Vulnerability Identification and Prioritization, IDS Security Auditing, Social Engineering Security Auditing, Web Application Security Auditing, Information Security Audit Deliverables and Writing Report, Result Analysis, Post Auditing Actions, Report Retention, Lab3: Web Application Security Configuration

Unit-III

Fundamentals of Risk **12 Hour**

What is Risk?, Information Security Risk Assessment Overview, Drivers, Laws, and Regulations, Risk Assessment Framework, Lab1: Risk assessment with NIST framework, Phases of Security Risk Assessment, Data Collection: The Sponsors, The Project Team, Data Collection Mechanisms, Executive Interviews, Document Requests, IT Assets Inventories, Lab2: Data Collection using Container method, Profile and Control Survey, Consolidation, Lab3: Survey Consolidation of the collected data

Unit-IV

Risk Analysis **12 Hour**

Compiling Observations, Data Analysis: Preparation of catalogues, Lab1: Prepare an automated Threat-vulnerability pair matrix, System Risk Computation, Designing Impact Analysis Scheme - Confidentiality, Integrity and Availability, Impact Score, Lab2: Preparation of an automated impact score, Designing Control Analysis, Designing Likelihood Analysis: Exposure, Frequency, Controls, Computing Final Risk Score, Lab3: Preparation of an automated Likelihood score and final risk score

Unit-V

Risk Classification and Prioritization **12 Hour**

System Risk Analysis, Risk Classification, Risk Ranking, Individual Risk Reviews, Lab1: Prepare the Risk Analysis with individual system risk review and threat and vulnerability risk review, Organization Risk Analysis, Risk Prioritization - Organization and System Specific Risk prioritization and Treatment, Lab2: Prepare an automated Organization and system specific risk prioritization and treatment template, Risk Assessment Methodologies, Result, Risk Registers, Process summary, Post mortem, Lab3: Prepare the risk register

Learning Resources

1. Mark Talabis, Information Security Risk Assessment Toolkit: Practical Assessments through Data Collection and Data Analysis, Syngress; 1st edition, ISBN: 978-1-59749-735-0, 2013

2. Whitman, Michael E., and Herbert J. Mattord, Management of Information Security, Cengage Learning, 2013
3. Andrew Vladimirov, Konstantin Michajlowski, Andrew A. Vladimirov, and Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic, and Framework, IT Governance Ltd, 2010
4. https://www.sans.org/reading-room/whitepapers/threats/implementing-vulnerability management process-34180
5. http://csrc.nist.gov/publications/nistpubs/800-40-Ver2/SP800-40v2.pdf

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Advanced Malware Analysis

Unit-I

Malware Analysis and Reverse Engineering **12 Hour**

Blueprint, Malware Analysis and Reverse Engineering, Types and purpose of Malware Analysis, Limitation, Effective Malware Analyst, Lab: Basic static analysis using Python

Unit-II

Malware Taxonomy and Deployment **12 Hour**

Malware Classes, Malware Infection Vectors, Types of Infection Vector, Potential Infection Vector, Lab: Setting up lab for dynamic analysis

Unit-III

Protective Mechanisms and Dependencies **12 Hour**

States of Malware - Static and Dynamic, Dependency Types, Malware Collections, Malware Inspection, PE File, Handle Files, Inspecting Static Malware, Inspecting Dynamic Malware, Malware Analysis Use Case, Tools of the trade, Lab: Dynamic analysis of Downloader, Dropper, Fake AV and Ransomware

Unit-IV

Reverse Engineering **12 Hour**

OllyDbg, Memory Map, Viewing thread and stack, Execution code, Breakpoints, Loading DLL's, Tracing, Exception Handling, Patching, Analyzing shell code, Understanding x64 debugger, Lab: Reverse applications using x64 debugger

Unit-V

Advanced Functionalities **12 Hour**

Launcher's, Process Injection, Process Replacement, Hook Injection, APC Injection, Simple Cipher's, Custom Encoding, Decoding, Lab: Use IDA Pro and look for potential encoding in given malware sample

Learning Resources

1. Michael Sikorski, Practical Malware Analysis – The Hands-On Guide to Dissecting Malicious Software, No Starch Press, Kindle Edition, 1st edition (2012), ISBN: 1593272901
2. Monnappa K A, Learning Malware Analysis: Explore the Concepts, Tools, and Techniques to Analyze and Investigate Windows Malware, Packt Publishing, 1st edition (2018)

3. Christopher C. C. Elisan, Advanced Malware Analysis, 1st Edition, Kindle Edition, ISBN-13: 978-0071819749

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Penetration Testing and Vulnerability Assessment

Unit-I

Need for Vulnerability Assessment **12 Hour**

The life cycles of Vulnerability Assessment and Penetration Testing, Introduction to Nessus, Installing Nessus on different platforms, prerequisites, Policy configuration, Scan configuration, Implementation of scanning the IT infrastructure using Nessus tool, Report interpretation, False positive analysis, Vulnerability analysis and Vulnerability exploiting, Performing scan results analysis which will cover false positive analysis, vulnerability analysis, exploiting vulnerabilities, and so on

Unit-II

Vulnerability Assessment Versus Penetration Testing **12 Hour**

The need for a penetration testing framework, Introduction to Metasploit, Setting up your environment, Metasploit components, Playing around with msfconsole, Variables in Metasploit, Browse through the directory structure of the Metasploit Framework and try out some of the common console commands, Information gathering and enumeration, Password sniffing, Advanced search with Shodan, Explore and execute the Shodan auxiliary module to find out various internet connected devices

Unit-III

Vulnerability Hunting with Metasploit **12 Hour**

Managing the database, NMAP, Post exploitation, Using any auxiliary module that can be used for vulnerability detection and explore various features of meterpreter, Need of client-side attacks with Metasploit, The msfvenom utility, Social engineering with Metasploit, Explore various other social engineering techniques provided by Social Engineering Toolkit and get familiar with various parameters and switches of msfvenom, Web application scanning with Metasploit, Web application scanning using WMAP, Metasploit auxiliaries for web application enumeration and scanning, Find and exploit vulnerabilities in the following vulnerable applications: DVWA, Mutillidae, OWASP Webgoat270

Unit-IV

Organizing a Penetration Test **12 Hour**

Conducting a penetration test with Metasploit, Case study diving deep into an unknown network, Perform post-exploitation on the Windows 7 system and identify five best post exploitation modules, The absolute basics of exploitation, Exploiting stack-based buffer overflows with Metasploit, Bypassing DEP in Metasploit modules, Implementation of Metasploit exploit module for DEP bypass, Performing a penetration test with integrated Metasploit services, Exploiting the Active Directory (AD) with Metasploit, Generating manual reports, Perform a penetration test on a network using OpenVAS built-in connectors and various Metasploit extensions and generate a proper report of the test

Unit-V

Vulnerability Management Plan **12 Hour**

The Six Stages of Vulnerability Management, Measuring the performance of a Vulnerability Management Program, Demonstration of any Windows-based Vulnerability Management Tools,

Vulnerability Management Tools, Evaluating Vulnerability Management Tools, Open source and free Vulnerability Management Tools, Demonstration of any open source Vulnerability Management Tools, Patch Management, Building a Patch Test Lab, Patch Distribution and Deployment, Demonstration of any Patch Management Software

Learning Resources

1. Himanshu Kumar, Learning Nessus for Penetration Testing: Master how to perform IT infrastructure security vulnerability assessments using Nessus with tips and insights from real-world challenges
2. Sagar Rahalkar, Nipun Jaswal, The Complete Metasploit Guide: Explore effective penetration testing techniques with Metasploit, Packt Publishing (2019)
3. Steve Manzuik, Andre Gold, Chris Gatford, Network Security Assessment: From Vulnerability to Patch, Syngress (2006)
4. Thomas R. Peltier, Justin Peltier, John A. Blackley, Managing A Network Vulnerability Assessment, Auerbach Publications (2003)

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Hacker Techniques, Tools, and Incident Handling

Unit-I

Introduction **12 Hour**

The Next Generation - TCP/IP Review, Cryptographic Basics, Symmetric and Asymmetric Encryption - Purpose of Public Key Infrastructure - Hashing - Physical Security –

Lab 1: Cloud Investigations for the steps for conducting a cloud security incident investigation and with essential cloud logging assets for incident response. Data collection and isolation for compromise assessment, applying cloud recovery and remediation following an incident, Complete cloud compromise incident response walkthrough.

Lab 2: Assessing and Securing Systems on a Wide Area Network (WAN)

Lab 3: Applying Encryption and Hashing Algorithms for Secure Communications.

Unit-II

Information Gathering and Foot Printing **12 Hour**

Technical Overview of Hacking - The Information-Gathering Process, The Information on a Company Web Site, Discovering Financial Information, Google Hacking, Exploring Domain Information Leakage, Tracking an Organization's Employees, Exploiting Insecure Applications, Using Basic Countermeasures. Port Scanning - Determining the Network Range, Identifying Active Machines, Mapping Open Ports, OS Fingerprinting, Mapping the Network, Analyzing the Results

Lab 4: Data Gathering and Footprinting on a Targeted Website

Lab 5: Using Ethical Hacking Techniques to Exploit a Vulnerable Workstation

Lab 6: Attacking a Vulnerable Web Application and Database.

Unit-III

Web and Database Attacks **12 Hour**

Enumeration and Computer System Hacking - Windows Basics, Commonly Attacked and Exploited Services, Enumeration, System Hacking, Types of Password Cracking, Using Password Cracking, Using PsTools, Rootkits, Covering Tracks, Wireless Vulnerabilities - The Importance of Wireless Security, A Brief History of Wireless Technologies, Working with and Securing Bluetooth, Working

with Wireless LANs, Threats to Wireless LANs, Wireless Hacking Tools, Protecting Wireless Networks, Web and Database Attacks - Attacking Web Servers, Examining an SQL Injection, Examining an SQL Injection, Vandalizing Web Servers, Database Vulnerabilities
Lab 7: Password Guessing Attacks with Hydra, Password Cracking with John the Ripper, Password Cracking with Hashcat.
Lab 8: Domain Password Audit Tool, Cloud Bucket Discovery, The Many Uses of Netcat.
Lab 9: Metasploit Attack and Analysis, Client-side Exploitation with the Browser Exploitation Framework (BeEF), Windows System Resource Usage Database Analysis, Command Injection Attack, Cross-Site Scripting Attack, SQL Injection Attack, Server-Side Request Forgery (SSRF) and Instance Metadata Service (IMDS) Attack.

Unit-IV

Attacks and Malware Lifecycle **12 Hour**

Sniffers session Hijacking and Denial of Service attacks - Malware - viruses and they function - worms and how they function works - significance of Trojans - Detection of Trojan and viruses, Trojan tools, distribution methods - Trojan construction kits - backdoors - covert communication - spyware - adware - scareware - ransomware
Lab 10: Identifying and Removing Malware on a Windows System
Lab 11: Analyzing Network Traffic to Create a Baseline Definition
Lab 12: Auditing a Wireless Network and Planning for a Secure WLAN Implementation.

Unit-V

Eless Security Technologies **12 Hour**

Defensive Technologies and incident response - Defence in depth, Intrusion detection system - the purpose of firewalls - Honeypots Honeynets - the role of controls - security best practices - incident response and defensive technologies - incident response - incident response plans - planning for disaster recovery - evidence handling and administration - requirements of regulated industries
Lab 13: Investigating and Responding to Security Incidents
Lab 14: Securing the Network with an Intrusion Detection System (IDS)
Lab 15: Defense Plan to Prevent Attacks.

Learning Resources

1. Hacker Techniques, Tools, and Incident Handling, 3rd Edition. By Sean-Philip Oriyan and Michael G. Solomon. Released August 2020. Publisher(s): Jones & Bartlett Learning.
2. Joshua Wright Hacker Techniques Training | Incident Handling Course | SANS SEC504 2019
3. Digital forensics and incident response, Johansen
4. Hacker Techniques Training | Incident Handling Course | SANS SEC504
5. Hacking Exposed: Network Security Secrets and Solutions, Mcclure(Stuart), Scambray(Joel)

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Basket of Professional Elective-II

Database Security

Unit-I

Security Issues in Database **9 Hour**

Poly instantiation, Integrity Lock, Sensitivity Lock, Security Models, Access Control (Grant & Revoke Privileges), Distributed Database Security, Outsourced Database and security requirements, Query Authentication Dimension, Condensed RSA & Merkle Tree

Unit-II

Security in Data Warehouse & OLAP **9 Hour**

Star Schema, Snowflake Schema, Multi-Dimension range query, Data cube - Data leakage in Data Cube, Geospatial Database Security, Geospatial data models, Geospatial Authorization, Access Control Models: Geo-RBAC & Geo-LBAC, Database Watermarking & Attacks on Watermarking

Unit-III

Introduction to Access Matrix Model **9 Hour**

Take Grant Model, Acten Model, PN Model, Harston Model, Hsiao's Model, Fernandez Model, Bell Lapadula's Model, Biba's Model, Dion's Model.

Unit-IV

Database Security Models **9 Hour**

Sea View Model, Jajodia Model, Sandhu's Model, The Orion Model, Jajodia Model, Kogan's Model, Sorion Model, A Model for Frame based systems, A Model for the Protection of Active Database

Unit-IV

Security Software Design **9 Hour**

A Methodological Approach to Security Software Design, Secure DBMS Design, Security Packages, Database Security Design, Retiss System, ASES System discovery, Bussolati and Martella's Model, Case Study

Learning Resources

1. Hassan A. Afyouni, Database Security and Auditing, India Edition, CENGAGE Learning, 2009
2. Castano, Database Security, Second edition, Pearson Education
3. Michael Gertz and Sushil Jajodia (Editors), Handbook of Database Security: Applications and Trends, Springer, 2007, ISBN-10: 0387485325
4. Bhavani Thuraisingham, Database and Applications Security: Integrating Information, Security and Data Management, CRC Press, Taylor & Francis Group, 2005
5. Alfred Basta, Melissa Zgola, Database Security, CENGAGE Learning
6. Handbook of Database Security: Applications and Trends, Springer US, 2008

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Operation System Security

Unit-I

Operating System Security **(9 Hours)**

Defining an operations center, Purpose of the operation center, Emergency operations center, Mission operations center, Threat operations center, Network operations center, Building a SOC, Logs, Events, Alerts, False positive, True positive, False negative, True negative, Incidents, Problems, Defining requirements, Identifying customers (internal versus external), Human resources, Legal,

Audit, Engineering/R&D, IT, External customers, Customer objectives, Service level agreements, Building and documenting use cases.

Unit-II

Infrastructure Security **(9 Hours)**

Organisational infrastructure, Operations infrastructure, Support infrastructure, Organisational security infrastructure, Perimeter defences, Network defences, Host defences, Application defences, Data defences, Policies and procedures, Security architecture, SIEM/Log management, Operation center infrastructure, Ticketing systems, Building the ticket system, Subject, Parsed values from events, Time ticket created, User/Group/Queue, Source (SIEM, Email, Phone), Category, Status, Reason codes, Acknowledgement/Ticket feedback, Workflow and automation, Portal interference, Mobile devices, Support infrastructure, Physical, Private SOC network, Video projectors, Labs, Different reporting lines, Legal, CISO, CIO, Compliance, SOC organisation, Engineering, Security architecture, Security monitoring and analysis, Responsibility, Authority, Fulfilling needs.

Unit-III

Most Valuable Resource **(9 Hours)**

Operational security, Culture, Personality, Core skill sets, Analysis, Security analyst job description, Security engineering, Security operation engineer job description, Security architect, Security architect job description, SOC team lead, SOC team lead job description, SOC management, SOC manager job description, SOC games, Special projects, Importance of people.

Unit-IV

Operations **(9 Hours)**

Problem and change event communications, Master stage logs, Shift turnovers, Daily operations calls, Critical bridges, IR, Detection, Confirmation, Analysis, Containment, Recovery, Review, Communication plan, Regular workshops, Checklists, Shift schedules, Types of shift schedules, Other shift options, Follow the sun, Shift rotation, Dealing with absenteeism, Internal functional training, Internal skill set training, Playbooks and runbooks, Job task qualification training, Tools and product training, Formal training and certifications, Schools and universities, Vendor training, OJT, Training plans, SOC shift operations, Leaders, Customer notifications, SOC phones, Progression and visibility, Training exercises.

Unit-V

Outsourcing **(9 Hours)**

Heads up display, Supervisor metrics, Vulnerabilities, Vulnerability prioritizing, Base CVSS2 threshold, Temporal CVSS2 threshold, Asset prioritizing as a part of metrics, Historical monitoring of patches, Know thyself, Known IP space, Know thy enemy, Blacklists, Block listing projects, Other types of lists, Organisational and industry partners, Proactive activity monitoring, Types of MSSPs (strategic partners, pure play providers, boutique providers), Advantages of MSSP outsourcing (cost, organisational, enhanced capabilities, SLA, documentation), Disadvantages of MSSP outsourcing (large numbers of customers, lack of dedicated resources, data storage issues, costs, quality of work and staffing), Service delivery, People, Size versus experience, Service execution, Tools, Similar versus larger MSSP, Security, DR, Exit strategy, MSSP selection, Providing the service, Testing your MSSP.

Learning Resources

1. David Nathans, Designing and Building a Security Operations Center, Elsevier Science – Syngress.
2. Gregory Jarpey and Scott McCoy, Security Operations Center Guidebook: A Practical Guide for a Successful SOC, Elsevier Science, 2017.
3. Robert McCrie, Security Operations Management, Elsevier Science, 2011.
4. Robert H. Deatherage, Jr., Security Operations: An Introduction to Planning and Conducting Private Security Details for High-Risk Areas, Taylor & Francis, 2021.
5. Joseph Muniz, Gary McIntyre, Nadhem AlFardan, Security Operations Center: Building, Operating, and Maintaining Your SOC, Pearson Education, 2015.

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Ethical Hacking

Unit-I

Introduction

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies - Laws of the Land - Overview of TCP/IP - The Application Layer - The Transport Layer - The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks - Intruder Attacks - Addressing Physical Security

Unit-II

Foot Printing, Reconnaissance And Scanning Networks **6**

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

Unit-III

Enumeration and Vulnerability Analysis

Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows - Linux OS Vulnerabilities - Vulnerabilities of Embedded Oss

Unit-IV System Hacking **6**

Hacking Web Servers - Web Application Components - Vulnerabilities - Tools for Web Attackers and Security Testers - Hacking Wireless Networks - Components of a Wireless Network - Wardriving - Wireless Hacking - Tools of the Trade

Unit-V

Network Protection Systems **6**

Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots

Text books

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. Patrick Engebretson, The Basics of Hacking and Penetration Testing, SYNGRESS, Elsevier, 2013.
3. Dafydd Stuttard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, 2011.

Reference

1. Justin Seitz, Black Hat Python: Python Programming for Hackers and Pentesters, 2014.

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Malware Analysis

Unit-I

Introduction and basic analysis **6**

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots

Unit-II

Advanced static analysis **7**

The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets, Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, Obfuscation, Packing, Metamorphism, Polymorphism

UNIT-III

Advanced dynamic analysis **7**

Live malware analysis, Dead malware analysis, Analyzing traces of malware, System calls, API calls, Registries, Network activities, Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

UNIT-IV

Malware functionality **5**

Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching - Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection

UNIT-V

Android malware analysis **5**

Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies

Text books

1. Michael Sikorski and Andrew Honig, Practical Malware Analysis, No Starch Press, 2012, ISBN: 9781593272906
2. Bill Blunden, The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System, Second Edition, Jones & Bartlett Publishers, 2009

Reference

1. Jamie Butler and Greg Hoglund, Rootkits: Subverting the Windows Kernel, Addison-Wesley Professional, 2005
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation, 2014
3. Victor Marak, Windows Malware Analysis Essentials, Packt Publishing, O'Reilly, 2015
4. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, Android Malware and Analysis, CRC Press, Taylor & Francis Group, 2015
5. Victor Marak, Windows Malware Analysis Essentials, Packt Publishing, 2015

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Social Network Security

Unit- I

fundamentals of social networking **6**

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms for understanding privacy and security

Unit- II

Security issues in social networks **6**

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world

Unit-III

Extraction and mining in social networking data **6**

Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities, Social network infrastructures and communities, Big data and Privacy

Unit- IV

Predicting human behavior and privacy issues **6**

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties

Unit-V

access control, privacy and identity management **6**

Understand the access control requirements for Social Network, Enforcing Access Control Strategies,

Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning

Text books

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer, 2007
2. Borko Furht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010
3. Jérôme Baton, Rik Van Bruggen, Learning Neo4j 3.x, Second Edition, Packt Publishing
4. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World, First Edition, Cambridge University Press, 2010

References

1. David Easley, Jon Kleinberg, Networks, Crowds, and Markets – Reasoning about a Highly Connected World, Cambridge University Press, 2010
2. Matthew O. Jackson, Social and Economic Networks, Princeton University Press, 2008
3. GuandongXu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition, Springer, 2011.
4. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling", IGI Global Snippet, 2009.
6. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web‖, Springer, 2009

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Modern Cryptography

Unit-I

Introduction **6**

Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions, Notions of Semantic Security (SS) and Message Indistinguishability (MI), Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption, Goldreich-Levin Theorem, Relation between Hardcore Predicates and Trap-door permutations

Unit- II

Formal notions of attacks **6**

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model

Unit- III

Random oracles **6**

Provable Security and asymmetric cryptography, Hash functions, One-way functions: Weak and Strong one-way functions, Pseudo-random Generators (PRG): Blum-Micali-Yao Construction,

Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudo-random Functions (PRF)

Unit-IV

Building a pseudorandom permutation **6**

The Luby-Rackoff Construction: Formal Definition, Application of the Luby-Rackoff Construction to the construction of Block Ciphers, The DES in the light of Luby-Rackoff Construction

Unit-V

Message authentication codes **6**

Left or Right Security (LOR), Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC, Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing, Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures, Shamir's Secret Sharing Scheme, Formally Analyzing Cryptographic Protocols, Zero Knowledge Proofs and Protocols

Text books

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag
2. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

References

1. Shafi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/
2. Oded Goldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 2
3. William Stallings, Cryptography and Network Security: Principles and Practice, PHI, 3rd Edition, 2006

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Digital and Mobile Forensics

Unit-I

Introduction to digital forensics **6**

Forensic Science, Digital Forensics, Digital Evidence, The Digital Forensics Process, The Identification Phase, The Collection Phase, The Examination Phase, The Analysis Phase, The Presentation Phase

Unit-II

Digital crime and investigation **6**

Digital Crime, Substantive Criminal Law, General Conditions, Offenses, Investigation Methods for Collecting Digital Evidence, International Cooperation to Collect Digital Evidence

Unit-III

Digital forensic readiness **6**

Law Enforcement versus Enterprise Digital Forensic Readiness, Rationale for Digital Forensic

Readiness, Frameworks, Standards and Methodologies, Enterprise Digital Forensic Readiness, Challenges in Digital Forensics

UNIT IV

IOS forensics **6**

Mobile Hardware and Operating Systems, iOS Fundamentals, Jailbreaking, File System, Hardware, iPhone Security, iOS Forensics Procedures and Processes, Tools, Oxygen Forensics, MobilEdit, iCloud

Unit-V

Android Forensics **6**

Android Basics, Key Codes, ADB, Rooting Android, Boot Process, File Systems, Security, Tools, Android Forensics, Forensic Procedures, ADB, Android Only Tools, Dual Use Tools, Oxygen Forensics, MobilEdit, Android App Decompiling

Text books

1. Andre Arnes, Digital Forensics, Wiley, 2018
2. Chuck Easttom, An In-depth Guide to Mobile Device Forensics, First Edition, CRC Press, 2022

References

1. Vacca, J., Computer Forensics, Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005, ISBN: 1-58450-389

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Cryptocurrency and Blockchain Technologies

Unit-I

Introduction to Blockchain **7**

Blockchain, Public Ledgers, Blockchain as Public Ledgers, Block in a Blockchain, Transactions, The Chain and the Longest Chain, Permissioned Model of Blockchain, Cryptographic Hash Function, Properties of a Hash Function, Hash Pointer and Merkle Tree

Unit-II

Bitcoin and cryptocurrency **6**

A Basic Cryptocurrency, Creation of Coins, Payments and Double Spending, FORTH the Precursor for Bitcoin Scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block Propagation and Block Relay

Unit-III

bitcoin consensus **6**

Bitcoin Consensus, Proof of Work (PoW), Hashcash PoW, Bitcoin PoW, Attacks on PoW, Monopoly Problem, Proof of Stake, Proof of Burn, Proof of Elapsed Time, Bitcoin Miner, Mining Difficulty, Mining Pool, Permissioned Model and Use Cases

Unit-IV

Hyperledger fabric & ethereum **5**

Architecture of Hyperledger Fabric v1.1, Chain Code, Ethereum Network, EVM, Transaction Fee, Mist Browser, Ether, Gas, Solidity

Unit-V

Blockchain applications **6**

Smart Contracts, Truffle Design and Issue, DApps, NFT, Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, Case Study

Text Books

1. Bashir and Imran, Mastering Blockchain: Deeper Insights into Decentralization, Cryptography, Bitcoin, and Popular Blockchain Frameworks, 2017
2. Andreas Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, O'Reilly, 2014

References

1. Daniel Drescher, Blockchain Basics, First Edition, Apress, 2017
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016
3. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly, 2015
4. Ritesh Modi, Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publishing
5. Handbook of Research on Blockchain Technology, Elsevier Inc., ISBN: 9780128198162, 2020

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Security and Privacy in Cloud

Unit-I

Fundamentals of cloud security concepts **7**

Overview of cloud security, Security Services, Confidentiality, Integrity, Authentication, Non-repudiation, Access Control, Basics of Cryptography, Conventional and Public-Key Cryptography, Hash Functions, Authentication, Digital Signatures

Unit-II

Security design and architecture for cloud **6**

Security Design Principles for Cloud Computing, Comprehensive Data Protection, End-to-End Access Control, Common Attack Vectors and Threats, Network and Storage, Secure Isolation Strategies, Virtualization Strategies, Inter-tenant Network Segmentation Strategies, Data Protection Strategies, Data Retention, Deletion and Archiving Procedures for Tenant Data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

Unit-III

Access control and identity management **6**

Access Control Requirements for Cloud Infrastructure, User Identification, Authentication and Authorization, Roles-based Access Control, Multi-factor Authentication, Single Sign-on, Identity Federation, Identity Providers and Service Consumers, Storage and Network Access Control Options, OS Hardening and Minimization, Verified and Measured Boot, Intruder Detection and Prevention

Unit-IV

Cloud security design patterns **6**

Introduction to Design Patterns, Cloud Bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

Unit-V

Monitoring, auditing and management **5**

Proactive Activity Monitoring, Incident Response, Monitoring for Unauthorized Access, Malicious Traffic, Abuse of System Privileges, Events and Alerts, Auditing, Record Generation, Reporting and Management, Tamper-proofing Audit Logs, Quality of Services, Secure Management, User Management, Identity Management, Security Information and Event Management

Text books

1. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley, 2013
2. Dave Shackleford, Virtualization Security, SYBEX, A Wiley Brand, 2013
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, O'Reilly, 2011

References

1. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing Foundations and Applications Programming

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Web Application Security

Unit-I

Fundamentals of web application security **6**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation144

Unit-II

Secure development and deployment **5**

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

Unit-III

Secure api development **6**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

Unit-IV

Vulnerability assessment and penetration testing **6**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database-based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

Unit-V

Hacking techniques and tools **7**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

Text boooks

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

References

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies

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PRACTICAL

Lab-I

Network Security LAB

PRACTICAL EXERCISES:

1. Using Wireshark explore the different layer protocol headers.

2. Demonstrate two different Certificates producing the same MD5 hash

3. Computing MACs, HASH and HMAC for messages

4. Implement and demonstrate Buffer overflow attack
5. Implement and demonstrate Denial of service attacks (DoS) and DDoS
6. Implement the ARP attack and MITM
7. Implement the Botnet attack detection using publically available dataset
8. Explore and install Snort intrusion detection tool
9. Implement Firewall rules using snort
10. Generate the network attack and Detect the attack using Snort

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Lab-II

IOT & Embedded System Security LAB

PRACTICAL EXERCISES:

1. Write 8051 Assembly Language experiments using simulator.
2. Test data transfer between registers and memory.
3. Perform ALU operations.
4. Write Basic and arithmetic Programs Using Embedded C.
5. Introduction to Arduino platform and programming
6. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)
7. Introduction to Raspberry PI platform and python programming
8. Interfacing sensors with Raspberry PI
9. Communicate between Arduino and Raspberry PI using any wireless medium
10. Setup a cloud platform to log the data
11. Log Data using Raspberry PI and upload to the cloud platform
12. Design an IOT based system

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Semester- VIth

PCC-I

AI & ML

Unit-I

Introduction to Artificial Intelligence - Overview of AI – History and Evolution of AI – Applications of AI in various domains – Turing Test and Rational Agents – Intelligent Agents: structure and types – Task environments

Unit-II

Problem-Solving and Search Techniques - Uninformed Search Strategies: Breadth-first, Depth-first, Depth-limited, Iterative deepening – Informed Search Strategies: Greedy best-first search, A* search – Heuristic functions – Constraint Satisfaction Problems (CSPs) – Local Search and Optimization: Hill climbing, Simulated annealing, Genetic algorithms

Unit-III

Knowledge Representation and Reasoning - Propositional and Predicate Logic – Syntax and Semantics – Resolution and Unification – Knowledge Representation Schemes: Semantic networks, Frames, Ontologies – Inference Mechanisms – Rule-based Systems – Forward and Backward Chaining – Reasoning under Uncertainty: Bayesian Networks, Dempster–Shafer Theory

Unit-IV

Machine Learning and Neural Networks - Supervised, Unsupervised, and Reinforcement Learning – Decision Trees – Naïve Bayes – Support Vector Machines – Neural Networks: Perceptron, Multilayer Perceptron, Backpropagation – Deep Learning overview – Introduction to Reinforcement Learning

Unit -V

Applications of Artificial Intelligence - Natural Language Processing: Syntax, Semantics, Machine Translation – Computer Vision: Image recognition, Object detection – Expert Systems: Design and Applications – Robotics and Planning – Case Studies of AI in Healthcare, Finance, and Autonomous Systems – Ethical Issues in AI

Textbooks

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th Edition, Pearson, 2021.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, *Artificial Intelligence*, 3rd Edition, McGraw Hill, 2009.

References

1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill, 2013.
2. Nils J. Nilsson, Principles of Artificial Intelligence, Springer, 2014.
3. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2017.
4. Tutorials and resources from IIT Madras (NPTEL: Artificial Intelligence by Prof. Deepak Khemani, IIT Madras).
5. AI Course structures and lecture materials from NIT Trichy, IIT Bombay, and SRM Institute of Science and Technology.

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PCC-II

Application & Web security

Unit-I

Overview and concepts **12 hrs**

Introduction to HTTP/HTTPS - Web Methods – Botnets – Worms - Automated Scanners

Unit-II

Rendering **12 hrs**

Isolation – Document Object Model - Communication - Navigation – Cookies – Cookies and Protocol Management Issues - Secure UI – Session Management – Session Hijacking – Generating Session Tokens

Unit-III

Traffic analysis **12 hrs**

Information Gathering in a web environment - Authentication/Authorization - Proxy Tools - Encoding/Encryption - Types of Encoding - Types of Encryption

Unit-IV

Owasp **12 hrs**

Web Security Attacks and Vulnerabilities - Frame Busting - Command Injection – Other types causes and analysis – Input validation – Blacklist Bypass

Unit-V

Threats & defenses **12 hrs**

SQL Injection - Running Online Background Check – Injection Defenses – Input validation for SQL – Input escaping for SQL – Cross site scripting – Script Injection – Cross Site Scripting

Text book

1. "Testing and Comparing Web Vulnerability Scanning Tools for SQL Injection and XSS Attacks" (PDF). Fonseca, J.; Vieira, M.; Madeira, H., Dependable Computing, IEEE. Dec 2007
2. Improving Web Application Security: Threats and Countermeasures. Microsoft Corporation. June 2003
3. Bryan Sullivan et al, (2012), Web Application Security, A Beginner's Guide, Mc Graw Hill

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Basket of Professional Elective- III

Cyber warfare

Unit-I

Cyber Warfare, Threatscape and Cyberspace Battlefield 9 Hour

What is Cyber Warfare? – What is Cyber Warfare? Have We Seen a Cyber War? Why Cyber Warfare Is Important? Introduction to Cyber Warfare Threatscape: definition of cyberwar, motivation, attackers, threats, Attack Methodology with the Tools and Techniques Used to Execute Them, Defense in Depth—How Organizations Defend Today (Defensive Mountain Range), What the Threat Is After (What We Should Focus on Defending). The Cyberspace Battlefield - Boundaries in Cyber Warfare, Where Cyber Fits in the War-Fighting Domains, Review of the Threat Actors, Fielding Systems at the Speed of Need.

Unit-II

Cyber Doctrine, Warrior and Accessing the Problem 9 Hour

Cyber Doctrine - Current U.S. Doctrine, Sample Doctrine/Strategy from Around the World, Key Military Principles That Must Be Adapted to Cyber Warfare, Guidance and Directives, Operations and Exercises. Cyber Warriors - What Does a Cyber Warrior Look Like? Differences from Traditional Forces, Present Cyber Warfare Forces, Staffing for Cyber War. Assessing the Problem The Complex Domain of Cyberspace, Cyber Warfare in the 20th and 21st Centuries, China, Israel, Russia, The Second Russian-Chechen War (1997–2001), The Estonian cyber-attacks (2007), The Russia-Georgia War (2008), Iran, North Korea, Cyber Espionage, Titan Rain, Cyber Crime, Future Threats, Increasing Awareness, Critical Infrastructure, The Conficker Worm: The Cyber Equivalent of an Extinction Event? Africa: The Future Home of the World's Largest Botnet? The Way Forward.

Unit-III

Weapons – Logical, Physical and Psychological 9 Hour

Logical Weapons - Reconnaissance Tools, DNS, Scanning Tools, Access and Escalation Tools, Exfiltration Tools, Sustainment Tools, Assault Tools, Obfuscation Tools. Physical Weapons - How the Logical and Physical Realms Are Connected? Infrastructure Concerns, Supply Chain Concerns, Tools for Physical Attack and Defense. Psychological Weapons - Social Engineering Explained, How the Military Approaches SE, How the Military Defends Against SE

Unit-IV

Computer Network Exploitation, Defense and Non-State Actors 9 Hour

Computer Network Exploitation - Intelligence and Counter-Intelligence, Reconnaissance, Surveillance. Computer Network Attack - Waging War in the Cyber Era, The Attack Process. Computer Network Defense - What We Protect, Security Awareness and Training, Defending Against Cyber Attacks. Non-State Actors in Computer Network Operations - Individual Actors, Corporations, Cyber Terrorism, Organized Cyber Crime, Autonomous Actors - The Rise of the Nonstate Hacker.

Unit-V

Legal System Impacts and Status of Cyber Warfare, Challenges and Future of Cyber War 9

Legal System Impacts - Legal Systems, Key U.S. Laws, Privacy Impacts, Digital Forensics. Ethics - Ethics in Cyber Warfare, Bellum Iustum (Just War Theory). The Legal Status of Cyber Warfare –

Cyberspace Challenges - Cybersecurity Issues Defined, Interrelationship of Cybersecurity Challenges, Way Ahead. The Future of Cyber War - Emerging Trends, Trends Driving Where We Will Go

Learning Resources

1. Cyber Warfare, 2nd Edition, by Jason Andress, Steve Winterfeld, Released October 2013, Publisher(s): Syngress, ISBN: 9780124166332.
2. Inside Cyber Warfare, 2nd Edition, Jeffrey Carr, Released December 2011, Publisher(s): O'Reilly Media, Inc.ISBN: 9781449310042
3. The Basics of Cyber Warfare: Understanding the Fundamentals of Cyber Warfare in Theory and Practice, Steve Winterfeld and Jason Andress, Elsevier, 2012, ISBN: 978012404737.
4. Information Operations - Doctrine and Practice: A Reference Handbook, Christopher Paul, Praeger Security International, 2008, ISBN: 0275995917,
5. Law, Policy, and Technology: Cyberterrorism, Information Warfare and Internet Immobilization, Pauline C. Reich, and Eduardo Gelbstein, IGI Global, 2012, ISBN: 1615208313
6. Information Warfare and Security, Dorothy Denning, Addison Wesley Professional, 1998, ISBN: 0201433036

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Hacker Mind: Profiling the IT Criminal

Unit-I

Principles and Concepts of Cyber Criminology **9 Hour**

Crime, Tort, Misdemeanour, Cyber Space, Cyber Crime, Cyber Criminology, Information Security, Penetration Testing, Incident Response, GRC, etc.- Conventional crimes vs. Cyber Crimes.

Unit-II

Contemporary Forms of Crimes **9 Hour**

White Collar Crimes, Economic Offences, Organized Crimes, Terrorism, Crime and Media and other contemporary forms of crimes.

Unit-III

Psychology of Cyber Criminals **9 Hour**

Types of Cyber Criminals – Modus Operandi of Cyber Criminals – Profiling of Cyber Criminals - Tools and Techniques adopted by Cyber Criminals – Psychological theories relating to cyber criminals.

Unit-IV

Cyber Crime **9 Hour**

Sociological and Criminological Perspectives – Causes of Cyber Crimes - Criminological Theories and Cyber Crime – Routine Activity Theory, Social Learning Theory, Differential Association Theory, Differential Opportunity Theory, Media and Crime and latest theories and other related theories.

Unit-V

Crime Prevention **9 Hour**

Crime and sense of security - Social control and crime prevention - Community and crime prevention - Contemporary crime prevention strategies Tutorial The Role of Criminal Justice Administration and Cyber Crimes a. Police – Organizational structure of Police in India – Different wings in the States and Districts and their functions - Police & Law Enforcement – F.I.R. – cognizable and non

cognizable offences, bail able and non-bail able offences – arrest , search, seizure – Interrogation of suspects and witnesses – charge sheet – Cybercrime cells – structure & investigation of cybercrime cases . b. Judiciary - Different types of courts – Cyber Appellate Court / Tribunals / Powers – Proceedings in the court before trial, after trial, plea of guilty, sentencing. c. The Role of N.G.O.s in the Prevention of Cyber Crimes d. The Role of Victims of Cyber Crimes in the Criminal Justice Administration

Learning Resources

1. Clifford, Ralph. 2021. Cybercrime: The Investigation, Prosecution and Defense of a Computer-Related Crime. Second Edition. Carolina Academic Press.
2. McQuade, Samuel. 2006. Understanding and Managing Cybercrime. Pearson
3. Holt, Thomas. 2019. Crime On-Line: Correlates, Causes and Context. Second Edition. Carolina Academic Press..
4. Yar, Majid. 2013. Cybercrime and Society. Second Edition. Sage Publications.

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Mobile and Wireless Security

Unit-I

Introduction to Mobile and Wireless Networks (9 Hours)

Mobile Cellular Networks – (Generation Networks), 802.11 Standards –802.11,802.15, 802.16, 802.20, 802.21, IEEE wireless networks, Mobile Internet networks, Attacks and defence strategies on Cellular networks, Security Issues in Mobile Communication: Mobile Communication History, Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application – level Security

Unit-II

Mobile Security (9 Hours)

Basics on security, Secure communication protocols, Importance of Authentication and Authorization, Challenges of Cybersecurity, Incident Response Process, Security risks in Mobile, Security in the GSM, GPRS security , 3G security ,Android Architecture, and Security Model for Android, Fundamentals of Android Development, Android Rooting, Intercepting Android Traffic, Attacks on Android, and Security Model for iOS, Case Studies on Mobile Security

Unit-III

Wireless Security (9 Hours)

Wi-Fi Security: Introduction, Attacks on wireless networks: Active, passive attacks, DoS attacks, TCP, Trojan and Dictionary Attacks, Security in the IEEE 802.11 standard, Security in 802.1x, Security in 802.11i, Authentication in wireless networks, Layer 3 security mechanisms. Bluetooth Security: Introduction, Bluetooth technical specification, Bluetooth security

Unit-IV

WiMAX and LTE Security (9 Hours)

Introduction, WiMAX architecture and OFDM, Security risks involved in 802.16-2004, Security risks involved in 802.16e Security in GSM, UMTS, GPRS, VoIP security, LTE security

Unit-V

Security of Downloadable Applications (9 Hours)

Introduction, Security policy, The implementation of a security policy, Execution environments for active contents, Validation of active contents, Detection of attacks

Learning Resources

1. Hakima Chaouchi, Maryline Laurent-Maknaviciu Wireless and Mobile Network Security, WileyISTE, 2013.
2. M. Au, R. Choo and G. Kessler, Mobile security and privacy. Cambridge, MA: Syngress, 2017.
3. J. Joshi, Network Security. New York: Elsevier, 2009.
4. S. AHMADI, MOBILE WIMAX. [Place of publication not identified]: ELSEVIER ACADEMIC Press, 2016.

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Windows and Linux Internals

Unit-I

Operating System Security (12 Hours)

Concepts and Tools, Windows Operating System Versions, Foundation Concepts and Terms, Windows API, Services, Functions, and Routines, Processes, Threads, and Jobs, Virtual Memory, Kernel Mode vs. User Mode, Terminal Services and Multiple Sessions, Objects and , Security , Registry , Unicode , Digging into Windows Internals , Reliability and Performance Monitor , Kernel Debugging , Windows Software Development Kit ,Windows Driver Kit , Sysinternals Tools.

Unit-II

Windows Architecture (12 Hours)

System Architecture, Requirements and Design Goals, Scalability, Differences Between Client and Server Versions, Operating System Model, Architecture Overview, Portability , Symmetric Multiprocessing , Checked Build, Key System Components , Environment Subsystems and Subsystem DLLs , Ntdll.dll ,Executive , Kernel. , Hardware Abstraction Layer, Device Drivers,

Unit-III

Windows Management (12 Hours)

Management Mechanisms , The Registry , Viewing and Changing the Registry , Registry Usage , Registry Data Types , Registry Logical Structure,Transactional Registry (TxR) , Monitoring Registry Activity , Registry Internals , Services , Service Applications ,The Service Control Manager ,www.it-ebooks.info viii Table of Contents Service Startup , Startup Errors ,Accepting the Boot and Last Known Good, Service Failures , Service Shutdown , Shared Service Processes , Service Tags, Service Control Programs, Windows Management Instrumentation , Providers , The Common Information Model and the Managed Object Format Language. , Class Association, WMI Implementation. , WMI Security, Windows Diagnostic Infrastructure. ,WDI Instrumentation, Diagnostic Policy Service , Diagnostic Functionality

Unit-IV

Linux Operating System (12 Hours)

Booting, Process and Interrupt Management, Virtual Filesystem (VFS, Linux Page Cache, IPC mechanisms.,Booting, Building the Linux Kernel Image, Booting: Overview, Booting: BIOS POST, Booting: bootsector and setup, Using LILO as a bootloader, High level initialization, SMP Bootup on x86, Freeing initialisation data and code, Processing kernel command line, Process and Interrupt

Management., Task Structure and Process Table, Creation and termination of tasks and kernel threads, Scheduler, Linux linked list implementation, Wait Queues, Kernel Timers., Bottom Halves, Task Queues, Tasklets, How System Calls Are Implemented on i386 Architecture, Atomic Operations

Unit-IV

Linux Kernel **(12 Hours)**

Linux Versus Other Unix-Like Kernels, Hardware Dependency, Linux Versions, Basic Operating System Concepts, An Overview of the Unix File system, An Overview of Unix Kernels , Memory Addressing, Memory Addresses , Segmentation in Hardware, Segmentation in Linux , Paging in Hardware , Paging in Linux , Processes, Processes, Lightweight Processes, and Threads , Process Descriptor , Process Switch , Creating Processes , Destroying Processes

Learning Resources

1. Solomon, David A., Mark E. Russinovich, and Alex Ionescu. Windows internals. Microsoft Press, 2009.

2. Yosifovich, Pavel, David A. Solomon, and Alex Ionescu. Windows Internals, Part 1: System architecture, processes, threads, memory management, and more. Microsoft Press, 2017.

3. Bovet, Daniel P., and Marco Cesati. Understanding the Linux Kernel: from I/O ports to process management. “O’Reilly Media, Inc.", 2005.

4. Mohanta, Abhijit, and Anoop Saldanha. "Windows Internals." Malware Analysis and Detection Engineering. Apress, Berkeley, CA, 2020.

5. Mauerer, Wolfgang. Professional Linux kernel architecture. John Wiley & Sons, 2010.

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Data Networks

Unit –I

Physical Layer Channels

Frequency- and Time- Division Multiplexing; Error Detection; ARQ; Framing, Point-to-Point Protocols

Unit –II

Network Layer

Error Recovery, The X.25 Network Layer Standard, The Internet Protocol

Unit –III

Transport Layer

Transport Layer Standards, Addressing and Multiplexing TCP, Error Recovery in TCP; Flow Control in TCP/IP, Asynchronous Transfer Mode (ATM)

Unit –IV

Delay Models in Data Networks

The M/M/1 Queueing System, M/M/m, M/M/∞, M/M/m/m and other Markov Systems, Networks of Transmission Lines, Networks of Queues – Jackson’s Theorem

Unit – V

Multi-Access Communication

Packet Radio Networks, Splitting Algorithms, Carrier Sensing, Multi-access Reservations

Unit – IV

Routing in Data Networks

Wide-Area Network Routing, Interconnected Network Routing, Network Algorithms and Shortest Path Routing, Broadcasting Routing Information, Flow Models, Optimal Routing and Topological Design; Characterization of Optimal Routing

Unit – VII

Flow Control

Main Objectives of Flow Control, Window Flow Control, Rate Control Schemes, Rate Adjustment Algorithms, Classification of TCPs

Unit – VIII

Software Defined Networks

Fundamental Characteristics of SDN, the OpenFlow Specification, SDN via Hypervisor-Based Overlays, SDN in the Data Center, SDN in Wide Area Networks, SDN in Mobile Networks, SDN Ecosystem and Network Virtualization

Text Books

1. Bertsekas, Dimitri, and Robert Gallager, Data Networks (2nd Edition). Upper Saddle River, NJ, USA, Pearson Education/Prentice Hall, 1992.
2. Walrand, Jean, and Pravin Varaiya, High Performance Communication Networks. Morgan Kaufmann Publishers, San Francisco, CA, 1996.

Reference Books

1. Stevens, W. Richard, TCP/IP Illustrated. Addison-Wesley Publishing Co., Reading, MA, 1994–1996.
2. Paul Goransson and Chuck Black, Software Defined Networking: A Comprehensive Approach. Morgan Kaufmann (Elsevier), 2014.

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Cyber Crimes and Cyber Security

Unit-I

Criminal Law and Judicial Procedure (9 Hours)

Introduction to Criminal Law, History of criminal law, Penology and Treatment of Offender, Judicial process as an instrument of social ordering, Indian Penal Code, Indian Evidence Act, Legislature and Judiciary, Nature, content and justiciability, Directive Principles of State Policy, Inter relationship between Fundamental Rights and DPSP, Definitions under Code of Criminal Procedure -1973

Unit-II

Cyber Law and IT Act 2000 (9 Hours)

Introduction to Cyber Law, Evolution of the Information Technology Act, Genesis and Necessity, Salient features of the Information Technology Act – 2000, Various authorities under Information Technology act, Powers. Penalties & Offences, Amendments, Cyber Space Jurisdiction, Jurisdiction Issues under IT Act, 2000, Traditional Principles of Jurisdiction, Extra Terrestrial Jurisdiction, Case Laws on Cyber Space Jurisdiction

Unit-III

Security Risks and Threats **(9 Hours)**

Security Threat Management, Risk Assessment, Forensic Analysis, Security threat correlation, Threat awareness, Vulnerability sources and assessment, Vulnerability assessment tools, Threat identification, Threat Analysis, Threat Modeling, Model for Information Security Planning.

Unit-IV

Security Policies **(9 Hours)**

Security Elements, Authorization and Authentication, types, policies and techniques, Security certification, Security monitoring and Auditing, Security Requirements Specifications, Security Policies and Procedures, Firewalls, IDS, Log Files, HoneyPots

Unit-V

Trusted Security Models (9 Hours)

Access control, Trusted Computing and multilevel, Security models, Trusted Systems, Software security issues, Physical and infrastructure security, Human factors, E-Mail Recovery, Encryption, Email, and Internet use policies

Learning Resources

1. Swiderski, Frank and Syndex, "Threat Modeling", Microsoft Press, 2018.
2. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", Prentice Hall, 2018.
3. Joseph M Kizza, "Computer Network Security", Springer Verlag, 2019.
4. Thomas Calabres and Tom Calabrese, "Information Security Intelligence: Cryptographic Principles & Application", Thomson Delmar Learning, 2018.

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Wireless Sensor Network Security

Unit-I

Overview of WSN: Introduction, Applications, Unique Constraints and challenges. Sensor Node Hardware: Mica2, TelosB, Cricket, i-Mote2, TMote, BTnode, Wasp mote, comparisons. Sensor Node platforms: TinyOS and Contiki. Network Architecture – Sensor network scenarioDesign principles of WSN-Physical layer and fundamentals of MAC protocols, Low Duty cycle Protocols: SMAC, STEM, Contention Based Protocols: CSMA, PAMAS, Scheduling based Protocols: LEACH, TRAMA.

Unit-II

Routing: Gossiping, Energy efficient unicast, Broadcast and multicast. Localization and Positioning: GPS based localization; Event Driven Localization- Overview of data aggregation. Overview of Wireless Sensor Network Security, Vulnerabilities and Attacks in Wireless Sensor Networks, Symmetric Primitives, Public-Key Primitives, Key Management in Wireless Sensor Networks.

Unit-III

WSN Link-Layer Security Frameworks, Secure Routing in Wireless Sensor Networks, Secure Data

Aggregation in Wireless Sensor Networks, Privacy Protection Mechanisms for Sensor Networks, Intrusion Detection Techniques in Sensor Networks, Remote Attestation – Identification, On the Hardware Implementation Efficiency of Cryptographic Primitives.

Text book(s)

1. Karl H, Willig A. Protocols and architectures for Wireless Sensor Networks. John Wiley & Sons; 2005.
2. Javier Lopez, and Jianying Zhou, Wireless Sensor Network Security, IOS Press; 2008

Reference(s)

1. Dargie W, Poellabauer C. Fundamentals of Wireless Sensor Networks: theory and practice. John Wiley & Sons; 2010
2. Zhao F, Guibas LJ, Guibas L. Wireless Sensor Networks: an information processing approach. Morgan Kaufmann; 2004

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Network Routing Algorithms

Unit-I
Routing Foundations 9 Hour
Introduction to Networking and Network Routing – IPV4 Addressing, Protocol Stack Architecture – Router Architecture – Network Topology Architecture – Network Management Architecture – Global Telephone Network – Communication Technologies – Standards Committees.

Unit-II
Routing Algorithms: Shortest Path, Widest Path, and Spanning Tree 9 Hour
Bellman–Ford Algorithm: Centralized View – A Distance Vector Approach: Distributed View – Dijkstra's Algorithm: Centralized Approach – Dijkstra's Algorithm: Distributed Approach – Widest Path Algorithm: Dijkstra-Based Approach – Widest Path Algorithm: Distance Vector-Based Approach – Spanning Tree: Breadth First Search and Depth First Search – Minimum Spanning Tree – Steiner Tree Algorithms – k-Shortest Paths Algorithm

Unit-III
Routing Protocols: Framework and Principles 9 Hour
Routing Protocol, Routing Algorithm, and Routing Table – Routing Information Representation and Protocol Messages – Distance Vector Routing Protocol: Illustration – Distance Vector Routing Protocol: Times – Babel Routing Protocol – Link State Protocol: In-Band Hop-by-Hop Dissemination – Link State Protocol: In-Band Based on End-to-End Session – Path Vector Routing Protocol – Link Cost

Unit-IV
IP Routing and Distance Vector Protocol Family 9 Hour
Routers, Networks, and Routing Information – Routing Table – Communication of Routing Information – Static Routes – Routing Information Protocol, Version 1 (RIPv1) : Communication and Message Format – RIPv1 General Operation – Routing Information Protocol, Version 2 (RIPv2) – Interior Gateway Routing Protocol (IGRP) – Enhanced Interior Gateway Routing Protocol (EIGRP)

Unit-V

Router Architecture and Design 9 Hour

Router Architectures – Functions of a Router – Types of Routers – Elements of a Router – Packet Flow – Packet Processing: Fast Path Versus Slow Path – Router Architectures, Impact of Addressing on Lookup – Longest Prefix Matching

Textbooks

1. Deepankar Medhi, Karthik Ramasamy, Network Routing Algorithms, Protocols, and Architectures, Morgan Kaufmann Publishers, Second Edition, 2017.
2. James Aweya, IP Routing Protocols, CRC Press, First Edition, 2021.

References

1. Yoram Orzach, Deepanshu Khanna, Network Protocols for Security Professionals, Packt Publishers, First Edition, 2022.
2. James H. Baxter, Wireshark Essentials, Packt Publishers, First Edition, 2017.

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Internet of Things

Unit-I

Introduction to IoT - IoT definition - Characteristics - Things in IoT - IoT Complete Architectural Stack - IoT Enabling Technologies - IoT Challenges - IoT Levels - A Case Study to realize the stack. Sensors and Hardware for IoT - Accelerometer, Proximity Sensor, IR sensor, Gas Sensor, Temperature Sensor, Chemical Sensor, Motion Detection Sensor. Hardware Kits - Arduino, Raspberry Pi, Node MCU.

Unit-II

Protocols for IoT - infrastructure protocol IPV4/V6|RPL), Identification (URLs), Transport (WiFi, LiFi, BLE), Discovery, Data Protocols, Device Management Protocols. - A Case Study with MQTT/CoAP usage. Cloud and Data analytics- Types of Cloud - IoT with cloud challenges - Selection of cloud for IoT applications - Fog computing for IoT - Edge computing for IoT – Cloud security aspects for IoT applications - RFM for Data Analytics - Case Study with AWS / AZURE / Adafruit / IBM Bluemix.

Unit-III

Case studies with architectural analysis: IoT applications - Smart City - Smart Water – Smart Agriculture - Smart Energy - Smart Healthcare - Smart Transportation - Smart Retail – Smart Waste Management.

Text book

1. Bahga A, Madisetti V. Internet of Things: A Hands-on Approach; 2014.

Reference(s)

1. Shriram K Vasudevan, Abhishek SN and Sundaram RMD. Internet of Things, First Edition, Wiley India;2019.

2. Raj P, Raman AC. The Internet of things: Enabling Technologies, Platforms, and Usecases. Auerbach Publications; 2017.
3. Adrian McEwen. Designing the Internet of Things, Wiley;2013.

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Program Obfuscation

Unit-I

Introduction to Program Obfuscation – applications of code obfuscation, tamper proofing, software watermarking, software similarity. Methods of attack and defense – attack and defense strategies. Program analysis- static and dynamic analysis. reverse engineering tools. Code obfuscation- Complicating control flow, Opaque predicates, Data encoding, Breaking abstractions.

Unit-II

Dynamic Obfuscation, Software tamper proofing – checking for tampering, responding mechanisms, remote tamper proofing. Software watermarking – different methods and its applications, tamper proofing watermarks, improving resilience and stealth, dynamic watermarking methods-by exploiting aliasing, parallelism, and expanding execution paths.

Unit-III

Software similarity analysis- k-gram based analysis, API based analysis, tree and graph-based analysis, metrics-based analysis. Basics on hardware for protecting software. Case study: Data hiding in digital Audio and Video, Operating System Data Hiding, Virtual Data Hiding, Data Hiding in Network Protocols, Data Hiding among Android Mobile Devices and Apple iOS, Forensics and Anti Forensics, Mitigation Strategies.

Text book(s):

1. C. Collberg and J. Nagra, Surreptitious Software: Obfuscation, Watermarking, and Tamperproofing for Software Protection, Addison-Wesley; 2010
2. M. T. Raggo and C. Hosmer, Data Hiding: Exposing Concealed Data in Multimedia, Operating Systems, Mobile Devices and Network Protocols, 1st Edition, Syngress; 2012

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Basket of Professional Elective-IV

Blockchain Technology

Unit-I

Blockchain Data Structure – Hash Chain - Distributed Database - Blockchain Architecture Terminologies in Blockchain: Hashes - Transactions - Addresses - Wallet - Private Key Storage - Ledgers - Blocks - Chaining Blocks

Unit-II
Consensus and multiparty agreements: Proof of Work (PoW) - Proof of Stake (PoS) - Delegated Proof of Stake (DPoS) - Proof of Elapsed Time (PoET) - Proof of Importance - Reputation-based mechanisms - Practical Byzantine Fault Tolerance (PBFT)

Unit-III
Blockchain Platforms: Cryptocurrencies (Bitcoin, Litecoin, Ethereum) - Hyperledger - Ethereum

Unit-IV
Blockchain implementation; Smart Contract - Web3.js - MetaMask; Forking; Soft Fork - Hard Fork - Cryptographic Changes and Forks

Unit-V
Blockchain as a Service - IPFS and Blockchain - Challenges in Blockchain; Concurrency, Scalability and Privacy

Text Book(s)

1. Imran Bashir, Mastering Blockchain; 2017.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton Univ Press; 2016.
3. Alex Leverington, Ethereum Programming, Packt Publishing Limited; 2017.

Reference(s)

1. Andreas M. Antonopoulos, Mastering Bitcoin - Programming the Open Blockchain, O'Reilly Media, Inc.; 2017.
2. Draft NISTIR 8202, Blockchain Technology Overview - NIST CSRC; 2018.
3. Roger Wattenhofer, CreateSpace, The Science of the Blockchain, Independent Publishing Platform; 2016.

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Formal Methods for Security

Unit-I
Formal Methods – Definition - Need for Formal Methods - Propositional and Predicate Logic, and theorem-proving

Unit-II
Fixed-points and their role in program analysis and model-checking

Unit-III
Verification of sequential programs using weakest preconditions and inductive methods, and

verification of concurrent and reactive programs/systems using model-checking and propositional temporal logic (CTL and LTL)

Unit-IV
Application of static and dynamic program analysis and model-checking for detecting common security vulnerabilities in programs and communication protocols

Unit-V
Information flow and taint analysis for security of web applications, SPIN, PVS, TAMARIN, Frama-C and Isabelle tools

Text Book(s)

1. Veith, Helmut, et al. Model Checking. United Kingdom, MIT Press; 2018.

2. G. Bella, Formal Correctness of Security Protocols, Springer; 2009.

3. Datta A, Jha S, Li N, Melski D and Reps T, Analysis Techniques for Information Security, Synthesis Lectures on Information Security, Privacy, and Trust; 2010.

Reference(s)

1. Lloyd, J.W., Logic and Learning: Knowledge Representation, Computation and Learning in Higher-order Logic, Springer Berlin Heidelberg; 2003.

2. M. Ruth and M. Ryan, Logic in Computer Science - Modelling and Reasoning about Systems, Cambridge University Press; 2004.

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Hardware Security

Unit-I
Development of crypto algorithms and other security features on to hardware platform, standards of security –FIPS, 140-2 level 3. Overview of different issues of hardware security - Basics of Digital Design on Field-programmable Gate Array (FPGA), Optimization of Cryptographic Hardware on FPGA, Physically Unclonable Functions (PUFs), PUF Implementations, PUF Quality Evaluation, Design Techniques to Increase PUF Response Quality.

Unit-II
Side-channel Attacks on Cryptographic Hardware: Current-measurement based Side channel Attacks (Case Study: Kocher's Attack on DES), Design Techniques to Prevent Side channel Attacks, Improved Side-channel Attack Algorithms (Template Attack, etc.), Cache Attacks.

Unit-III
Testability and Verification of Cryptographic Hardware: Fault-tolerance of Cryptographic Hardware, Fault Attacks, Verification of Finite-field Arithmetic Circuits Hardware Trojans: Hardware Trojan Nomenclature and Operating Modes, Countermeasures such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans, Logic Testing and Sidechannel Analysis based techniques for

Trojan Detection

Textbooks:

1. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, Hardware Security: Design, Threats, and Safeguards, CRC Press; 2014
2. Bhunia, Swarup, and Mark Tehranipoor. Hardware security: a hands-on learning approach. Morgan Kaufmann; 2018

References:

1. Sadeghi, Ahmad-Reza, and David Naccache. Towards hardware-intrinsic security. Springer Berlin Heidelberg; 2010.
2. Huffmire, Ted, Cynthia Irvine, Thuy D. Nguyen, Timothy Levin, Ryan Kastner, and Timothy Sherwood. Handbook of FPGA design security. Springer Science & Business Media; 2010.
3. 3. Mangard, Stefan, Elisabeth Oswald, and Thomas Popp. Power analysis attacks: Revealing the secrets of smart cards. Springer Science & Business Media; 2008
4. 4. Tehranipoor, Mohammad, and Cliff Wang, eds. Introduction to hardware security and trust. Springer Science & Business Media; 2011.

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Biometrics and Security

Unit-I

Biometric Fundamentals and Standards: Biometrics versus traditional techniques, Characteristics, Key biometric processes: Verification -Identification -Biometric matching, Performance measures in biometric systems, Assessing the privacy risks of biometrics -Designing privacy sympathetic biometric systems, Different biometric standards, Application properties.

Unit-II

Physiological Biometrics: Facial scan, Ear scan, Retina scan, Iris scan, Finger scan, Automated fingerprint identification system, Palm print, Hand vascular geometry analysis, Knuckle, DNA, Dental, Cognitive Biometrics -ECG, EEG.

Unit-III

Behavioral Biometrics: Signature scan, Keystroke scan, Voice scan, Gait recognition, Gesture recognition, Video face, Mapping the body technology.

Unit-IV

User interfaces: Biometric interfaces: Human machine interface -BHMI structure, Human side interface: Iris image interface -Hand geometry and fingerprint sensor, Machine side interface: Parallel port -Serial port -Network topologies, Case study: Palm Scanner interface.

Unit-V

Biometric applications: Categorizing biometric applications, Application areas: Criminal and citizen identification –Surveillance -PC/network access -E-commerce and retail/ATM, Costs to deploy, Issues in deployment, Biometrics in medicine, cancellable biometrics.

Text Books/References

1. Anil K Jain, Patrick Flynn and Arun A Ross, Handbook of Biometrics, Springer, US; 2010.
2. John R Vacca, Biometric Technologies and Verification Systems, Elsevier, USA; 2009.
3. Samir Nanavati, Michael Thieme and Raj Nanavati, Biometrics –Identity Verification in a Networked World, John Wiley and Sons; 2003.
4. Paul Reid, Biometrics for Network Security, Pearson Education; 2004.
5. ReidM. Bolle et al, Guide to Biometrics, Springer, USA; 2004.
6. David D Zhang, Automated Biometrics: Technologies and Systems, Kluwer Academic Publishers; 2000.

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Quantum Cryptography

Unit-I

Introduction to Qubits, Quantum Entanglement, Bell's Inequality, Density matrices, Measurements, Quantum algorithms, No cloning theorem, Quantum Key Distribution, BB84 protocol, E91 protocol, privacy amplification, randomness extractor.

Unit-II

Properties of Lattices, Worst case to Average case reduction, Cryptographic hard problems, LWE, SIS problems, Ring and module Variants.

Unit-III

Key encapsulation mechanisms, Number Theoretic Transforms, CRYSTALS-Kyber, CRYSTALS-Dilithium.

Text books/references

1. Micciancio, Daniele, and Oded Regev. "Worst-case to average-case reductions based on Gaussian measures." SIAM Journal on Computing 37.1 (2007): 267-302.
2. Peikert, Chris. "A decade of lattice cryptography." Foundations and Trends® in Theoretical Computer Science 10.4 (2016): 283-424.
3. Bernstein, D. J., Buchmann, J., & Dahmen, E. (2009). Post-Quantum Cryptography.
4. Micciancio, D., & Regev, O. (2009). Lattice-based cryptography.
5. Micciancio, D., & Peikert, C. (2012). Trapdoors for Lattices: Simpler, Tighter, Faster, Smaller.
6. Schönhage, A. (1982). Fast algorithms for number-theoretic transforms.
7. Lenstra, Arjen K., Hendrik Willem Lenstra, and László Lovász. "Factoring polynomials with rational coefficients." Mathematische Annalen 261 (1982): 515-534.
8. Shor, Peter W. "Algorithms for quantum computation: discrete logarithms and factoring." Proceedings 35th Annual Symposium on Foundations of Computer Science. IEEE, 1994.
9. Dilithium official repository and documentation.

10. Kyber official repository and documentation.

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Cyber Analytics

Unit-I
Introduction to Cyber Analytics - Overview and significance of cyber analytics - Key concepts, terminologies, and metrics used in cyber analytics.

Unit-II
MITRE ATT&CK Framework - In-depth understanding of Tactics, Techniques, and Procedures (TTPs) - Mapping and analyzing cyber threats using the ATT&CK framework - Practical applications and case studies.

Unit-III
MITRE Shield Framework - Principles of active defense and deception in cybersecurity - Implementing MITRE Shield strategies in real-world scenarios - Integration of Shield with ATT&CK for comprehensive defense mechanisms.

Unit-IV
MITRE Cyber Analytics Repository (CAR) - Introduction to the MITRE CAR framework - Developing and engineering detection analytics - Hands-on exercises and labs using CAR data sets.

Unit-V
Advanced Cyber Analytics Techniques - Advanced data collection and preprocessing techniques - Machine learning applications in cyber analytics - Predictive analytics, anomaly detection, and their practical implementation.

Text books/references

1. Vandana P Janeja, Data Analytics for Cybersecurity. Cambridge University Press, 2022.
2. The CAR Guide to Cyber Analytics, MITRE Corporation. https://car.mitre.org/
3. MITRE ATT&CK Framework for Threat Detection. https://attack.mitre.org/
4. MITRE Shield Framework, MITRE Corporation. Introduction to MITRE Shield (PDF)
5. MITRE ENGAGE. https://engage.mitre.org/
6. MITRE DEFEND. https://d3fend.mitre.org/
7. NIST Special Publication 800-86: Guide to Integrating Forensic Techniques into Incident Response. https://csrc.nist.gov/pubs/sp/800/86/final
8. David Stuart. Practical Data Science for Information Professionals. Facet Publishing, 2020. Cambridge Link
9. Knapp ED, Samani R. Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure. Newnes, 2013. ScienceDirect Link

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Zero-Trust Architecture

Unit-I
Introduction to Zero Trust Architecture - Overview of zero trust principles - Importance and benefits of ZTA in modern cybersecurity

Unit-II

Components of Zero Trust Architecture - Core components: identity, devices, networks, applications, and data - Implementing zero trust in identity and access management

Unit-III

Implementing Zero Trust - Designing and engineering a zero trust network - Implementing zero trust access policies - Case studies on successful zero trust implementations

Unit-IV

Zero Trust in Cloud Environments - Cloud security challenges and engineering solutions - Applying zero trust principles to cloud infrastructure

Unit-V

Advanced Topics in Zero Trust - Zero trust for remote workforces - Implementing zero trust in operational technology (OT) environments - Future trends and engineering advancements in zero trust architecture

Text books/references

1. Cindy Green-Ortiz, Brandon Fowler, David Houck, Hank Hensel, Patrick Lloyd, Andrew McDonald, Jason Frazier. Zero Trust Architecture. Cisco Press, 2024.
2. Razi Rais, Christina Morillo, Evan Gilman, Doug Barth. Zero Trust Networks: Building Secure Systems in Untrusted Networks. O'Reilly Media, Incorporated, 2024.
3. Zero Trust Enterprise Infrastructure, DZone Magazine, Oct 2023.

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Image Processing

Unit-I

Fundamentals of Digital Image Processing (9 Hours)

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization. Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Unit-II

Image Enhancement (Spatial and Frequency Domain) (9 Hours)

Spatial Domain: Basic relationship between pixels- Basic Gray level Transformations – Histogram Processing – Smoothing spatial filters- Sharpening spatial filters. Frequency Domain: Smoothing frequency domain filters- sharpening frequency domain filters Homomorphic filtering.

Unit-III

Image Restoration Techniques (9 Hours)

Introduction to Image Restoration- degradation model, Properties, Noise models – Mean Filters –

Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

Unit-IV

Concepts on Image Segmentation (9 Hours)

Region of interest (ROI) selection - Feature extraction: Histogram based features - Intensity Features-Color, Shape Features-Local Binary Patterns (LBP), Texture descriptors- Grey Level Occurrence Matrix (GLCM). Fundamentals of Image Compression models – Error Free Compression – Variable Length Coding –Bit – Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding.

Unit-V

Feature Extraction (9 Hours)

Extracting Interest Points and Their Descriptors (with Harris, SIFT and SURF) in Image Pairs, Principal Component Analysis (PCA) and Linear Discriminant Analysis for Image Recognition-Image Classification using SVM-ANN- Feedforward and Back propagation-Object Detection using CNN-RCNN

Textbooks

1. Rafael C. Gonzales, Richard E. Woods, Digital Image Processing, Third Edition, Pearson Education, 2010.
2. S. Sridhar, Digital Image Processing, Second Edition, Oxford University Press, 2016.
3. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011.
4. S. Jayaraman, S. Esaki Rajan, T. Veera Kumar, Digital Image Processing, Second Reprint, Tata McGraw Hill Pvt. Ltd., 2010.

References

1. Bhabatosh Chanda, Dwejesh Dutta Majumder, Digital Image Processing and Analysis, Second Edition, PHI Learning Pvt. Ltd., 2011.
2. Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition, PHI Learning Pvt. Ltd., 2011.

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Digital Signal Processing

UNIT I

DISCRETE FOURIER TRANSFORM (DFT)

The DFT & its properties; Inverse DFT, Linear filtering methods based on DFT - Use of DFT in linear filtering, filtering of long data sequences, Efficient computation of DFT algorithms-Radix2 (DIT & DIF), Radix4, Split radix algorithms. Linear filtering approach to computation of DFT-Goertzel algorithm, Chirp z transform, Fast Fourier Transform (FFT)

UNIT II

DIGITAL FILTERS

Linear phase FIR filter, characteristic response, location of zeros, Design of FIR filter-Windowing, Frequency sampling, Design of IIR filters from Analog filters-Impulse invariance, Bilinear transformation, Matched z-transform.

UNIT III

DIGITAL FILTER STRUCTURES

FIR filters - Direct form, Cascade form, Frequency sampling, Lattice IIR filter - Direct form I, Direct form II, Cascade form, Parallel form, Lattice & Lattice ladder.

UNIT IV MULTIRATE DIGITAL SIGNAL PROCESSING
Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D.

UNIT V
DSP PROCESSORS
TMS C6xxx, Features, Architecture and Applications. Harvard Architecture, pipelining, Multiplier-Accumulator (MAC) Hardware. Architectures of Fixed- and Floating-point DSP processors. Addressing modes, functional modes. Memory architecture, on-chip peripherals of a DSP processor.

Text Books:

1. J. G. Proakis & D. G. Manolakis, Digital Signal Processing - Principles, Algorithms & Applications, PHI, 2000.
2. S. K. Mitra, Digital Signal Processing – A Computer Based Approach, MGH, 2010, 4th Edition.

Reference Books:

1. A. V. Oppenheim and Ronald W. Schafer, Discrete Time Signal Processing, PHI, 2000, 2nd Edition.
2. P. P. Vaidyanathan, Multi-Rate Systems and Filter Banks, Pearson Education, 1993.
3. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using MATLAB, Thomson, 2010, 2nd Edition.

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Data Mining

Unit I
Introduction to Data Mining and Preprocessing
Introduction to Data Mining: Process of Knowledge Discovery; Database to Data Warehouses; Data Mining Functionalities
Data Preprocessing: Data Summarization; Data Cleaning; Data Integration; Data Transformation; Data Reduction; Data Discretization & Concept Hierarchy Generation

UnitII
Data Warehousing and OLAP
Data Warehousing Techniques: OLAP vs. OLTP; Data cubes; Multidimensional Data Models and Schemas with their definitions; OLAP operations; Data Warehouse Architectures and Design Strategies

Unit III
Frequent Pattern Mining and Association
Frequent Pattern Mining, Association Rule Generation, Correlation Analysis: Concepts; Frequent Itemset Mining Algorithms - Apriori, FP-Tree Growth; Association Rules & their types; Association to Correlation Data visualization

Unit IV
Classification and Clustering
Classification Algorithms: Eager Learning Techniques – Decision trees, Naïve Bayesian Methods, Lazy Learning Techniques - K Nearest Neighbours, Case Based Reasoning Cluster Analysis- Various Data types involved and Data Structures; Categories of Clustering Methods: Partitioning, Hierarchical, Density-based, Model-based; Industry Standard Techniques

Unit V

Advanced Mining and Applications

Mining Specific Data: Stream, Time-Series and Sequence Data Mining; Graph Mining; Text Mining; Web Data Mining Applications and Trends in Data Mining: Outlier Analysis and Fraud Detection; Social Impacts of Data Mining

Textbooks

1. J. Han, M. Kamber, and J. Pei, Data Mining: Concepts and Techniques, 3rd Edition, ELSEVIER.
2. P.-N. Tan, M. Steinbach, V. Kumar, Introduction to Data Mining, Pearson Education.

Reference Books

1. Margaret H. Dunham & S. Sridhar, Data Mining: Introductory and Advanced Topics, Pearson Education.
2. A. Berson, S. J. Smith, Data Warehousing, Data Mining, & OLAP, Tata McGraw-Hill Edition.

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Basket of Open Elective I

Web Programming

Unit-I

Introduction **9 Hour**

Introduction to WEB, Basics of WWW, HTTP protocol, Client Server architecture, Introduction to web server installation and configuration, Web Design Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation

Unit-II

Html and css **9 Hour**

Basics of HTML and CSS, Structure of HTML page, HTML tags for data formatting, tables, links, images, meta tags, frames, html form tags, media, APIs, HTML5 tags and validation. Need for CSS, Syntax and structure, CSS rules for Backgrounds, Colors and properties, manipulating texts, Fonts, borders and boxes, Margins, Padding Lists, CSS Positioning. Animations, Tool-Tips, Style images, Variables, Media Queries, Wildcard Selectors (*, ^ and $) in CSS, Working with Gradients, Pseudo Class and Pseudo elements

Unit-III

Client side scripting **9 Hour**

Client Side Scripting using JavaScript Syntax of JavaScript, Execution of JavaScript, Internal, Embedded and External JavaScript, JavaScript: variables, arrays, functions, conditions, loops, Pop up boxes, JavaScript objects and DOM, JavaScript inbuilt functions, JavaScript validations and Regular expressions, Event handling with JavaScript

Unit-IV

Server side programming **9 Hour**

Server Side Programming with PHP Difference between Client side and Server side scripting, Structure of PHP page, PHP Syntax: variables, decision and looping with examples, PHP and HTML, Arrays and Functions, String, Form processing, File uploads, Dates and time zone, Working with Regular Expressions, Exception Handling

Unit-V

Database connectivity **9 Hour**

Database programming with PHP and MySQL Basic MySQL commands, PHP functions for database connectivity, Implementation of CRUD operations using PHP, Prepared Statement and stored procedure execution in PHP, Advanced Web Programming concepts, Asynchronous Web Programming, Difference between synchronous and asynchronous web programming

Learning resources

1. Web Technology, Moseley and Savaliya, Wiley India, 2016
2. Web Design, Joel Sklar, Cengage Learning, 2015
3. Learning PHP, MySQL, JavaScript, CSS & HTML5, 3rd Edition, Robin Nixon, O'Reilly, 2014
4. Internet and World Wide Web How to Program, P.J. Deitel & H.M. Deitel, Pearson, 5th edition, 2014
5. HTML 5 Black Book, 2nd Edition, Kogent Learning Solutions Inc, Dreamtech, 2016
6. A Step-by-Step Guide to Creating Dynamic Websites, Robin Nixon, O'Reilly Media, 2021
7. JavaScript for Impatient Programmers, Dr. Axel Rauschmayer, 2022
8. PHP: The Complete Reference, Steven Holzner, McGraw Hill, 2017

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Python Programming

Unit-I

Introduction **9 Hour**

Introduction - History of Python - Getting Started with Python - Programming style and Documentation - Identifiers - Variables - Assignment statements - Expressions - Data Types - Operators - Precedence - Comments - Type Conversions - Common Python Functions - Introduction to Methods and Strings

Unit-II

Loops and functions **9 Hour**

Introduction - Scope - IF Statements - Types of IF Statements - Conditional Expressions - Loops - While Loops - For Loop - Nested Loops - Functions - Definitions - Default Arguments - Calling a Function - Functions with or without returning values - Passings arguments to a function - Call by Value - Call by Reference - Recursion

Unit-III

Classes and objects **9 Hour**

Introduction to Object oriented Programming - Need of class and objects - Defining classes - Constructing Objects - Abstraction and Encapsulation - Overriding Methods - Inheritance and Polymorphism - Modules and Packages - Introduction to String Class - String Functions - Formatting Strings

Unit-IV

Lists tuples sets **9 Hour**

Introduction to Lists - Creation of List - Functions for Lists - Passing List to Functions - Operation on Lists - Searching and Sorting - Multidimensional Lists - Advanced List Processing - Sample programs on Lists - Lotto number and Deck of Cards - Introduction to Tuples - Sets - Creation and Accessing Sets - Dictionary Operations and Methods

Unit-V

Files and exception handling **9 Hour**

Introduction - Structure of File - Opening and Writing Data - Accessing Files - File Dialogs - Retrieving data from web - Introduction to Exceptions - Errors and Exceptions - Command line arguments - Need for Exception - Handling Exceptions - Raising Exceptions - Exception Objects - Custom Exception Classes

Learning resources

1. Y. Daniel Liang, Introduction to Programming using Python, 1st edition, Pearson, 2021.
2. Karl Beecher, Computational Thinking - A Beginner's Guide to Problem Solving and Programming, 2017.
3. Allen Downey, Think Python - How to Think Like a Computer Scientist, Green Tea Press, 2021.

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Mobile Application Development

Unit-I

Introduction to mobile application development **9 Hour**

Introduction, Android platform: Features and architecture, versions, ART (Android Runtime), ADB (Android Debug Bridge). Development environment/IDE: Android studio and its working environment, Application anatomy: Application framework basics: resources layout, values, asset XML representation and generated R.Javafile, Android manifest file. Creating a simple application.

Unit-II

GUI for android **9 Hour**

Introduction to activities life-cycle, intent filters, adding categories, linking activities, user interface design components, Views and View Groups: Basic views, picker views, adapter views, Menu, App Bar, basics of screen design; different layouts, App widgets. Lollipop Material design: new themes, new widgets, Card layouts. Recycler View, Fragments: Introduction to Fragments, life-cycle.

Unit-III

Memory management **9 Hour**

Introduction to different data persistence schemes, Shared preferences, File Handling, Managing data using SQLite database. Content providers: user content provider, Android in-built content providers, Integration of social media apps.

Unit-IV

Threads and android services **9 Hour**

Introduction to services – local service, remote service and binding the service, the communication between service and activity, Intent Service, Multi-Threading: Handlers, Async Task, android network programming: HTTP URL Connection, Connecting to REST-based and SOAP based Web services, Broadcast receivers: Local Broadcast Manager, Dynamic broadcast receiver, System Broadcast. Pending Intent, Notifications, Telephony Manager: Sending SMS and making calls, Interaction with server side apps.

Unit-V

Building android applications **9 Hour**

Introduction to location based services, Google maps V2 services using Google API. Animations and Graphics: Property Animation, View Animations, Drawable Animations, Media and Camera API: Working with video and audio inputs, Camera API, Sensor programming: Motion sensors, Position sensors, Environmental sensors, Guidelines, policies and process of uploading apps to Google play.

Learning resources

1. Dawn Griffiths, David Griffiths, Head First: Android Development, O'Reilly, 2015, ISBN: 9781449362188.
2. Greg Milette, Adam Stroud, Professional Android Sensor Programming, John Wiley and Sons, Inc., 2012, ISBN: 978111265055.
3. Paul Deital, Harvey Deital, Alexander Wald, Android 6 for Programmers, App Driven Approach, Prentice Hall, 2015, ISBN: 9780134289366.

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Data Analytics

Unit-I

Introduction to data analytics **9 Hour**

Types – Phases – Quality and Quantity of data – Measurement – Exploratory data analysis – Analytic processes and tools

Unit-II

Big data and cloud technologies **9 Hour**

Streams concepts – Stream data model and architecture – Introduction to Hadoop: Big Data, Apache Hadoop, MapReduce – Data serialization – Data extraction

Unit-III

Data visualization **9 Hour**

Introduction to data visualization – Data visualization options – Filters – Dashboard development tools – Creating an interactive dashboard with dc.js – Summary

Unit –IV

Machine learning **9 Hour**

Modeling process – Training model – Validating model – Predicting new observations – Supervised learning algorithms – Unsupervised learning algorithms

Unit-V

Case studies **9 Hour**

Case studies and projects – Understanding business scenarios – Scalable and parallel computing with Hadoop and MapReduce – Feature engineering and visualization

Learning resources

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Introducing Data Science, Manning Publications Co., 1st Edition, 2016.
2. Hadoop: The Definitive Guide, 4th Edition, O'Reilly.
3. Data Analytics Made Accessible, 2023, Kindle Edition.
4. https://www.amazon.in/Data-Analytics-Made-Accessible-2018-ebook/dp/B00K2I2JL8

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Space Science

Unit-I

Introduction **9**

Introduction to space science and applications – historical development – Space Environment – Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Debris Environment and its Effects – Newton's Law of gravitation – Fundamental Physical Principles.

Unit-II

Origin of Universe **9**

Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy.

Unit-III

Galaxies **7**

Galaxies, their evolution and origin – active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays.

Unit-IV

Stars **10**

Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) – Chandrasekhar limit.

Unit-V

Solar System **10**

Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun – Bode's law – Kepler's Laws of planetary motion – Newton's deductions from Kepler's Laws – correction of Kepler's third law – determination of mass of

earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets.

Text Books

1. Hess W., "Introduction to Space Science", Gordon & Breach Science Pub; Revised Ed., 1968.
2. Krishnaswami K. S., "Astrophysics: A modern Perspective", New Age International, 2006.

References

1. Arnab Rai Choudhuri, "Astrophysics for Physicists", Cambridge University Press, New York, 2010.
2. Krishnaswami K. S., "Understanding Cosmic Panorama", New Age International, 2008.

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Introduction to Industrial Engineering

Unit-I

Introduction **9**

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

Unit-II

Plant Location and Layout **9**

Factors affecting Plant location – Course Objectives of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

Unit-III

Work System Design & Ergonomics **9**

Need – Course Objectives – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Time Study – Work sampling – Ergonomics and its areas of application in the work system – Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures – sitting, standing.

Unit-IV

Statistical Quality Control **9**

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling – O.C curve – Single sampling plan – Double sampling plan.

Unit-V

Production Planning and Control **9**

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity – Loading – Scheduling and control of production – Dispatching – Progress control.

Text Book

1. O.P. Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications.

References

1. Ravi Shankar, 2009, Industrial Engineering and Management, Galgotia Publications & Private Limited.
2. Martand Telsang, 2006, Industrial Engineering and Production Management, S. Chand and Company.

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Food, Nutrition and Health

Unit-I

Food and Microbiology of Health **9**

Food resources (plant, animal, microbes); Overview of current production systems; constraints and necessity of novel strategies. Functional and "Super" Foods - role in optimal nutrition. Sugar, protein and fat substitutes. Food and behaviour- physiological disturbances in alcoholism, drug abuse and smoking. Food Related Laws: Inspection – Microbial Indicators of product quality – Indicators of food safety – Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept) – Microbiological criteria.

Unit-II

Nutrients and Food Additives **9**

Macro nutrients- carbohydrates, proteins and lipids. Micronutrients-Minerals: Calcium, Magnesium, Iron, Zinc, Copper and Selenium; Vitamins. Nutritional Physiology: Digestion, absorption, and utilization of major and minor nutrients. Biotechnology of food additives- Bioflavors and colors, microbial polysaccharides, recombinant enzymes in food sector.

Unit-III

Nano Food Technology **9**

Nano materials as food components, food packaging and nano materials, policies on usage of nanomaterials in foods. Food product development: steps involved in food product development, shelf-life assessment.

Unit IV

Food Related Nutritional Disorders and Energy Calculation **9**

Type I Disorders-Causes of life style and stress related diseases. Cardio-vascular diseases, hypertension, obesity. Type-II Disorders: Cancer, diabetics, ulcers, electrolyte and water imbalance. Health indices. Preventive and remedial measures. Energy balance and methods to calculate individual nutrient and energy needs. Planning a healthy diet.

Unit-V

Consumers on GM Foods and Contemporary Issues **9**

Global perspective of consumers on GM foods; Major concerns of transgenic foods GM ingredients in

food products (labeling, bioavailability, safety aspects); regulatory agencies involved in GM foods, Case studies- GM foods.

Text Books

1. P.J. Fellows. 2009. Food Processing Technology - Principles and Practice (Third Edition). A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition.
2. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. 2015. Food Biotechnology. CRC Press. Second edition.

Reference Books

1. Understanding Nutrition. 2010. Ellie Whitney, Sharon Rady Rolfes, 11e. Thompson Wadsworth.
2. Nutritional Sciences- From Fundamentals to Food. 2013. Michelle McGuire, Kathy A. Beerman, 2nd edition. Thompson Wadsworth.
3. Yasmine Motarjemi, Huub Lelieveld, Food Safety Management - A Practical Guide for the Food Industry (2014), 1st Edition, Academic Press, London, UK.

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Environmental and Social Impact Assessment

Unit-I

Introduction **9**

Impacts of Development on Environment – Rio Principles of Sustainable Development – Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle – EIA Notification and Legal Framework – Stakeholders and their Role in EIA – Selection & Registration Criteria for EIA Consultants.

Unit-II

Environmental Assessment **9**

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna – Matrices – Networks – Checklist Methods – Mathematical models for Impact prediction – Analysis of alternatives.

Unit-III

Environmental Management Plan **9**

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing – Environmental Clearance Post Project Monitoring.

Unit-IV

Socio Economic Assessment **9**

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan – Economic valuation of Environmental impacts – Cost benefit Analysis.

Unit-V

Case Studies **9**

EIA case studies pertaining to Infrastructure Projects – Real Estate Development – Roads and Bridges

– Mass Rapid Transport Systems – Ports and Harbor – Airports – Dams and Irrigation projects – Power plants – CETPs – Waste Processing and Disposal facilities – Mining Projects.

Text Books

1. Canter, R.L, "Environmental Impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank, 1997.
3. Peter Morris, Riki Therivel, "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

References

1. Becker H. A., Frank Vanclay, "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

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Renewable Energy System

Unit I

Introduction 9

Primary energy sources, renewable vs. non-renewable primary energy sources, renewable energy resources in India, Current usage of renewable energy sources in India, future potential of renewable energy in power production and development of renewable energy technologies.

Unit II

Solar Energy 9

Solar Radiation and its measurements, Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types, Efficiency and performance of collectors. Direct Solar Electricity Conversion from Photovoltaic, types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes. Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems.

Unit III

Wind Energy 9

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and applications.

Unit IV

Bio-Energy **9**

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Biogas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifiers, Application of biomass and biogas plants and their economics.

Unit V

Other Types of Energy **9**

Energy conversion from Hydrogen and Fuel cells, Geothermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants and their economics.

References

1. Twidell & Wier, 'Renewable Energy Resources' CRC Press(Taylor & Francis).
2. Tiwari and Ghosal, Narosa, 'Renewable Energy Resources'.
3. D.P. Kothari, K.C. Singhal, 'Renewable Energy Sources and Emerging Technologies', P.H.I.
4. D.S. Chauhan, S.K. Srivastava, 'Non – Conventional Energy Resources', New Age Publishers, 2006.
5. B.H. Khan, 'Non – Conventional Energy Resources', Tata McGraw Hill, 2006.

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Introduction to Industrial Instrumentation and Control

Unit-I

Common Unit Operations in Process Industries **9**

Unit Operation, Measurement and Control:-Transport of solid, liquid and gases - Evaporators – Crystallizers-Dryers.

Unit-II

Common Unit Operations in Process Industries **9**

Unit Operation, Measurement and Control: - Distillation – Refrigeration processes – Chemical reactors.

Unit-III

Process Measurement and Control in Petrochemical Industry **9**

Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionation Column – Catalytic Cracking unit – Catalytic reforming unit

Unit- IV

Process Measurement and Control in Thermal Power Plant Industry **9**

Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

Unit-V

Process Measurement and Control in Paper & Pulp Industry **9**

Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphate digestor – Control problems on the paper machine.

Text Books

1. Balchen ,J.G., and Mumme, K.J., "Process Control structures and applications", Van Nostrand Reinhold Co., New York, 1988.
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, Sixth Edition, 2001.

References

1. Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", Fifth Edition, CRC Press, 2016.
2. James R. Couper, Roy Penny, W., James R. Fair and Stanley M. Walas, "Chemical Process Equipment: Selection and Design", Gulf Professional Publishing, 2010.
3. Austin G.T and Shreeves, A.G.T., "Chemical Process Industries", McGraw–Hill International student, Singapore, 1985.
4. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw-Hill International edition, USA, 1989.
5. K. Krishnaswamy, Process Control, New Age Publishers, 2009.

List of Open Source Software/ Learning Website

1. https://www.aspentech.com/en
2. http://avtechscientific.com/
3. https://www.chemstations.com/CHEMCAD/
4. https://www.prosim.net/en/product/prosimplus-steady-state-simulation-and-optimization-of-processes/
5. https://www.cocosimulator.org/
6. https://dwsim.fossee.in/

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Graph Theory

Unit-I

Introduction to Graphs **9**

Graphs and Graph Models – Connected graphs – Common classes of graphs – Multi graphs and Digraphs – Degree of a vertex – Degree Sequence – Graphs and Matrices – Isomorphism of graphs.

Unit-II

Trees and Connectivity **9**

Bridges – Trees – Characterization and properties of trees – Cut vertices – Connectivity.

Unit-III

Traversability **9**

Eulerian graphs – Characterization of Eulerian graphs – Hamiltonian graphs – Necessary condition for Hamiltonian graphs – Sufficient condition for Hamiltonian graphs.

Unit-IV

Planarity and Colouring **9**

Planar Graphs – The Euler Identity – Non planar Graphs – Vertex Colouring – Lower and Upper bounds of chromatic number.

Unit-V

Optimization Graph Algorithms **9**

Dijkstra's shortest path algorithm – Kruskal's and Prim's minimum spanning tree algorithms – Transport Network – The Max-Flow Min-Cut Theorem – The Labeling Procedure – Maximum flow problem.

Text Books

1. Gary Chatrand and Ping Zhang, "Introduction to Graph Theory", Tata McGraw – Hill companies Inc., New York, 2006.
2. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics, An applied introduction" Fifth edition, Pearson Education, Inc, Singapore, 2004.

References

1. Balakrishnan R. and Ranganathan K., "A Text Book of Graph Theory", Springer – Verlag, New York, 2012.
2. Douglas B. West, "Introduction to Graph Theory", Pearson, Second Edition, New York, 2018.

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Mechatronics

Unit-I

Introduction and Sensors **9**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor – Temperature Sensors – Light Sensors.

Unit-II

8085 Microprocessor **9**

Introduction – Pin Configuration - Architecture of 8085 – Addressing Modes – Instruction set, Timing diagram of 8085.

Unit-III

Programmable Peripheral Interface **9**

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface.

Unit-IV

Programmable Logic Controller **9**

Introduction – Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

Unit-V

Actuators and Mechatronics System Design **9**

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts with

Examples – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier.

Text Books

1. Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.

References

1. Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.
2. Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.
5. Smaili. A and Mrad. F, "Mechatronics Integrated Technologies for Intelligent Machines", Oxford University Press, 2007.

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Foundation of Robotics

Unit-I

Fundamentals of robot **9**

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

Unit-II

Robot kinematics **9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

Unit-III

Robot drive systems and end effectors **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper.

Unit-IV

Sensors in robotics **9**

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction,

segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

Unit -V

Programming and applications of robot **9**

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

Text books

1. Ganesh S. Hedge, "A textbook of Industrial Robotics", Lakshmi Publications, 2006.
2. Mikell P. Groover, "Industrial Robotics – Technology, Programming and applications", McGraw Hill, 2nd edition, 2012.

References

1. Fu K.S., Gonalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 2007.
2. Yoram Koren, "Robotics for Engineers", McGraw Hill Book Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 2005.
4. John J. Craig, "Introduction to Robotics: Mechanics and Control", 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.

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Fundamentals of Aeronautical Engineering

Unit-I

History of flight **8**

Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

Unit-II

Aircraft configurations and its controls **10**

Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

Unit-III

Basics of aerodynamics **9**

Physical Properties and structures of the Atmosphere, Temperature, pressure and altitude relationships, Newton's Law of Motions applied to Aeronautics-Evolution of lift, drag and moment. Aerofoils, Mach number, Maneuvers.

Unit -IV

Basics of aircraft structures **9**

General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium, stainless steel and composite materials. Stresses and strains-Hooke's law- stress-strain diagrams-elastic constants-Factor of Safety.

Unit-V

Basics of propulsion **9**

Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

Text books

1. Anderson J.D., Introduction to Flight, McGraw-Hill, 8th edition, 2015.
2. E. Rathakrishnan, Introduction to Aerospace Engineering: Basic Principles of Flight, John Wiley, NJ, 2021.
3. Stephen A. Brandt, Introduction to Aeronautics: A Design Perspective, 2nd edition, AIAA Education Series, 2004.

References

1. Sadhu Singh, Internal Combustion Engines and Gas Turbine, SS Kataria & Sons, 2015.
2. Kermode, Flight Without Formulae, Pitman, 4th Revised edition, 1989.

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Remote Sensing Concepts

Unit-I

Remote sensing and electromagnetic radiation **9**

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities

Unit-II

EMR interaction with atmosphere and earth material **9**

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

Unit-III

Orbits and platforms **9**

Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

Unit-IV

Sensing techniques **9**

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites.

Unit-V

Data products and interpretation **9**

Photographic and digital products – Types, levels and open source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

Textbooks

1. Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 2015.
2. George Joseph and C. Jeganathan, Fundamentals of Remote Sensing, Third Edition, Universities Press (India) Private Limited, Hyderabad, 2018.

References

1. Janza F.Z., Blue H.M. and Johnson J.E., Manual of Remote Sensing, Vol.1, American Society of Photogrammetry, Virginia, USA, 2002.
2. Verbyla David, Satellite Remote Sensing of Natural Resources, CRC Press, 1995.
3. Paul Curran P.J., Principles of Remote Sensing, Longman, RLBS, 1988.
4. Charles Elachi and Jacob Van Zyl, Introduction to Physics and Techniques of Remote Sensing, 2nd Edition, Wiley Publication, 2006.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011.

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Urban Agriculture

Unit-I

Introduction **9**

Benefits of urban agriculture - economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

Unit-II

Vertical farming **9**

Vertical farming - types, green facade, living/green wall - modular green wall, vegetated mat wall - Structures and components for green wall system: plant selection, growing media, irrigation and plant nutrition: design, light, benefits of vertical gardening. Roof garden and its types. Kitchen garden, hanging baskets: the house plants/indoor plants.

Unit-III

Soil less cultivation **9**

Hydroponics, aeroponics, aquaponics: merits and limitations, costs and challenges, backyard gardens, tactical gardens, street landscaping, forest gardening, greenhouses, urban beekeeping.

Unit-IV

Modern concepts **9**

Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, greenhouse, polyhouse and shade net system of crop production on roof tops.

Unit-V

Waste management **9**

Concept, scope and maintenance of waste management - recycle of organic waste, garden wastes, solid waste management, scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

Textbooks

1. Martellozzo F. and J. S. Landry, Urban Agriculture, Scitus Academics LLC, 2020.
2. Rob Roggema, Sustainable Urban Agriculture and Food Planning, Routledge Taylor and Francis Group, 2016.
3. Akrong M. O., Urban Agriculture, LAP Lambert Academic Publishing, 2012.

References

1. Agha Rokh A., Evaluation of ornamental flowers and fishes breeding in Bushehr urban wastewater using a pilot-scale aquaponic system, Water and Wastewater, 19 (65): 47–53, 2008.
2. Agrawal M., Singh B., Rajput M., Marshall F. and Bell J. N. B., Effect of air pollution on peri-urban agriculture: A case study, Environmental Pollution, 126 (3): 323–329, 2003.
3. Jac Smit and Joe Nasr, Urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources, Environment and Urbanization, 1992.

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Drinking Water Supply and Treatment

Unit–I

Sources of water **9**

Public water supply system – Planning, objectives, design period, population forecasting; Water demand – Sources of water and their characteristics, surface and groundwater – Impounding reservoir – Development and selection of source – Source water quality – Characterization – Significance – Drinking water quality standards.

Unit-II

Conveyance from the source **9**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – Appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

Unit-III

Water treatment **9**

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, coagulation and flocculation – Sand filters – Disinfection – Construction, operation and maintenance aspects.

Unit-IV

Advanced water treatment **9**

Water softening – Desalination – R.O. plant – Demineralization – Adsorption – Ion exchange – Membrane systems – Iron and manganese removal – Defluoridation – Construction and operation and maintenance aspects.

Unit-V

Water distribution and supply **9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs – Functions – Network design – Economics – Computer applications – Appurtenances – Leak detection – Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

Textbooks

1. Garg S. K., Water Supply Engineering, Khanna Publishers, Delhi, 2008.
2. Punmia B. C., Arun K. Jain, Ashok K. Jain, Water Supply Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 2016.
3. Rangwala, Water Supply and Sanitary Engineering, 2022.
4. Birdie G. S., Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, 2018.

References

1. Fair G. M., Geyer J. C., Water Supply and Wastewater Disposal, John Wiley and Sons, 1954.
2. Babbit H. E., Donald J. J., Water Supply Engineering, McGraw Hill, 1984.
3. Steel E. W. et al., Water Supply Engineering, McGraw Hill International, 1984.
4. Duggal K. N., Elements of Public Health Engineering, S. Chand and Company Ltd., New Delhi, 1998.

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Electric Vehicle technology

Unit-I

Rotating power converters **9**

Magnetic circuits – DC machine and AC machine – Working principle of generator and motor – DC and AC – Voltage and torque equations – Characteristics and applications. Working principle of special machines like brushless DC motor, switched reluctance motor and PMSM.

Unit-II

Static power converters **9**

Working and characteristics of power diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (single phase and three phase), DC choppers, single and three phase inverters, multilevel inverters and matrix converters.

Unit-III

Control of DC and AC motor drives **9**

Speed control for constant torque, constant HP operation of all electric motors – DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f operation (motoring and braking) of induction motor drives, transformation theory, vector control operation of induction motor and PMSM, brushless DC motor drives, switched reluctance motor drives.

Unit-IV

Hybrid electric vehicle architecture and power train components **9**

History of evolution of electric vehicles – Comparison of electric vehicles with internal combustion engines – Architecture of electric vehicles (EV) and hybrid electric vehicles (HEV) – Plug-in hybrid electric vehicles (PHEV) – Power train components and sizing, gears, clutches, transmission and brakes.

Unit-V

Mechanics of hybrid electric vehicles and control of vehicles **9**

Fundamentals of vehicle mechanics – Tractive force, power and energy requirements for standard drive cycles of HEVs – Motor torque and power rating and battery capacity. HEV supervisory control – Selection of modes – Power split mode – Parallel mode – Engine brake mode – Regeneration mode – Series parallel mode.

References

1. Stephen D. Umans, Fitzgerald & Kingsley's Electric Machinery, Tata McGraw Hill, 7th Edition, 2020.
2. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011.
3. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, Analysis of Electric Machinery and Drive Systems, 3rd Edition, Wiley-IEEE Press, 2013.
4. Rashid M. H., Power Electronics Circuits, Devices and Applications, Pearson, 4th Edition, 10th Impression 2021.
5. Iqbal Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2021.
6. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, 2nd Edition, Wiley, 2017.
7. James Larminie, John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.

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Introduction to PLC Programming

Unit-I

Introduction to plc **9**

introduction to plc: microprocessor, i/o ports, isolation, filters, drivers, microcontrollers/dsp, plc/ddc-plc construction: what is a plc, plc memories, plc i/o, , plc special i/o, plc types.

Unit-II

PLC instructions **9**

plc basic instructions: plc ladder language- function block programming- ladder/function block functions- plc basic instructions, basic examples (start stop rung, entry/reset rung)- configuration of sensors, switches, solid state relays-interlock examples- timers, counters, examples.

Unit-III

PLC programming **9**

different types of plc program, basic ladder logic, logic functions, plc module addressing, registers basics, basic relay instructions, latching relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

Unit-IV

Communication of PLC and SCADA **9**

Communication protocol – modbus, hart, profibus- communication facilities scada: - hardware and software, remote terminal units, master station and communication architectures

Unit-V

Case studies **9**

Stepper motor control- elevator control-CNC machine control- conveyor control-interlocking problems

Text books

1. Frank petruzzula, programmable logic controllers, tata mc-graw hill edition
2. John w. webb, ronald a. reis, programmable logic controllers principles and applications, phi publication

References

1. Madhuchanndmitra and samerjit sengupta, programmable logic controllers industrial automation an introduction, penram international publishing pvt. ltd.
2. J. R. Hackworth and F. D. Hackworth, programmable logic controllers principles and applications, pearson publication

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Nano Technology

Unit-I

Introduction **8**

General definition and size effects–important nano structured materials and nano particles-importance

of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and electrochemistry of nanomaterials – ionic properties of nanomaterials- nano catalysis.

Unit-II

Synthesis of nanomaterials **8**

Bottom up and top-down approach for obtaining nano materials - precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

Unit-III

Nano composites **10**

Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-influence of size, shape and role of interface in composites applications.

Unit-IV

Nano structures and characterization techniques **10**

Classifications of nanomaterials - zero dimensional, one-dimensional and two-dimensional nanostructures- kinetics in nanostructured materials- multilayer thin films and superlattice-clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, diffraction methods, thermal analysis method, BET analysis method.

Unit-V

Applications of nano materials **9**

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, molecular electronics and nanoelectronics – nanobots-biological applications. Emerging technologies for environmental applications- practice of nanoparticles for environmental remediation and water treatment.

Text books

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmom, Burkhard Raguse, “Nano Technology: Basic Science & Engineering Technology”, 2005, Overseas Press
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications” Imperial College Press, 2004
3. William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3rd Edition, CRC Taylor and Francis group 2012

References

1. R.H.J.Hannink & A.J.Hill, Nanostructure Control, Wood Head Publishing Ltd., Cambridge, 2006
2. C.N.R.Rao, A.Muller, A.K.Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J. Muray, “The Physics of Micro/Nano – Fabrication”, Springer International Edition, 2010

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Practical

Lab-I

AI & ML LAB

List of Programme

1. Write a program to implement Breadth-First Search for a given graph and display the order of traversal
2. Write a program to implement Depth-First Search for a given graph and display the order of traversal
3. Implement the A* Search algorithm to solve the 8-puzzle problem using heuristics (misplaced tiles and Manhattan distance)
4. Implement the Branch and Bound algorithm to find the optimal path for the Travelling Salesman Problem
5. Write a program to place N queens on an N×N chessboard so that no two queens attack each other
6. Data Preprocessing: Handling Missing Data, Encoding Categorical Variables, Feature Scaling
7. Implementation of Linear Regression and Polynomial Regression
8. Logistic Regression and Evaluation Metrics (Accuracy, Precision, Recall, F1 Score)
9. Decision Tree and Random Forest Classifiers
10. K-Nearest Neighbors (k-NN) for Classification and Regression
11. Support Vector Machines (SVM) for Classification

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Lab-II

Application & Web security LAB

List of Experiments

Module 1: Basics of Web Security

1. Study and setup of a secure web server (Apache/Nginx with HTTPS & SSL/TLS).
2. Implement **secure authentication and authorization** in a sample web app.
3. Experiment with **session management** – secure cookie handling, HttpOnly & Secure flags.
4. Input validation experiment – test and prevent **SQL Injection**.

Module 2: OWASP Top 10 Based Experiments

5. Test for **Cross-Site Scripting (XSS)** vulnerabilities in a demo web application.
6. Identify and exploit **Insecure Direct Object References (IDOR)** and mitigate them.

7. Demonstration of **Cross-Site Request Forgery (CSRF)** attack and defense techniques.
8. Exploitation of **Broken Authentication** vulnerabilities (weak password policy, session hijacking).
9. Testing for **Security Misconfiguration** in a web server / application.
10. Conduct **File Upload Vulnerability** testing and apply secure file handling.

Module 3: Application Security Tools

11. Install and use **Burp Suite / OWASP ZAP** for scanning web application vulnerabilities.
12. Perform **SQL Injection exploitation** using SQLMap and apply defenses (prepared statements).
13. Run a **Vulnerability Assessment & Penetration Test (VAPT)** on a sample application.
14. Analyze source code for **insecure coding practices** using static code analysis tools.

Module 4: Secure Development & Deployment

15. Implement **secure password storage** using hashing and salting (bcrypt/argon2).
16. Develop a simple **secure login and registration system** in PHP/Python/Java.
17. Use **JWT (JSON Web Tokens)** for secure API authentication.
18. Demonstrate **secure API development** with rate limiting and input sanitization.

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Lab-III

Mobile Applications Development Lab(Android & iOS

List of experiments:

1. Install the Android SDK and developer tools and build a test project to confirm that those tools are properly installed and configured

2. Write a program using a Table Layout for our restaurant data entry form, add a set of radio buttons to represent the type of restaurant
3. Write a program using activity class to show different events
4. Write a program to send user from one application to another. (For example redirection to map)
5. Write a program to play audio files
6. Write a program to play video files
7. Write a program to capture image using built in camera
8. Write a program to send SMS
9. Write a program to convert text to speech
10. Write a program to call a number

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Semester- VIIth

PCC-I

Cyber laws & Digital Forensics

Unit-I

Cyber law **9hrs**

Fundamentals of Cyber Law – Concepts of cyber law – cyber space – jurisprudence – cyber jurisprudence – jurisdiction – jurisdiction and cyber law