Subject Name Solutions

4361101 – Winter 2024

Semester 1 Study Material

Detailed Solutions and Explanations
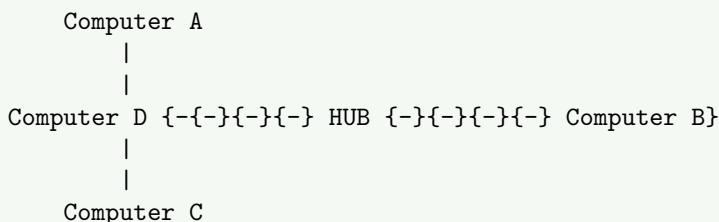
Question 1(a) [3 marks]

Explain star topology in detail.

> **Solution**
>
> Star topology connects all devices to a central hub or switch. Each device has dedicated point-to-point connection with central device.
>
> **Diagram:**
>
> ```
>      Computer A
>          |
>          |
> Computer D {-{-}{-}{-} HUB {-}{-}{-}{-} Computer B}
>          |
>          |
>      Computer C
> ```
>
> **Key Features:**
> - **Central Hub**: All connections pass through central device
> - **Dedicated Links**: Each node has separate connection
> - **Easy Management**: Simple to add/remove devices

> **Mnemonic**
>
> "Star Shines Central" - All devices connect to central point

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Question 1(b) [4 marks]

Explain client-server network.

> **Solution**
>
> Client-server is network architecture where clients request services from centralized servers. Server provides resources and services to multiple clients.
>
> Table 1: Client vs Server
>
> | Client | Server |
> |---|---|
> | Requests services | Provides services |
> | Limited resources | Powerful hardware |
> | Depends on server | Independent operation |
>
> **Key Components:**
> - **Client**: Requests data/services from server
> - **Server**: Provides centralized resources and processing
> - **Network**: Medium for communication between client-server

> **Mnemonic**
>
> "Client Calls, Server Serves"

Question 1(c) [7 marks]

Write a functional description of all layer of TCP/IP model.

Solution

TCP/IP model has four layers providing end-to-end communication over networks.

Table 2: TCP/IP Model Layers

Layer	Function	Protocols
Application	User interface, network services	HTTP, FTP, SMTP
Transport	End-to-end delivery, error control	TCP, UDP
Internet	Routing, logical addressing	IP, ICMP, ARP
Network Access	Physical transmission	Ethernet, WiFi

Layer Functions:
- **Application Layer**: Provides network services to user applications
- **Transport Layer**: Ensures reliable data delivery between processes
- **Internet Layer**: Routes packets across multiple networks using IP
- **Network Access Layer**: Handles physical transmission of data

Mnemonic

"All Transport Internet Networks" (ATIN)

Question 1(c OR) [7 marks]

Explain the functions of Data Link Layer & Network Layer of OSI reference model.

Solution

Data Link and Network layers provide reliable transmission and routing capabilities in OSI model.

Table 3: Layer Comparison

Feature	Data Link Layer	Network Layer
Main Function	Node-to-node delivery	End-to-end delivery
Addressing	MAC addresses	IP addresses
Error Control	Frame-level	Packet-level

Data Link Layer Functions:
- **Framing**: Organizes bits into frames
- **Error Control**: Detects and corrects transmission errors
- **Flow Control**: Manages data transmission rate

Network Layer Functions:
- **Routing**: Determines best path for packets
- **Logical Addressing**: Uses IP addresses for identification
- **Packet Forwarding**: Routes packets between networks

Mnemonic

"Data Links Locally, Network Routes Globally"

Question 2(a) [3 marks]

Compare repeater and hub.

Solution

Both devices amplify signals but operate differently in network architecture.

Table 4: Repeater vs Hub

Feature	Repeater	Hub
Ports	2 ports	Multiple ports
Function	Signal amplification	Signal distribution
Collision Domain	Single	Single shared

Key Differences:
- **Port Count**: Repeater has 2 ports, hub has multiple
- **Usage**: Repeater extends distance, hub connects multiple devices

Mnemonic

"Repeater Extends, Hub Connects"
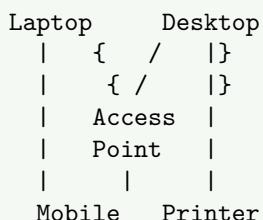
Question 2(b) [4 marks]

Explain wireless LAN.

Solution

Wireless LAN uses radio waves for network communication without physical cables.
Diagram:

```
Laptop     Desktop
   |    {   /   |}
   |     { /    |}
   |    Access  |
   |    Point   |
   |      |     |
  Mobile   Printer
```

Key Components:
- **Access Point**: Central wireless communication device
- **Wireless Clients**: Devices with WiFi capability
- **Radio Frequencies**: 2.4GHz and 5GHz bands commonly used

Advantages:
- **Mobility**: Users can move freely within coverage area
- **Easy Installation**: No physical cable installation required

Mnemonic

"Wireless Waves Connect"

Question 2(c) [7 marks]

Explain FDDI & CDDI.

Solution

FDDI and CDDI are ring-based network technologies providing high-speed data transmission.

Table 5: FDDI vs CDDI Comparison

| Feature	FDDI	CDDI
Medium	Fiber optic	Copper (UTP)
Speed	100 Mbps	100 Mbps
Distance	200 km	100 meters
Cost	High	Lower
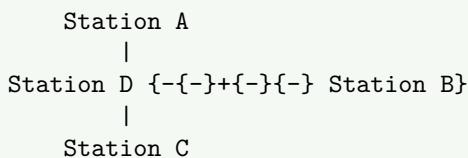
FDDI Features:
- **Dual Ring**: Primary and secondary rings for fault tolerance
- **Token Passing**: Deterministic access method
- **Self-Healing**: Automatic recovery from failures

CDDI Features:
- **Copper Medium**: Uses unshielded twisted pair cables
- **Same Protocol**: Identical to FDDI except transmission medium
- **Cost Effective**: Lower implementation cost than FDDI

Ring Structure:

```
    Station A
        |
Station D {-{-}+{-}{-} Station B}
        |
    Station C
```

Mnemonic

"FDDI Fiber Fast, CDDI Copper Cheap"

Question 2(a OR) [3 marks]

How does a firewall protect data.

Solution

Firewall acts as security barrier between trusted internal network and untrusted external networks.
Protection Methods:
- **Packet Filtering**: Examines packet headers for security rules
- **Access Control**: Blocks unauthorized access attempts
- **Traffic Monitoring**: Monitors all incoming and outgoing traffic

Mnemonic

"Firewall Filters Foes"

Question 2(b OR) [4 marks]

Explain the structure of FDDI and give its advantages.

Solution

FDDI uses dual counter-rotating rings for high-speed, fault-tolerant networking.
Structure Components:
- **Primary Ring**: Main data transmission path
- **Secondary Ring**: Backup path for fault recovery
- **Dual Attachment Stations**: Connect to both rings
- **Single Attachment Stations**: Connect to one ring only

Advantages:
- **High Speed**: 100 Mbps transmission rate

- **Fault Tolerance**: Automatic recovery using secondary ring
- **Long Distance**: Supports up to 200 km networks

Mnemonic

"FDDI Dual Rings Deliver Reliability"

Question 2(c OR) [7 marks]

Explain and distinguish Ethernet, Fast Ethernet, Gigabit Ethernet.

Solution

Evolution of Ethernet standards providing increasing bandwidth and improved performance.

Table 6: Ethernet Comparison

Feature	Ethernet	Fast Ethernet	Gigabit Ethernet
Speed	10 Mbps	100 Mbps	1000 Mbps
Standard	802.3	802.3u	802.3z/ab
Cable	Coax/UTP	UTP/Fiber	UTP/Fiber
Distance	500m (coax)	100m (UTP)	100m (UTP)

Key Differences:
- **Bandwidth**: Each generation increases speed by factor of 10
- **Media Support**: Newer standards support more cable types
- **Backward Compatibility**: Higher standards support lower speeds

Applications:
- **Ethernet**: Legacy systems, basic connectivity
- **Fast Ethernet**: Desktop connections, small networks
- **Gigabit Ethernet**: Server connections, backbone networks

Mnemonic

"Ethernet Evolves: 10-100-1000"

Question 3(a) [3 marks]

Explain types of DSL.

Solution

DSL provides high-speed internet over existing telephone lines using different frequency bands.

Table 7: DSL Types

Type	Full Form	Speed
ADSL	Asymmetric DSL	Up to 8 Mbps down
SDSL	Symmetric DSL	Equal up/down
VDSL	Very-high-bit-rate DSL	Up to 52 Mbps

Characteristics:
- **ADSL**: Different upload/download speeds for home users
- **SDSL**: Same speed both directions for business use

Question 3(b) [4 marks]

Explain ARP & RARP.

> **Solution**
>
> ARP and RARP provide address resolution between IP and MAC addresses.
>
> Table 8: ARP vs RARP
>
> | Feature | ARP | RARP |
> |---------|-----|------|
> | Purpose | IP to MAC | MAC to IP |
> | Used by | All devices | Diskless workstations |
> | Direction | Logical to Physical | Physical to Logical |
>
> **ARP Process:**
> - **Request**: Broadcast "Who has IP address X?"
> - **Reply**: Target responds with MAC address
> - **Caching**: Stores mapping in ARP table
>
> **RARP Process:**
> - **Request**: "What is my IP address?"
> - **Server Response**: RARP server provides IP address

Question 3(c) [7 marks]

Describe circuit switching and packet switching.

> **Solution**
>
> Two fundamental approaches for establishing communication paths in networks.
>
> Table 9: Circuit vs Packet Switching
>
> | Feature | Circuit Switching | Packet Switching |
> |---------|-------------------|------------------|
> | Path Setup | Dedicated path | No dedicated path |
> | Resource Usage | Reserved throughout | Shared dynamically |
> | Delay | Constant | Variable |
> | Examples | Telephone | Internet |

Circuit Switching:
- **Path Establishment**: Dedicated circuit created before communication
- **Resource Reservation**: Bandwidth reserved for entire session
- **Guaranteed Service**: Consistent performance throughout connection

Packet Switching:
- **Store and Forward**: Packets stored temporarily at intermediate nodes
- **Dynamic Routing**: Each packet can take different path
- **Resource Sharing**: Network resources shared among multiple connections

Diagram: Packet Switching

```
Source {-{-}{-} Router1 {-}{-}{-} Router2 {-}{-}{-} Destination}
    {           |           /}
     {          |          /}
      {{-}{-}{-} Router3 {-}{-}{-}/}
```

Mnemonic

"Circuit Commits, Packet Partitions"

Question 3(a OR) [3 marks]

Describe DHCP & BOOTP protocol.

Solution

Both protocols automatically assign IP addresses to network devices.

Table 10: DHCP vs BOOTP

Feature	DHCP	BOOTP
Address Type	Dynamic/Static	Static only
Lease Time	Temporary	Permanent
Configuration	Automatic	Manual setup

Functions:
- **DHCP**: Dynamic address assignment with lease management
- **BOOTP**: Bootstrap protocol for diskless workstations

Mnemonic

"DHCP Dynamic, BOOTP Bootstrap"

Question 3(b OR) [4 marks]

Explain IPv4 & IPv6 in detail.

Solution

Internet Protocol versions providing addressing and routing capabilities.

Table 11: IPv4 vs IPv6

Feature	IPv4	IPv6
Address Size	32 bits	128 bits
Address Format	Dotted decimal	Hexadecimal
Address Space	4.3 billion	340 undecillion
Header Size	20-60 bytes	40 bytes

IPv4 Features:
- **Address Format**: 192.168.1.1 (4 octets)
- **Classes**: A, B, C, D, E address classes
- **NAT Required**: Address shortage requires NAT

IPv6 Features:
- **Address Format**: 2001:db8::1 (8 groups of 4 hex digits)
- **No NAT Needed**: Abundant address space
- **Built-in Security**: IPSec support mandatory

Mnemonic

"IPv4 Four Octets, IPv6 Six-teen Bytes"
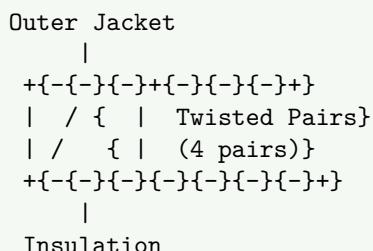
Question 3(c OR) [7 marks]

Draw and explain constructional details of twisted pair cable, coaxial cable, and fiber optic cable with label.
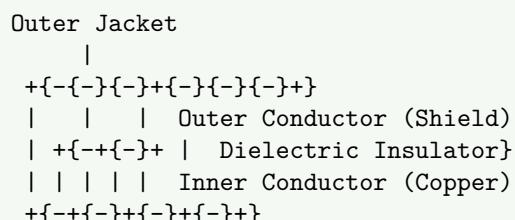
Solution

Three main types of guided transmission media with different construction and characteristics.

Twisted Pair Cable:

```
  Outer Jacket
       |
  +{-{-}{-}+{-}{-}{-}+}
  |  / {  |  Twisted Pairs}
  | /   { |  (4 pairs)}
  +{-{-}{-}{-}{-}{-}{-}+}
       |
  Insulation
```

Coaxial Cable:

```
  Outer Jacket
        |
   +{-{-}{-}+{-}{-}{-}+}
   |   |   |  Outer Conductor (Shield)
   | +{-+{-}+ |  Dielectric Insulator}
   | | | | |  Inner Conductor (Copper)
   +{-+{-}+{-}+{-}+}
```

Fiber Optic Cable:

```
  Outer Jacket
        |
   +{-{-}{-}+{-}{-}{-}+}
   |   |   |  Cladding
   | +{-+{-}+ |  Core (Glass/Plastic)}
   |   |   |  Light travels here
   +{-{-}{-}+{-}{-}{-}+}
```

Construction Details:
- **Twisted Pair**: Copper wires twisted to reduce interference
- **Coaxial**: Central conductor surrounded by dielectric and shield
- **Fiber Optic**: Glass core with cladding for total internal reflection

Characteristics:
- **Twisted Pair**: Low cost, easy installation, limited bandwidth
- **Coaxial**: Better shielding, higher bandwidth than twisted pair
- **Fiber Optic**: Highest bandwidth, immune to electromagnetic interference

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Question 4(a) [3 marks]

Name any three data link layer protocol and explain any one in detail.

> **Solution**
>
> Common data link layer protocols: HDLC, PPP, Ethernet.
> **HDLC (High-Level Data Link Control):**
> - **Frame Structure**: Flag, Address, Control, Data, FCS, Flag
> - **Error Control**: Uses sequence numbers and acknowledgments
> - **Flow Control**: Sliding window protocol for efficient transmission
>
> **Key Features:**
> - **Bit-oriented**: Works with bit streams rather than characters
> - **Full-duplex**: Simultaneous bidirectional communication

> **Mnemonic**
>
> "HDLC Handles Data Link Control"

Question 4(b) [4 marks]

Explain TCP and UDP protocol.

> **Solution**
>
> Transport layer protocols providing different levels of service reliability.
>
> Table 12: TCP vs UDP
>
> | Feature | TCP | UDP |
> |---|---|---|
> | Connection | Connection-oriented | Connectionless |
> | Reliability | Reliable | Unreliable |
> | Speed | Slower | Faster |
> | Header Size | 20+ bytes | 8 bytes |
>
> **TCP Features:**
> - **Connection Setup**: Three-way handshake establishes connection
> - **Error Recovery**: Retransmits lost packets automatically
> - **Flow Control**: Prevents sender from overwhelming receiver
>
> **UDP Features:**
> - **No Connection**: Sends data without establishing connection
> - **Best Effort**: No guarantee of delivery or order
> - **Low Overhead**: Minimal header for fast transmission

> **Mnemonic**
>
> "TCP Trustworthy, UDP Unreliable but Quick"

Question 4(c) [7 marks]

Describe VoIP with example.

Voice over Internet Protocol transmits voice communications over IP networks instead of traditional telephone systems.

VoIP Components:
- **IP Phone**: Hardware device for VoIP calls
- **Softphone**: Software application for computer-based calls
- **Gateway**: Connects VoIP to traditional phone networks
- **PBX**: Private branch exchange for business phone systems

VoIP Process:
1. **Voice Capture**: Microphone converts voice to analog signal
2. **Digitization**: ADC converts analog to digital samples
3. **Compression**: Codec compresses audio data
4. **Packetization**: Voice data divided into IP packets
5. **Transmission**: Packets sent over IP network
6. **Reconstruction**: Receiving end reassembles and plays audio

Example Applications:
- **Skype**: Consumer VoIP service for personal calls
- **WhatsApp Calling**: Mobile VoIP application
- **Business PBX**: Corporate phone systems using VoIP

Advantages:
- **Cost Effective**: Lower long-distance call costs
- **Feature Rich**: Video calling, conferencing, call forwarding
- **Scalability**: Easy to add new users

Disadvantages:
- **Internet Dependency**: Requires stable internet connection
- **Quality Issues**: May suffer from network congestion
- **Power Dependency**: Requires electricity unlike traditional phones

Mnemonic

"VoIP: Voice over Internet Protocol"

Question 4(a OR) [3 marks]

Explain DNS (Domain Name System).

Solution

DNS translates human-readable domain names into IP addresses for network communication.

DNS Components:
- **Domain Names**: Hierarchical naming system (www.example.com)
- **Name Servers**: Computers that store DNS records
- **Resolvers**: Client software that queries DNS servers

DNS Process:
1. User enters domain name in browser
2. Local resolver queries DNS server
3. DNS server returns corresponding IP address

Mnemonic

"DNS: Domain Name to IP Address"

Question 4(b OR) [4 marks]

Write a short note on DSL.

> **Solution**
>
> Digital Subscriber Line provides high-speed internet access over existing telephone infrastructure.
> **DSL Technology:**
> - **Frequency Division**: Uses higher frequencies than voice calls
> - **Simultaneous Use**: Internet and phone can work together
> - **Distance Limitation**: Performance decreases with distance from exchange
>
> **DSL Types:**
> - **ADSL**: Asymmetric speeds for residential users
> - **SDSL**: Symmetric speeds for business applications
> - **VDSL**: Very high speeds over short distances
>
> **Advantages:**
> - **Existing Infrastructure**: Uses existing telephone lines
> - **Always On**: Continuous internet connection
> - **Cost Effective**: Lower cost than dedicated lines

> **Mnemonic**
>
> "DSL: Digital Subscriber Line over Phone Lines"

Question 4(c OR) [7 marks]

Explain forum and blogs with example.

> **Solution**
>
> Online platforms for information sharing and community interaction.
>
> Table 13: Forum vs Blog
>
> | Feature | Forum | Blog |
> |---------|-------|------|
> | Structure | Discussion threads | Chronological posts |
> | Interaction | Multi-user discussions | Comments on posts |
> | Moderation | Community moderated | Author controlled |
> | Purpose | Community support | Information sharing |
>
> **Forum Characteristics:**
> - **Discussion Threads**: Topics organized by subject
> - **User Participation**: Multiple users contribute to discussions
> - **Categories**: Topics organized into different sections
> - **Moderation**: Community rules and moderators maintain order
>
> **Blog Characteristics:**
> - **Personal Publishing**: Individual or organization publishes content
> - **Chronological Order**: Posts displayed by date
> - **Comments**: Readers can respond to blog posts
> - **RSS Feeds**: Readers can subscribe to updates
>
> **Examples:**
> - **Technical Forums**: Stack Overflow for programming questions
> - **Community Forums**: Reddit for diverse topics
> - **Personal Blogs**: Individual websites sharing experiences
> - **Corporate Blogs**: Company blogs for marketing and updates
>
> **Benefits:**
> - **Knowledge Sharing**: Users share expertise and experiences
> - **Community Building**: Brings together people with common interests
> - **Problem Solving**: Forums help users find solutions
> - **Content Creation**: Blogs provide platform for publishing

> **Mnemonic**
>
> "Forums Foster Discussion, Blogs Broadcast Information"

Question 5(a) [3 marks]

Define the terms "encryption".

> **Solution**
>
> Encryption converts plaintext data into ciphertext to protect information from unauthorized access.
> **Encryption Process:**
> - **Plaintext**: Original readable data
> - **Algorithm**: Mathematical process for transformation
> - **Key**: Secret parameter used in encryption algorithm
> - **Ciphertext**: Encrypted unreadable data
>
> **Purpose:**
> - **Confidentiality**: Prevents unauthorized data access
> - **Data Protection**: Secures sensitive information during transmission

> **Mnemonic**
>
> "Encryption: Plain to Cipher with Key"

Question 5(b) [4 marks]

Explain any two of following: (1) WWW (2) FTP (3) SMTP

> **Solution**
>
> **WWW (World Wide Web):**
> - **Hypertext System**: Documents linked through hyperlinks
> - **HTTP Protocol**: HyperText Transfer Protocol for web communication
> - **Web Browser**: Client software for accessing web pages
> - **Web Server**: Hosts websites and serves web pages
>
> **FTP (File Transfer Protocol):**
> - **File Transfer**: Protocol for transferring files between computers
> - **Client-Server**: FTP client connects to FTP server
> - **Two Modes**: Active and passive modes for data transfer
> - **Authentication**: Username and password for access control
>
> **Features:**
> - **WWW**: Graphical interface, multimedia support, hyperlinks
> - **FTP**: Large file transfer, directory navigation, resume capability

> **Mnemonic**
>
> "WWW: Web World Wide, FTP: File Transfer Protocol"

Question 5(c) [7 marks]

Difference between symmetric and asymmetric encryption algorithms

> **Solution**
>
> Two fundamental approaches to cryptographic key management with different characteristics.
>
> Table 14: Symmetric vs Asymmetric Encryption
>
> | Feature | Symmetric | Asymmetric |
> |---------|-----------|------------|
> | Keys | Single shared key | Key pair (public/private) |

Speed	Fast	Slower
Key Distribution	Difficult	Easier
Key Management	Complex for large groups	Simpler
Examples	AES, DES	RSA, ECC

Symmetric Encryption:
- **Single Key**: Same key used for encryption and decryption
- **Speed**: Fast processing due to simple algorithms
- **Key Sharing Problem**: Secure key distribution challenge
- **Session Keys**: Often used for bulk data encryption

Asymmetric Encryption:
- **Key Pair**: Public key for encryption, private key for decryption
- **Digital Signatures**: Private key signs, public key verifies
- **Key Exchange**: Solves key distribution problem
- **Computationally Intensive**: Slower than symmetric encryption

Usage Scenarios:
- **Symmetric**: Bulk data encryption, secure communications
- **Asymmetric**: Key exchange, digital signatures, authentication

Hybrid Approach:
- **Best of Both**: Asymmetric for key exchange, symmetric for data
- **SSL/TLS**: Uses both types for secure web communications

Security Considerations:
- **Symmetric**: Key compromise affects all communications
- **Asymmetric**: Private key compromise affects only one party

Mnemonic

"Symmetric Single Key, Asymmetric Key Pair"

Question 5(a OR) [3 marks]

Write brief note on Cyber Security.

Solution

Cyber security protects digital systems, networks, and data from digital attacks and unauthorized access.
Key Components:
- **Network Security**: Protects network infrastructure from intrusions
- **Data Protection**: Safeguards sensitive information from theft
- **Application Security**: Secures software applications from vulnerabilities

Common Threats:
- **Malware**: Viruses, worms, trojans that damage systems
- **Phishing**: Fraudulent attempts to steal credentials

Mnemonic

"Cyber Security: Protect Digital Assets"

Question 5(b OR) [4 marks]

Explain hacking and its precautions.

Solution

Hacking involves unauthorized access to computer systems, often with malicious intent.
Types of Hacking:
- **White Hat**: Ethical hacking for security testing

- **Black Hat**: Malicious hacking for illegal purposes
- **Gray Hat**: Between ethical and malicious hacking

Common Hacking Methods:
- **Password Attacks**: Brute force, dictionary attacks
- **Social Engineering**: Manipulating people to reveal information
- **Malware**: Viruses, trojans, ransomware
- **Network Attacks**: Man-in-the-middle, packet sniffing

Precautions:
- **Strong Passwords**: Complex, unique passwords for all accounts
- **Regular Updates**: Keep software and systems updated
- **Firewall**: Use firewall to block unauthorized access
- **Antivirus**: Install and update antivirus software regularly

Mnemonic

"Hacking Hurts, Precautions Protect"

Question 5(c OR) [7 marks]

Briefly describe the Information Technology (Amendment) Act, 2008, and its impact on cyber laws in India.

Solution

The IT Amendment Act 2008 significantly strengthened India's cyber law framework and expanded the scope of cybercrime legislation.

Key Amendments:
- **Data Protection**: Enhanced provisions for protecting sensitive personal data
- **Cybercrime Definitions**: Expanded definitions of cybercrime including identity theft
- **Penalties**: Increased penalties for various cyber offenses
- **Cyber Terrorism**: Introduced provisions to deal with cyber terrorism

Major Provisions:
- **Section 43A**: Data protection and compensation for negligence
- **Section 66A**: Punishment for offensive messages (later struck down)
- **Section 66C**: Identity theft punishment
- **Section 66D**: Cheating by personation using computer resource

Impact on Cyber Laws:
- **Legal Framework**: Provided comprehensive legal framework for cybercrime
- **Business Compliance**: Mandated data protection measures for businesses
- **Law Enforcement**: Empowered authorities with investigation tools
- **International Cooperation**: Facilitated cooperation in cybercrime investigation

Regulatory Bodies:
- **CERT-In**: Computer Emergency Response Team for incident response
- **Cyber Cells**: Specialized police units for cybercrime investigation
- **Adjudicating Officers**: For compensation and penalty determination

Data Protection Requirements:
- **Reasonable Security**: Companies must implement reasonable security practices
- **Breach Notification**: Mandatory reporting of data breaches
- **Compensation**: Victims can claim compensation for data breaches

Challenges and Criticisms:
- **Implementation**: Difficulty in implementation across diverse digital landscape
- **Jurisdiction**: Cross-border cybercrime investigation challenges
- **Technology Gap**: Keeping pace with rapidly evolving technology

Recent Developments:
- **Digital India**: Integration with Digital India initiatives
- **Privacy Laws**: Preparation for comprehensive data protection legislation
- **Emerging Technologies**: Addressing challenges from AI, IoT, blockchain