

Subject Name Solutions

4353204 – Summer 2025

Semester 1 Study Material

Detailed Solutions and Explanations

Question 1(a) [3 marks]

Describe CIA triad with example.

Solution

CIA Triad Components:

Component	Definition	Example
Confidentiality	Protecting data from unauthorized access	Password protection on bank accounts
Integrity	Ensuring data accuracy and completeness	Digital signatures on documents
Availability	Ensuring systems are accessible when needed	24/7 online banking services

- **Confidentiality:** Only authorized users can access sensitive information
- **Integrity:** Data remains accurate and unaltered during transmission
- **Availability:** Systems remain operational and accessible to legitimate users

Mnemonic

“CIA Keeps Information Safe”

Question 1(b) [4 marks]

Explain Public key and Private Key cryptography.

Solution

Public Key Cryptography (Asymmetric):

Key Characteristics:

Feature	Public Key	Private Key
Distribution	Freely shared	Kept secret
Usage	Encryption/Verification	Decryption/Signing
Security	Can be public	Must be protected

- **Public Key:** Used for encryption and signature verification
- **Private Key:** Used for decryption and digital signing
- **Security:** Based on mathematical complexity (RSA, ECC algorithms)

Mnemonic

“Public Encrypts, Private Decrypts”

Question 1(c) [7 marks]

Explain various security attacks, mechanisms, and services associated with each layer of the OSI model.

Solution

OSI Security Framework:

Layer	Attacks	Mechanisms	Services
Physical Data Link	Wiretapping, Jamming MAC flooding, ARP poisoning	Physical security, Shielding Encryption, Authentication	Access control Frame integrity
Network	IP spoofing, Routing attacks	IPSec, Firewalls	Packet filtering
Transport	Session hijacking, SYN flooding	SSL/TLS, Port security	End-to-end security
Session	Session replay, Hijacking	Session tokens, Timeouts	Session management
Presentation	Data corruption, Format attacks	Encryption, Compression	Data transformation
Application	Malware, Social engineering	Antivirus, User training	Application security

Key Security Services:

- Authentication:** Verifying user identity
- Authorization:** Controlling access permissions
- Non-repudiation:** Preventing denial of actions
- Data integrity:** Ensuring data accuracy

Mnemonic

“All People Seem To Need Data Protection”

Question 1(c OR) [7 marks]

Explain MD5 hashing and Secure Hash Function (SHA) algorithms.

Solution

Hash Function Comparison:

Feature	MD5	SHA-1	SHA-256
Output Size	128 bits	160 bits	256 bits
Security Level	Weak	Weak	Strong
Speed	Fast	Moderate	Slower
Current Status	Deprecated	Deprecated	Recommended



Hash Properties:

- Deterministic:** Same input produces same hash
- Avalanche Effect:** Small input change causes major hash change
- One-way Function:** Cannot reverse hash to original data
- Collision Resistant:** Difficult to find two inputs with same hash

Applications:

- Password storage and verification
- Digital signatures and certificates
- Data integrity verification

Mnemonic

“Hash Always Produces Same Output”

Question 2(a) [3 marks]

What is firewall? List out types of firewall.

Solution

Firewall Definition: Network security device that monitors and controls incoming/outgoing traffic based on security rules.

Types of Firewalls:

Type	Function	Level
Packet Filter	Examines packet headers	Network Layer
Stateful	Tracks connection state	Transport Layer
Application Proxy	Inspects application data	Application Layer
Personal Firewall	Protects individual devices	Host-based

- **Hardware Firewall:** Dedicated network appliance
- **Software Firewall:** Installed on individual computers
- **Cloud Firewall:** Delivered as a service (FWaaS)

Mnemonic

“Firewalls Protect Networks Always”

Question 2(b) [4 marks]

Define: HTTPS and describe working of HTTPS.

Solution

HTTPS Definition: Hypertext Transfer Protocol Secure - HTTP over SSL/TLS encryption.

HTTPS Working Process:

HTTPS Components:

- **Port 443:** Standard HTTPS port
- **SSL/TLS:** Encryption protocols
- **Digital Certificates:** Server authentication
- **Symmetric Encryption:** Data transmission security

Benefits:

- Data encryption during transmission
- Server authentication verification
- Data integrity protection
- SEO ranking improvement

Mnemonic

“HTTPS Secures Web Traffic”

Question 2(c) [7 marks]

Explain different types of malicious software and their effect.

Solution

Malware Classification:

Type	Behavior	Effect	Example
Virus	Attaches to files	File corruption	Boot sector virus
Worm	Self-replicating	Network congestion	Conficker worm
Trojan	Disguised malware	Data theft	Banking Trojans
Ransomware	Encrypts files	Data hostage	WannaCry

Spyware	Monitors activity	Privacy breach	Keyloggers
Adware	Shows unwanted ads	Performance degradation	Pop-up ads
Rootkit	Hides presence	System compromise	Kernel rootkits

Effects on Systems:

- **Performance:** Slow system response
- **Data:** Loss, corruption, or theft
- **Privacy:** Unauthorized monitoring
- **Financial:** Direct monetary loss

Prevention Methods:

- Regular antivirus updates
- Safe browsing practices
- Email attachment caution
- System security patches

Mnemonic

“Viruses Worms Trojans Really Steal All Resources”

Question 2(a OR) [3 marks]

What is authentication? Explain different methods of authentication.

Solution

Authentication Definition: Process of verifying user identity before granting system access.

Authentication Methods:

Method	Description	Example
Password	Something you know	PIN, passphrase
Biometric	Something you are	Fingerprint, iris
Token	Something you have	Smart card, USB key

- **Single-Factor:** Uses one authentication method
- **Multi-Factor:** Combines multiple methods
- **Two-Factor (2FA):** Uses exactly two factors

Mnemonic

“Password Biometric Token Authentication”

Question 2(b OR) [4 marks]

Define: Trojans, Rootkit, Backdoors, Keylogger

Solution

Malware Definitions:

Term	Definition	Characteristics
Trojans	Malware disguised as legitimate software	Appears harmless, hidden payload
Rootkit	Software that hides malware presence	Deep system access, stealth operation
Backdoors	Unauthorized access method	Bypasses normal authentication
Keylogger	Records keyboard input	Captures passwords, sensitive data

- **Trojans:** Named after Greek Trojan Horse
- **Rootkit:** Operates at kernel level
- **Backdoors:** Can be hardware or software based
- **Keylogger:** Can be software or hardware device

Mnemonic

“Trojans Root Backdoors Keylog”

Question 2(c OR) [7 marks]

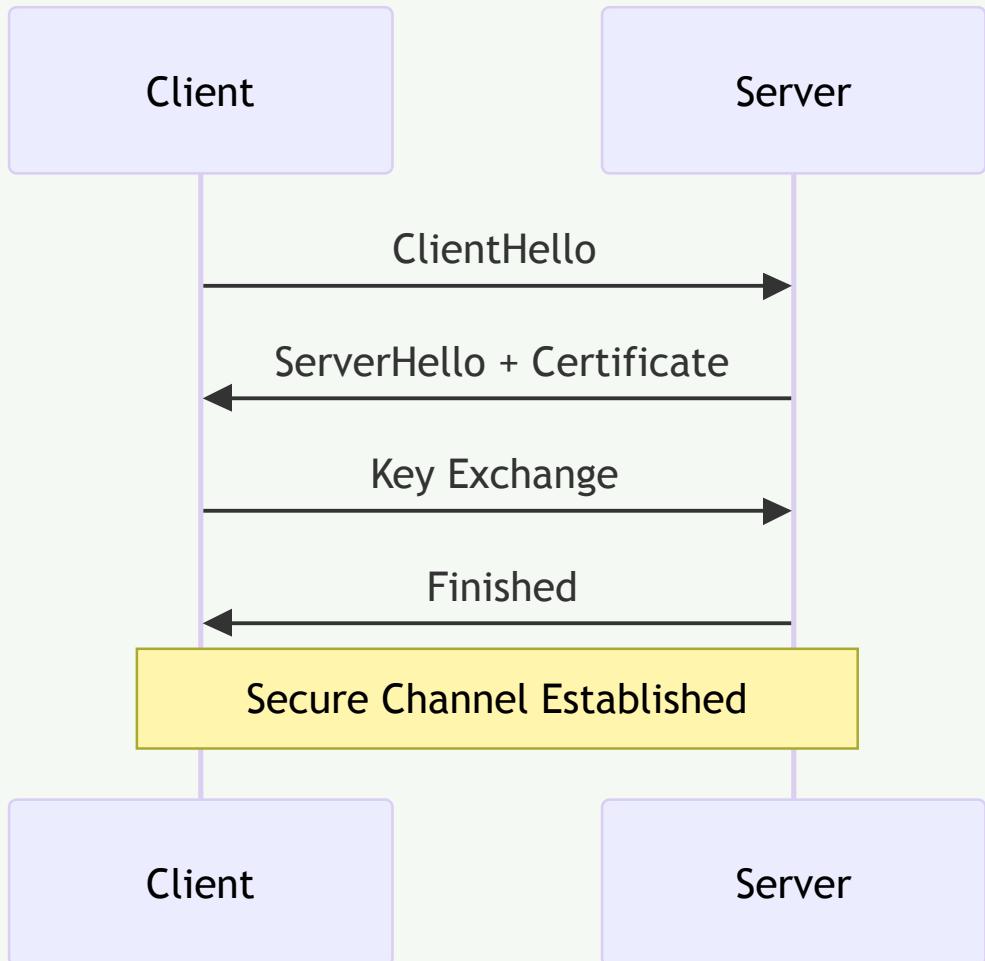
Explain Secure Socket Layer (SSL) and Transport Layer Security (TLS) protocols.

Solution

SSL/TLS Protocol Evolution:

Version	Year	Status	Security Level
SSL 2.0	1995	Deprecated	Weak
SSL 3.0	1996	Deprecated	Vulnerable
TLS 1.0	1999	Legacy	Limited
TLS 1.2	2008	Widely used	Good
TLS 1.3	2018	Current	Strong

TLS Handshake Process:



Key Features:

- **Encryption**: Symmetric and asymmetric algorithms
- **Authentication**: Server and client verification
- **Integrity**: Message authentication codes
- **Forward Secrecy**: Session key protection

Applications:

- HTTPS web browsing
- Email security (SMTPhS)
- VPN connections
- Secure file transfers

Mnemonic

"TLS Encrypts All Network Traffic"

Question 3(a) [3 marks]

Explain in detail cybercrime and cybercriminal.

Solution

Cybercrime Definition: Criminal activities conducted through computers or internet networks.

Diagram:

Cybercriminal Types:

Type	Motivation	Skills	Target
Script Kiddies	Fun/Fame	Low	Random
Hacktivists	Political/Social	Moderate	Organizations
Cybercriminals	Financial Gain	High	Individuals/Banks

- **Cybercrime:** Illegal activities using digital technology
- **Cybercriminal:** Person who commits cybercrimes
- **Impact:** Financial loss, privacy breach, system damage

Mnemonic

“Cyber Criminals Create Chaos”

Question 3(b) [4 marks]

Describe cyber stalking and cyber bullying in detail.

Solution

Digital Harassment Comparison:

Aspect	Cyber Stalking	Cyber Bullying
Target	Specific individual	Often minors
Duration	Persistent, long-term	Can be episodic
Intent	Intimidation, control	Harassment, humiliation
Platform	Social media, email	Schools, gaming platforms

Cyber Stalking Characteristics:

- Persistent unwanted contact
- Monitoring victim's online activity
- Threatening messages or behavior
- Identity theft or impersonation

Cyber Bullying Forms:

- Public humiliation online
- Exclusion from digital groups
- Spreading false information
- Sharing private content without consent

Prevention Measures:

- Privacy settings on social media
- Reporting harassment to platforms
- Legal action when necessary
- Digital literacy education

Mnemonic

“Stop Bullying, Report Stalking”

Question 3(c) [7 marks]

Explain Property based classification in cybercrime.

Solution

Property-Based Cybercrime Categories:

Category	Crime Type	Description	Example
Intellectual Property	Copyright infringement	Unauthorized use of copyrighted material	Software piracy

Financial Property	Credit card fraud	Unauthorized use of financial information	Online shopping fraud
Digital Property	Data theft	Stealing digital information	Database breaches
Virtual Property	Gaming asset theft	Stealing virtual goods	Online game currency theft

Diagram:

Legal Aspects:

- **Copyright Laws:** Protect creative works
- **Trademark Laws:** Protect brand identity
- **Patent Laws:** Protect inventions
- **Trade Secret Laws:** Protect confidential information

Impact on Economy:

- Revenue loss for legitimate businesses
- Reduced innovation incentives
- Consumer trust erosion
- Legal enforcement costs

Prevention Strategies:

- Digital rights management (DRM)
- Watermarking and tracking
- Legal enforcement mechanisms
- Public awareness campaigns

Mnemonic

“Property Protection Prevents Piracy”

Question 3(a OR) [3 marks]

Explain Data diddling.

Solution

Data Diddling Definition: Unauthorized alteration of data before or during input into computer systems.
Characteristics:

Aspect	Description
Method	Changing data values
Timing	Before system processing
Detection	Often difficult to identify

- **Examples:** Changing salary figures, altering exam scores
- **Target:** Input data during entry process
- **Impact:** Financial loss, incorrect records

Mnemonic

“Data Diddling Damages Databases”

Question 3(b OR) [4 marks]

Explain cyber spying and cyber terrorism.

Solution

Cyber Threats Comparison:

Aspect	Cyber Spying	Cyber Terrorism
Purpose	Information gathering	Causing fear/disruption

Target	Government, corporations	Critical infrastructure
Methods	Stealth infiltration	Destructive attacks
Impact	Intelligence loss	Public safety risk

Cyber Spying Activities:

- Corporate espionage
- Government surveillance
- Trade secret theft
- Personal information gathering

Cyber Terrorism Methods:

- Infrastructure attacks
- Mass disruption campaigns
- Psychological warfare
- Economic damage

Prevention Measures:

- Network security monitoring
- Incident response planning
- International cooperation
- Public-private partnerships

Mnemonic

“Spies Steal, Terrorists Terror”

Question 3(c OR) [7 marks]

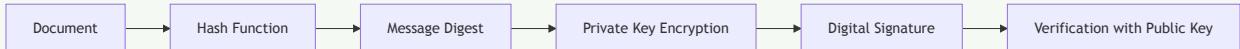
Explain the role of digital signatures and digital certificates in cybersecurity.

Solution

Digital Security Components:

Component	Purpose	Function	Benefit
Digital Signature	Authentication	Proves sender identity	Non-repudiation
Digital Certificate	Verification	Validates public keys	Trust establishment

Digital Signature Process:



Digital Certificate Components:

- **Subject Information:** Certificate owner details
- **Public Key:** For encryption/verification
- **Digital Signature:** CA's signature
- **Validity Period:** Certificate expiration date

Certificate Authority (CA) Role:

- Issues digital certificates
- Verifies identity before issuance
- Maintains certificate revocation lists
- Provides trust infrastructure

Applications in Cybersecurity:

- Email security (S/MIME)
- Code signing for software
- SSL/TLS certificates for websites
- Document authentication

Security Benefits:

- **Authentication:** Verifies sender identity
- **Integrity:** Ensures data hasn't been modified
- **Non-repudiation:** Prevents denial of actions
- **Confidentiality:** Enables secure communication

Mnemonic

“Digital Signatures Authenticate Documents Securely”

Question 4(a) [3 marks]

What is Hacking? List out types of Hackers.

Solution

Hacking Definition: Unauthorized access to computer systems or networks to exploit vulnerabilities.

Hacker Classifications:

Type	Intent	Legal Status
White Hat	Security improvement	Legal
Black Hat	Malicious activities	Illegal
Gray Hat	Mixed motivations	Questionable

- **White Hat:** Ethical hackers, security researchers
- **Black Hat:** Cybercriminals, malicious intent
- **Gray Hat:** Sometimes legal, sometimes not

Mnemonic

“White Good, Black Bad, Gray Questionable”

Question 4(b) [4 marks]

Explain Vulnerability and 0-Day terminology of Hacking.

Solution

Security Terminology:

Term	Definition	Risk Level	Example
Vulnerability 0-Day	System weakness Unknown vulnerability	Varies Critical	Unpatched software Undiscovered flaw

Vulnerability Characteristics:

- **Discovery:** Found through security testing
- **Disclosure:** Responsible reporting to vendors
- **Patching:** Vendor provides security updates
- **Window:** Time between discovery and patch

0-Day Attack Process:

- Hacker discovers unknown vulnerability
- Exploits flaw before vendor awareness
- No available patches or defenses
- High success rate due to surprise element

Protection Strategies:

- Regular security updates
- Intrusion detection systems
- Behavioral analysis tools
- Zero-trust security models

Mnemonic

“Vulnerabilities Need Patches, Zero-Days Need Vigilance”

Question 4(c) [7 marks]

Explain Five Steps of Hacking.

Solution

Hacking Methodology:

Detailed Steps:

Step	Description	Tools/Methods	Objective
Reconnaissance	Information gathering	Google dorking, Social media	Target profiling
Scanning	System enumeration	Nmap, Nessus	Vulnerability identification
Gaining Access	Exploit vulnerabilities	Metasploit, Custom exploits	System compromise
Maintaining Access	Persistent presence	Backdoors, Rootkits	Long-term control
Covering Tracks	Evidence removal	Log cleaning, File deletion	Avoid detection

Information Gathering Types:

- **Passive:** No direct target contact
- **Active:** Direct interaction with target systems

Scanning Techniques:

- Port scanning for open services
- Vulnerability scanning for weaknesses
- Network mapping for topology

Access Methods:

- Password attacks (brute force, dictionary)
- Exploit vulnerabilities
- Social engineering
- Physical access

Persistence Mechanisms:

- Installing backdoors
- Creating user accounts
- Scheduling tasks
- Registry modifications

Track Covering Methods:

- Clearing system logs
- Deleting temporary files
- Modifying timestamps
- Using encryption

Mnemonic

“Reconnaissance Scans Generate Access, Maintain Coverage”

Question 4(a OR) [3 marks]

Explain any three basic commands of Kali Linux with suitable example.

Solution**Essential Kali Linux Commands:**

Command	Function	Example
nmap	Network scanning	<code>nmap -sS 192.168.1.1</code>
netcat	Network communication	<code>nc -l -p 1234</code>
hydra	Password cracking	<code>hydra -l admin -P passwords.txt ssh://target</code>

- **Nmap:** Discovers hosts and services on network
- **Netcat:** Creates network connections for data transfer
- **Hydra:** Performs brute-force password attacks

Mnemonic

“Network Map, Connect, Crack”

Question 4(b OR) [4 marks]

Describe Session Hijacking in detail.

Solution

Session Hijacking Overview: Attack where attacker takes over legitimate user's session.

Types of Session Hijacking:

Type	Method	Prevention
Active	Takes over session	Strong session management
Passive	Monitors session	Encryption (HTTPS)
Network-level	TCP hijacking	Secure protocols
Application-level	Cookie theft	Secure cookie attributes

Attack Process:

1. Monitor network traffic
2. Capture session identifiers
3. Replay session tokens
4. Access user account

Prevention Measures:

- Use HTTPS for all communications
- Implement secure session management
- Set secure cookie attributes
- Monitor for suspicious activity

Mnemonic

“Sessions Hijacked Need Secure Handling”

Question 4(c OR) [7 marks]

Explain how Virtual Private Networks (VPNs) create secure, encrypted connections over public networks.

Solution

VPN Architecture:

VPN Components:

Component	Function	Benefit
Tunneling	Creates secure pathway	Data protection
Encryption	Scrambles data	Confidentiality
Authentication	Verifies identity	Access control
IP Masking	Hides real IP	Anonymity

VPN Protocols:

Protocol	Security Level	Speed	Use Case
OpenVPN	High	Good	General purpose
IPSec	Very High	Moderate	Enterprise
WireGuard	High	Excellent	Modern solution
PPTP	Low	Fast	Legacy (deprecated)

VPN Working Process:

1. **Connection:** Client connects to VPN server
2. **Authentication:** User credentials verified
3. **Tunnel Creation:** Encrypted pathway established
4. **Data Encryption:** All traffic encrypted
5. **Routing:** Traffic routed through VPN server
6. **Decryption:** Data decrypted at destination

Security Benefits:

- **Data Protection:** Encryption prevents eavesdropping
- **Privacy:** IP address masking
- **Access Control:** Authenticate before connection
- **Bypass Restrictions:** Access geo-blocked content

Business Applications:

- Remote worker access
- Site-to-site connectivity
- Secure cloud access
- Compliance requirements

Personal Use Cases:

- Public Wi-Fi protection
- Privacy enhancement
- Content access
- Location privacy

Mnemonic

“VPNs Provide Network Privacy”

Question 5(a) [3 marks]

Explain Network forensics.

Solution

Network Forensics Definition: Investigation of network traffic to detect and analyze security incidents.

Key Components:

Component	Purpose	Tools
Traffic Capture	Record network data	Wireshark, tcpdump
Analysis	Examine patterns	NetworkMiner, Snort
Evidence	Document findings	Forensic reports

- **Scope:** Analyzes packets, flows, and network behavior
- **Objective:** Identify security breaches and attack patterns
- **Challenge:** Large data volumes and real-time processing

Mnemonic

“Network Forensics Finds Facts”

Question 5(b) [4 marks]

Explain why CCTV plays an important role as evidence in digital forensics investigations.

Solution

CCTV in Digital Forensics:

Aspect	Importance	Value
Visual Evidence	Direct observation	High credibility
Timeline	Time-stamped records	Event correlation
Digital Format	Easy to analyze	Metadata extraction
Backup	Multiple copies	Evidence preservation

Evidence Value:

- **Corroboration:** Supports other digital evidence
- **Timeline:** Establishes sequence of events
- **Identity:** May reveal perpetrator identity
- **Context:** Shows physical environment during incident

Forensic Considerations:

- **Chain of Custody:** Proper evidence handling
- **Authentication:** Verify video integrity
- **Analysis:** Enhancement and interpretation
- **Legal Admissibility:** Court-acceptable format

Mnemonic

“CCTV Captures Criminal Conduct Clearly”

Question 5(c) [7 marks]

Explain phases of Digital forensic investigation.

Solution

Digital Forensics Investigation Phases:

Detailed Phase Breakdown:

Phase	Activities	Tools	Objective
Identification	Recognize potential evidence	Visual inspection	Scope definition
Preservation	Prevent evidence contamination	Write blockers	Evidence integrity
Collection	Acquire digital evidence	Forensic imaging	Complete data capture
Examination	Extract relevant data	Autopsy, FTK	Data recovery
Analysis	Interpret findings	Timeline tools	Pattern identification
Presentation	Document results	Report generators	Legal presentation

Phase 1 - Identification:

- Survey the scene
- Identify potential evidence sources
- Document initial observations
- Establish investigation scope

Phase 2 - Preservation:

- Secure the crime scene
- Prevent evidence contamination
- Use write-protection mechanisms
- Document evidence condition

Phase 3 - Collection:

- Create forensic images
- Maintain chain of custody
- Use proper collection techniques
- Generate hash values for verification

Phase 4 - Examination:

- Extract file systems
- Recover deleted data
- Identify relevant files
- Document findings

Phase 5 - Analysis:

- Correlate evidence
- Reconstruct events
- Identify patterns
- Form conclusions

Phase 6 - Presentation:

- Prepare detailed reports
- Create visual presentations
- Explain technical findings
- Support legal proceedings

Quality Assurance:

- **Documentation:** Detailed records at each phase
- **Validation:** Verify procedures and results
- **Reproducibility:** Ensure results can be replicated
- **Legal Compliance:** Follow jurisdictional requirements

Mnemonic

“Investigators Preserve, Collect, Examine, Analyze, Present”

Question 5(a OR) [3 marks]

List applications of microcontrollers in various fields related to cybersecurity.

Solution**Microcontroller Security Applications:**

Field	Application	Security Function
IoT Security	Smart home devices	Authentication, encryption
Access Control	Key cards, biometric	Identity verification
Network Security	Hardware firewalls	Packet filtering

- **Smart Cards:** Secure authentication tokens
- **HSM (Hardware Security Modules):** Cryptographic processing
- **Embedded Systems:** Secure boot, tamper detection

Mnemonic

“Microcontrollers Manage Multiple Security Functions”

Question 5(b OR) [4 marks]

Explain the importance of port scanning in ethical hacking.

Solution

Port Scanning in Ethical Hacking:

Aspect	Importance	Benefit
Service Discovery	Identify running services	Attack surface mapping
Vulnerability Assessment	Find open ports	Security gap identification
Network Mapping	Understand topology	Infrastructure analysis
Security Testing	Validate configurations	Compliance verification

Port Scanning Techniques:

- **TCP Connect:** Full connection establishment
- **SYN Scan:** Stealth scanning method
- **UDP Scan:** User Datagram Protocol scanning
- **Service Detection:** Identify service versions

Ethical Considerations:

- **Authorization:** Obtain proper permissions
- **Scope:** Stay within defined boundaries
- **Documentation:** Record all activities
- **Reporting:** Provide detailed findings

Mnemonic

“Port Scanning Provides Security Insights”

Question 5(c OR) [7 marks]

Describe the process of conducting a vulnerability assessment using Kali Linux tools.

Solution

Vulnerability Assessment Process:

Kali Linux Tools and Commands:

Step-by-Step Process:

Step	Kali Tool	Command Example	Purpose
Reconnaissance	Nmap	nmap -sn 192.168.1.0/24	Host discovery
Port Scanning	Nmap	nmap -sS -O target	Open port identification
Service Enumeration	Nmap, Banner grabbing	nmap -sV target	Service version detection
Vulnerability Scanning	OpenVAS, Nessus	openvas-start	Automated vulnerability detection
Web Application Testing	Nikto, Dirb	nikto -h target	Web vulnerability scanning

Detailed Process:

Phase 1 - Target Identification:

- Use Nmap for network discovery
- Identify live hosts and their IP addresses
- Document network topology
- Determine target scope

Phase 2 - Port and Service Analysis:

- Perform comprehensive port scans
- Identify running services and versions
- Check for default credentials
- Analyze service configurations

Phase 3 - Automated Vulnerability Scanning:

- Configure vulnerability scanners (OpenVAS)
- Run comprehensive scans
- Analyze scan results
- Prioritize findings by severity

Phase 4 - Manual Testing:

- Verify automated findings
- Perform targeted testing
- Test for specific vulnerabilities
- Validate false positives

Phase 5 - Web Application Assessment:

- Use web vulnerability scanners
- Test for OWASP Top 10 vulnerabilities
- Analyze application logic
- Check for misconfigurations

Common Kali Tools:

Tool	Function	Use Case
Nmap	Network scanning	Port and service discovery
OpenVAS	Vulnerability scanning	Automated assessment
Nikto	Web scanning	Web server vulnerabilities
Dirb	Directory brute forcing	Hidden file discovery
SQLmap	SQL injection testing	Database vulnerabilities
Burp Suite	Web proxy	Manual web testing
Metasploit	Exploitation framework	Vulnerability validation

Assessment Methodology:

- **Scope Definition:** Clearly define assessment boundaries
- **Information Gathering:** Collect target intelligence
- **Vulnerability Detection:** Use multiple scanning methods
- **Risk Assessment:** Evaluate impact and likelihood
- **Remediation Planning:** Provide actionable recommendations

Reporting Components:

- **Executive Summary:** High-level findings for management
- **Technical Details:** Detailed vulnerability descriptions
- **Risk Ratings:** CVSS scores and business impact
- **Remediation Steps:** Specific mitigation recommendations
- **Supporting Evidence:** Screenshots and proof-of-concept

Best Practices:

- **Authorization:** Always obtain written permission
- **Documentation:** Maintain detailed logs of all activities
- **Minimal Impact:** Avoid disrupting production systems
- **Confidentiality:** Protect sensitive information discovered

Mnemonic

“Vulnerability Assessment Validates Application Security”