**UNIT 1**

1. **Wireless Sensor Networks (WSNs):**
   1. **Concept in WSN:**
      1. Sensor Nodes
      2. Communication
      3. Data Aggregation
      4. Routing.
      5. Energy Efficiency
      6. Security
      7. Localization
   2. **Architectures in WSNs:**
      1. Flat Architecture
      2. Hierarchical Architecture.
      3. Multihop Architecture.
      4. Cluster-based Architecture.
   3. **Application:**
      1. Military and Defense.
      2. Environmental Monitoring.
   4. **Design Challenges:**
      1. Limited Resources
      2. Dynamic Network Topology.
      3. Energy Efficiency
      4. Security and Privacy.
      5. Scalability
      6. Quality of Service (QoS).
2. **Wireless Networks:**
3. **Issues in Adhoc wireless networks:**
   * 1. Routing and Connectivity.
     2. Resources Constraints.
     3. Security and Privacy.
4. **Routing Protocol for Ad Hoc Wireless Networks:**
   1. **Type**
      1. Proactive (Table-Driven) Protocols.
      2. Reactive (On-Demand) Protocols.
      3. Hybrid Protocols.
5. **Classification of Routing Protocols:**
   1. Interior Gateway Protocols (IGPs) and Exterior Gateway Protocol (EGPs).
   2. Distance-Vector Protocols and Link-State Protocols.
   3. Static Routing and Dynamic Routing.
6. **Table Driven Routing Protocols.**
   1. **Type:**
      1. Open Shortest Path First (OSPF).
      2. Intermediate System to Intermediate System (IS-IS).
      3. Border Gateways Protocols (BGP).
7. **Destination Sequenced Distance Vector (DSDV):**
8. **On Demand Routing Protocols:**
   1. **Types**
      1. Adhoc On-Demand Distance Vector (AODV).
      2. Dynamic Source Routing (DSR).
      3. Temporally Ordered Routing Algorithm (TORA).
      4. Dynamic MANET On-demand (DYMO).

**UNIT 2**

* + - 1. **WSN NETWORKING CONCEPT.**
      2. **Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks:**
         1. **Several Key Issues:**

Channel Access

Energy Efficiency

Scalability

Quality of Services (QoS)

Security

* + - 1. **Design Goals of a MAC Protocol for Ad Hoc Wireless Networks**
         1. **Goals:**

Efficient Utilization of Resources.

Collision Avoidance.

Latency Reduction.

Energy Efficiency.

Scalability.

* + - 1. **MAC Protocols for Wireless Sensor Networks.**
         1. **Types:**

TDMA (Time Division Multiple Access)

Carrier Sense Multiple Access.

Multiple Access with Collision Avoidance.

SMAC (Sensor-MAC)

B-MAC (Berkeley-MAC):

* + - 1. **Low duty cycle Protocols and Wakeup concepts.**
         1. **Low duty cycle protocols.**

LPL (Low Power Listening).

TDMA (Time Division Multiple Access).

* + - * 1. **Wakeup concepts.**

Scheduled Wakeup.

* + - 1. **Classification of MAC Protocols.**
         1. **Type:**

**contention-based protocols without reservation/scheduling-**

**Sender-initiated protocols.**

**Receiver-initiated protocols.**

**Contention-based protocols with reservations mechanism.**

**Synchronous protocols.**

**Asynchronous protocols.**

* + - 1. **S-MAC (Sensor Medium Access Control)**
      2. **Contention Based protocols.**
         1. **Type:**

1. Carrier Sense Multiple Access with Collision Detection (CSMA/CD):

2. Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA):

Random Access Protocols:

* + - 1. **PAMAS schedule-based protocols:**
      2. **LEACH**
      3. **IEEE 802.15.4. MAC protocols:**
         1. **Type:**

Beacon-Enabled Mode

Non-Beacon-Enabled Mode.

* + - 1. **Energy efficient routing challenges and issues in transport layer.**

**UNIT 3**

**Routing Protocol.**

**Issues in Designing routing Protocol:**

* 1. **Issues:**

Energy Efficiency.

Scalability

Dynamic Networks Topology.

Quality of Service.

Security

1. **Classification**
   1. **Type:**
2. Reactive Routing Protocols.
   1. DSDV
   2. OLSR
3. Proactive Routing Protocols.
   1. AODV
   2. DSR (Dynamic Source Routing).
4. Hybrid Routing Protocols.
   1. ZRP (Zone Routing Protocols.
5. **Transport Layer protocol for Ad hoc networks:**
   1. **Type:**

User Datagram Protocol (UDP).

Transmission Control Protocols.

* 1. **Desigen goal for Tarnsaport Layer.**

Adaptability to Dynamic Changes.

Robustness and Reliability.

Efficient Congestion Control.

Energy Efficiency.

Quality of Services Support.

Security Enhancement.

1. **Classification of Transport Layer Solutions**

**Type: :** Based on Underlying Protocol.

UDP-Based Protocols.

TCP -Based Protocols.

Based on Functionality and Features.

Reliability Data Delivery Solution.

Real-time Communication solution.

1. **TCP over Adhoc Wireless.**
   1. **Type:**

Some of the key challenges

Dynamic Network Topology

Limited Bandwidth and Resources

Packet Loss and Link Instability

Enhanced TCP.

Adaptive Congestion Control Schemes:

Cross-layer Interactions

Hybrid or Multipath TCP:

**UNIT 4**

* + 1. **Challenges for Wireless Sensor Networks:**

Limited Energy Resources.

Limited Processing and Memory Capabilities.

Communication Reliability and Scalability.

Security and Privacy Concerns.

Fault Tolerance and Resilience.

Quality of Service (QoS) Provisioning.

* + 1. **Enabling Technologies for Wireless Sensor Networks.**
* **Wireless Communication Technologies:**

**Bluetooth**

**Zigbee**

* **Energy Harvesting Techniques.**

Solar Energy Harvesting.

Vibration Energy Harvesting**.**

* **Sensor Technologies.**

**Temperatures Sensors.**

**Pressures Sensor.**

* + 1. **WSN application examples:**

Environment Monitoring.

Healthcare Automation and Smart Buildings.

Structural Health Monitoring.

Military and Defense Application.

* + 1. **Single-Node Architecture.**
* **Component:**

**Controller.**

**Memory.**

**Sensor**

**Actuators.**

**Communication Devices.**

**Power Supply**

* **Hardware Components:**

**Se**nsor Nodes.

Radio Transceivers.

Power Sources and Management Units.

Processing Unit and Memory.

Sensor and Actuators.

Antennas.

* + 1. **Networks Architectures.**
* **Types:**

Client-server Architectures.

Peer-to-peer (P2P Architectures.

Centralized Architectures.

Distributed Architectures.

Hybrid Architecture

* + 1. **Sensor Network Scenarios.**
* **common sensor network scenarios**

1. Environmental Monitoring.
2. Healthcare and Biomedical Application.
3. Home Automation and Internet of Things (IoT).
4. Traffic Monitoring and Management.
   * 1. **Transceiver Design Considerations.**

* **Design Consideration:**

1. Frequency Band and Spectrum.
2. Data Rate and Throughput.
3. Power Consumption and Efficiency.
4. Antenna Design and Integrations.
5. Noise and Privacy Features.
6. Size, Weight and From Factors.
7. Cost and Manufacturability.

**UNIT 5**

* + - 1. **Security in Ad Hoc Wireless Networks.**
* **key security considerations**

1. Authentication and Access Control.
2. Data Encryption.
3. Instruction Detection and Prevention.
4. Secure Routing Protocols.
5. Key Management.
6. Firewall and Filtering.
7. Instruction Repones and Recovery.
   * + 1. **Network Security Requirements.**

* **Key network security requirements include**

1. Access Control.
2. Data Confidentiality.
3. Integrity Assurance.
4. Availability Management.
5. Authentication and Identity Management.
6. Networks Monitoring and Surveillance.
7. Security Policy Enforcement.
   * + 1. **Security Attacks**

* **Types:**

1. Malware Attacks
2. Phishing Attacks
3. Dos Attack
4. SQL Injection Attacks.
   * + 1. **Layer wise attack in wireless sensor networks**

* **Type:**

1. Physical layer Attack
2. Data Link Layer attack
3. Networks Layer Attacks.
4. Transport Layer Attack.
5. Application Layer Attacks.
   * + 1. **Possible solutions for Jamming**

* **Type:**

1. Frequency Hopping Spread Spectrum.
2. Spread Spectrum Technique.
3. Power Control Mechanisms.
   * + 1. **Flooding attack.**

* **Type:**

1. Ping Flood.
2. SYN Flood
3. UDP Flood.
4. ICMP Flood.
   * + 1. **Key Distribution Management.**

* **Types:**

1. Symmetric and Asymmetric Encryption.
2. Key Rotation and Renewal.
3. Multi-factor Authentication (MFA).
4. Digital Signatures and Certificates.
   * + 1. **Secure Routing- SPINS reliability requirements in Sensor Networks.**

* **Type:**

1. Data Authentication.
2. Data Freshness.
3. Data Confidentiality.
4. Node Authentication.
5. Secure Keys Establish**.**
   * + 1. **Sensor Networks Platform and Tools.**

* **Type:**

1. TinyOS
2. Contiki
3. RIOT OS.
4. Cooja Simulator.
5. OMNeT++
6. MATLAB/Simulink.
7. Wireless Sensor Networks Development Kits.
8. WSN Monitoring Tools.