SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

VI SEMESTER

PEC504 – WIRELESS SENSOR NETWORK DESIGN

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PEC504 – WIRELESS SENSOR NETWORK DESIGN

UNIT-I : APPLICATION LAYER PROTOCOL

Principles of Wireless Sensor Network - Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards- IEEE 802.15.4, Zig bee and Bluetooth. Physical layer and transceiver design considerations.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	State the principle of WSN and mention the three components of it.	CO1	BTL 1	Remembering
2.	List the challenges of designing and deploying in WSNs.	CO1	BTL 1	Remembering
3.	Compare the Ad-hoc networks with WSN.	CO1	BTL 2	Understanding
4.	Draw the architecture of sensor node.	CO1	BTL 1	Remembering
5.	Differentiate between active and passive Sensors.	CO1	BTL 2	Understanding
6.	What is a wireless sensor network?	CO1	BTL 1	Remembering
7.	Illustrate the characteristic requirements of a wireless sensor network.	CO1	BTL 2	Understanding
8.	Summarize the characteristics of gateway.	CO1	BTL 2	Understanding
9.	Define Zigbee.	CO1	BTL 1	Remembering
10.	Compare single hop with multiple hops.	CO1	BTL 2	Understanding
11.	List various modes of a sensor node.	CO1	BTL 1	Remembering
12.	Name the hardware components of a wireless sensor network.	CO1	BTL 1	Remembering
13.	Compare Zigbee and Bluetooth for WSN applications.	CO1	BTL 2	Understanding
14.	Write about the star topology support in Zigbee.	CO1	BTL 1	Remembering
15.	Mention two optimization goals in WSN design principles.	CO1	BTL 2	Understanding
16.	Draw and label the basic architecture of a WSN node.	CO1	BTL 1	Remembering
17.	Differentiate WSN and ad hoc networks based on application focus.	CO1	BTL 2	Understanding
18.	List the key features of IEEE 802.15.4 standard.	CO1	BTL 1	Remembering
19.	Mention the frequency bands used in IEEE 802.15.4.	CO1	BTL 2	Understanding

20.	List four physical layer design considerations for WSN transceivers.		CO1	BTL 1	Remembering
21.	Name the main topological difference between WSN and ad hoc networks.		CO1	BTL 1	Remembering
22.	What is meant by node failure challenge in WSN?		CO1	BTL 2	Understanding
23.	Compare WSN and MANET in terms of energy management		CO1	BTL 2	Remembering
24.	Outline the gateway concept in WSN.		CO1	BTL 2	Understanding
	PART B				
1.	Describe in detail about Node Architecture WSN.	(16)	CO1	BTL 4	Analyzing
2.	Explain in detail about Network Architecture of WSN.	(16)	CO1	BTL 4	Analyzing
3.	Elaborate the physical layer and transceiver considerations of WSN.	(16)	CO1	BTL 3	Applying
4.	Explain in detail about the concept of Gateway with relevant diagrams.	(16)	CO1	BTL 4	Analyzing
5.	Enumerate the following:- i) Design Principles Service interfaces ii) Node Architecture	(16)	CO1	BTL 3	Applying
6.	Explain the key features of IEEE 802.15.4 in detail and mention its tole in wireless sensor networks.	(16)	CO1	BTL 4	Analyzing
7.	Explain the following: i) Zigbee Bluetooth ii) IEEE 802.15.4	 (8) (8)	CO1	BTL 4	Analyzing
8.	How do factors such as energy efficiency, scalability, and reliability pose challenges in the design and deployment of wireless sensor networks?	(16)	CO1	BTL 3	Applying
9.	What is a routing protocol? Describe the issues in designing a routing protocols or ad hoc wireless networks.	(16)	CO1	BTL 3	Applying
10.	Summarize the major challenges in WSN deployment and compare their impact on network lifetime versus traditional wireless networks.	(16)	CO1	BTL 3	Applying
11.	Examine the node architecture components and analyze how each contributes to overall power efficiency in WSN.	(16)	CO1	BTL 4	Analyzing
12.	Design and apply a sensor node architecture for underwaterWSN, specifying components and power management.	(16)	CO1	BTL 3	Applying
13.	Compare and analyze design principles of WSN with those of ad hoc networks, highlighting optimization trade-offs.	(16)	CO1	BTL 4	Analyzing

14.	Examine IEEE 802.15.4, Zigbee, and Bluetooth standards; analyze their strengths/weaknesses for WSN applications.	(16)	CO1	BTL 3	Applying
15.	Analyze physical layer design considerations and their influence on transceiver performance in resource-limited WSN nodes.	(16)	CO1	BTL 4	Analyzing
16.	Compare Bluetooth and Zigbee; apply the better standard to a wearable health monitoring WSN case study.	(16)	CO1	BTL 3	Applying
17.	Analyze physical layer design trade-offs (data rate vs. range vs. power vs. robustness) for different frequency bands. Evaluate impact of multipath fading, interference, and duty cycling on transceiver architecture.	(16)	CO1	BTL 4	Analyzing

UNIT-II : MAC AND ROUTING PROTOCOLS

MAC protocols – low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define low duty cycle protocols.	CO2	BTL 1	Remembering
2.	Mention the categories of low duty cycle protocols.	CO2	BTL 2	Understanding
3.	What are contention-based MAC protocols?	CO2	BTL 1	Remembering
4.	Mention the primary characteristic of B-MAC.	CO2	BTL 2	Understanding
5.	Differentiate between S-MAC and B-MAC in terms of performance.	CO2	BTL 2	Understanding
6.	What are schedule-based MAC protocols?	CO2	BTL 1	Remembering
7.	Identify the drawbacks of schedule-based approaches.	CO2	BTL 2	Understanding
8.	What is SMAC?	CO2	BTL 1	Remembering
9.	How SMAC does minimizes energy consumption?	CO2	BTL 2	Understanding
10.	Define BMAC.	CO2	BTL 1	Remembering
11.	Expand the acronym TRAMA.	CO2	BTL 2	Understanding
12.	Mention the key requirement of TRAMA.	CO2	BTL 2	Understanding

13.	List the three message types used in SPIN.	CO2	BTL 1	Remembering
14.	What is the ACQUIRE protocol?	CO2	BTL 1	Remembering
15.	What is LEACH?	CO2	BTL 1	Remembering
16.	Summarize the features of PEGASIS.	CO2	BTL 2	Understanding
17.	List any four requirements for routing protocols in WSN.	CO2	BTL 1	Remembering
18.	Why energy efficiency is critical in WSN routing protocols?	CO2	BTL 2	Understanding
19.	What is the role of leader node in PEGASIS?	CO2	BTL 1	Remembering
20.	State two benefits of PEGASIS compared to LEACH.	CO2	BTL 1	Remembering
21.	What is the limitation of LEACH protocol?	CO2	BTL 1	Remembering
22.	How does query forwarding work in ACQUIRE?	CO2	BTL 2	Understanding
23.	Write about Directed Diffusion routing protocol.	CO2	BTL 2	Understanding
24.	What is gradient reinforcement in the context of Directed Diffusion?	CO2	BTL 2	Understanding

PART B

1.	Explain the concept of wakeup radios, compare them with traditional duty cycling, and analyze their advantages and disadvantages in dense networks.	(16)	CO2	BTL 4	Analyzing
2.	Explain the fundamental concept of Low Duty Cycle protocols in wireless sensor networks and how the "Listen/Sleep" cycle helps in energy conservation.	(16)	CO2	BTL 4	Analyzing
3.	Compare contention based and schedule based MAC protocols with respect to energy efficiency, delay, scalability, and robustness to topology changes. Analyze for low load and high load conditions separately.	(16)	CO2	BTL 3	Applying
4.	(i)Explain the working of S-MAC in detail. (ii)How does S-MAC handle periodic sleep, neighbor synchronization, and collision avoidance?	(8) (8)	CO2	BTL 3	Applying
5.	Analyze the limitations of using fixed duty cycle in S-MAC in highly variable traffic conditions and suggest modifications to improve performance.	(16)	CO2	BTL 4	Analyzing
6.	Describe the principle of low-power listening in B-MAC and illustrate with a timing diagram how a sender transmits a long	(16)	CO2	BTL 3	Applying

	preamble and how a receiver detects it for a given check interval and traffic rate.				
7.	Analyze how B-MAC behaves under network congestion and explain the effects of long preambles and CSMA mechanism on collisions, channel utilization, and fairness.	(16)	CO2	BTL 4	Analyzing
8.	Compare TRAMA with a contention-based MAC for high traffic sensor applications. Analyze conditions under which TRAMA clearly outperforms the contention-based approach and where it may be less attractive.	(16)	CO2	BTL 4	Analyzing
9.	List and explain the main requirements of routing protocols in wireless sensor networks. For each requirement, give a brief example scenario where it becomes critical.	(16)	CO2	BTL 3	Applying
10.	Explain the operation of SPIN with the help of ADV, REQ, and DATA messages. Illustrate the dissemination of a single data item in a network of 5 nodes using a sequence diagram	(16)	CO2	BTL 3	Applying
11.	Compare SPIN with flooding and Directed Diffusion in terms of energy efficiency, redundancy control, and scalability.	(16)	CO2	BTL 4	Analyzing
12.	Describe the phases of Directed Diffusion: interest propagation, gradient setup, data delivery, and reinforcement.	(16)	CO2	BTL 3	Applying
13.	Explain the basic idea of COUGAR, treating the sensor network as a distributed database and show how, using an example query, how data is processed and aggregated before reaching the sink.	(16)	CO2	BTL 3	Applying
14.	Discuss the challenges COUGAR faces when dealing with changing network topologies and dynamic queries. Analyze how these challenges affect scalability and consistency.	(16)	CO2	BTL 4	Analyzing
15.	Explain the ACQUIRE (Active Querying in Sensor Networks) protocol. How does it use look-ahead parameters to resolve complex queries?	(16)	CO2	BTL 3	Applying
16.	Explain the complete operation of LEACH in one round: cluster head selection, cluster formation, schedule creation, and data transmission to the base station. Illustrate with a neat diagram for 8–10 nodes.	(16)	CO2	BTL 3	Applying
17.	Describe the operation of PEGASIS. For a linear arrangement of nodes, show how the chain is formed, how token passing works, and how data is aggregated and sent to the base station in one	(16)	CO2	BTL 4	Analyzing

	round.				

UNIT-III : APPLICATION LAYER PROTOCOL

Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	List any four design considerations for IoT application layer protocols.	CO4	BTL 1	Remembering
2.	What are the main constraints of resource-limited devices that affect application protocol design?	CO4	BTL 1	Remembering
3.	Why is energy efficiency critical in IoT application protocol design?	CO4	BTL 2	Understanding
4.	Define the Request-Response communication model.	CO4	BTL 1	Remembering
5.	What is a broker in the publish-subscribe model?	CO4	BTL 1	Remembering
6.	Illustrate the QoS (Quality of Service) levels in messaging protocols.	CO4	BTL 2	Understanding
7.	Interpret the Web Service paradigm.	CO4	BTL 2	Understanding
8.	Summarize the features of RESTful web services.	CO4	BTL 2	Understanding
9.	Illustrate the primary principle of REST.	CO4	BTL 2	Understanding
10.	Define CoAP (Constrained Application Protocol).	CO4	BTL 1	Remembering
11.	Differentiate between CoAP and HTTP.	CO4	BTL 2	Understanding
12.	Outline the characteristics of MQTT-S (MQTT for Sensor Networks).	CO4	BTL 2	Understanding
13.	Name the three QoS levels in MQTT.	CO4	BTL 1	Remembering
14.	Differentiate between MQTT and MQTT-S.	CO4	BTL 2	Understanding
15.	Mention the significance of ZigBee Compact Application Protocol.	CO4	BTL 2	Understanding
16.	What is service discovery in IoT networks?	CO4	BTL 1	Remembering
17.	Name two service discovery protocols used in IoT.	CO4	BTL 1	Remembering
18.	Interpret the primary purpose of SNMP.	CO4	BTL 2	Understanding

19.	Write about the three versions of SNMP.		CO4	BTL 1	Remembering
20.	What is an SNMP agent?		CO4	BTL 1	Remembering
21.	Define SIP (Session Initiation Protocol).		CO4	BTL 1	Remembering
22.	Illustrate the purpose of RTCP (RTP Control Protocol).		CO4	BTL 2	Understanding
23.	Name two industry-specific IoT protocols.		CO4	BTL 1	Remembering
24.	Mention the purpose of Modbus protocol.		CO4	BTL 2	Understanding
	PART B				
1.	Elaborate the major design issues and challenges in developing application layer protocols for IoT system	(16)	CO4	BTL 4	Analyzing
2.	Analyze the challenges in designing protocols for resource-constrained sensor networks.	(16)	CO4	BTL 4	Analyzing
3.	Describe operational principles, client-server architecture, and connection of the End-to-End protocol.	(16)	CO4	BTL 3	Applying
4.	Elaborate on the publish/subscribe communication concept with architecture, working, and advantages.	(16)	CO4	BTL 4	Analyzing
5.	Explain real-time streaming protocols and their requirements in IoT applications.	(16)	CO4	BTL 3	Applying
6.	Compare and contrast SOAP-based web services and RESTful web services for IoT applications.	(16)	CO4	BTL 4	Analyzing
7.	Analyze the CoAP's two-layer architecture, reliability mechanisms, and how it operates over UDP.	(16)	CO4	BTL 4	Analyzing
8.	(i) Write a brief note on the MQ Telemetry Transport for Sensor Networks (MQTT-S) protocol. (ii) Discuss its architecture, message types, and advantages for sensor networks.	(8) (8)	CO4	BTL 3	Applying
9.	Analyze the QoS levels in MQTT-S and explain how reliability is achieved in sensor networks.	(16)	CO4	BTL 3	Applying
10.	Explain the design objectives of ZigBee Compact Application Protocol (CAP).	(16)	CO4	BTL 3	Applying
11.	(i)Provide a detailed explanation of service discovery mechanisms in IoT networks. (ii)Explain service announcement, query, and response mechanisms in a sensor network.	(8) (8)	CO4	BTL 4	Analyzing
12.	Describe the Simple Network Management Protocol (SNMP) and explain its architecture, components, and operations.	(16)	CO4	BTL 3	Applying
13.	Explain the Management Information Base (MIB) structure and design in SNMP.	(16)	CO4	BTL 4	Analyzing
14.	Summarize the features of the Real-Time Transport Protocol (RTP) and RTP Control Protocol (RTCP) in detail.	(16)	CO4	BTL 3	Applying
15.	How the Session Initiation Protocol (SIP) and Real-Time Streaming Protocol (RTSP) are used in the IoT applications?	(16)	CO4	BTL 4	Analyzing

16.	Illustrate how the real-time transport protocols and session management are used in IoT and multimedia applications.	(16)	CO4	BTL 3	Applying
17.	Analyze the role of industry-specific communication protocols in enabling reliable and secure Industrial IoT (IIoT) systems.	(16)	CO4	BTL 4	Analyzing

UNIT-IV: 6LOWPAN

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh-Under – Route Over, Header Compression - Stateless header compression - Context based header compression, Fragmentation and Reassembly, Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing

PART A

Q.No	Questions	CO	BT Level	Competence
1.	What does 6LoWPAN stand for and mention its primary purpose.	CO3	BTL 1	Remembering
2.	List the four main layers in the 6LoWPAN protocol stack.	CO3	BTL 1	Remembering
3.	Illustrate the role of the 6LoWPAN adaptation layer.	CO3	BTL 2	Understanding
4.	Name the two types of 6LoWPAN nodes in a network architecture.	CO3	BTL 1	Remembering
5.	Interpret the function of an edge router in 6LoWPAN networks.	CO3	BTL 2	Understanding
6.	Mention the significance of the PAN ID in 6LoWPAN addressing.	CO3	BTL 2	Understanding
7.	Define unicast and multicast addressing in 6LoWPAN context.	CO3	BTL 1	Remembering
8.	Differentiate between Mesh-Under and Route-Over routing approaches.	CO3	BTL 2	Understanding
9.	Why is header compression necessary in 6LoWPAN networks?	CO3	BTL 2	Understanding
10.	Define LOWPAN_IPHC (IP Header Compression).	CO3	BTL 1	Remembering
11.	What is the difference between stateless and stateful header compression?	CO3	BTL 1	Remembering
12.	Illustrate the term "context" in context-based header compression.	CO3	BTL 2	Understanding
13.	Why is fragmentation required in 6LoWPAN?	CO3	BTL 1	Remembering
14.	List the types of fragmentation headers defined in 6LoWPAN.	CO3	BTL 1	Remembering
15.	Mention the use of datagram tag field in 6LoWPAN fragmentation.	CO3	BTL 2	Understanding
16.	Classify the types of mobility supported in 6LoWPAN networks.	CO3	BTL 2	Understanding

17.	Define handover in mobile 6LoWPAN networks.		CO3	BTL 1	Remembering
18.	Identify the role of a Home Agent in Mobile IPv6.		CO3	BTL 2	Understanding
19.	What is a Care-of Address (CoA)?		CO3	BTL 1	Remembering
20.	Outline the main advantage of Proxy Mobile IPv6 over standard MIPv6?		CO3	BTL 2	Understanding
21.	Interpret what does NEMO stand for in mobile IPv6 context.		CO3	BTL 2	Understanding
22.	Differentiate the proactive routing and reactive routing.		CO3	BTL 2	Understanding
23.	What is upward routing and downward routing in RPL?		CO3	BTL 1	Remembering
24.	List two main functions of a border router in 6LoWPAN networks.		CO3	BTL 1	Remembering
	PART B				
1.	Explain the 6LoWPAN architecture and protocol stack with a neat diagram.	(16)	CO3	BTL 3	Applying
2.	Describe the 6LoWPAN adaptation layer and explain its position in the protocol stack and its key functions.	(16)	CO3	BTL 3	Applying
3.	Analyze the addressing mechanisms in 6LoWPAN networks in detail.	(16)	CO3	BTL 4	Analyzing
4.	(i)Describe the address autoconfiguration process in 6LoWPAN networks. (ii)Mention the challenges and solutions specific to low-power wireless networks.	(8) (8)	CO3	BTL 3	Applying
5.	Compare and contrast Mesh-Under and Route-Over routing approaches in 6LoWPAN.	(16)	CO3	BTL 4	Analyzing
6.	Summarize the routing mechanism of Mesh-Under routing and explain how it operates at the link layer.	(16)	CO3	BTL 3	Applying
7.	Explain stateless header compression in detail and its encoding mechanisms.	(16)	CO3	BTL 4	Analyzing
8.	Describe context-based header compression (LOWPAN_IPHC).	(16)	CO3	BTL 4	Analyzing
9.	Illustrate the fragmentation and reassembly mechanism in 6LoWPAN in detail.	(16)	CO3	BTL 3	Applying
10.	Explain Mobile IPv6 (MIPv6) and its adaptation for 6LoWPAN networks.	(16)	CO3	BTL 3	Applying
11.	(i)Describe the Network Mobility (NEMO) and its relevance to 6LoWPAN. (ii)Analyze the scenarios where network mobility is required and challenges in implementing NEMO for low-power devices.	(8) (8)	CO3	BTL 4	Analyzing
12.	Explain the role of Proxy Home Agent and NEMO in supporting network mobility.	(16)	CO3	BTL 3	Applying
13.	Analyze the MANET (Mobile Ad-hoc Network) routing protocols and their applicability to 6LoWPAN networks.	(16)	CO3	BTL 4	Analyzing

14.	Illustrate the significant features of on-demand and table-driven routing protocols in MANETs.	(16)	CO3	BTL 3	Applying
15.	Elaborate about Routing Over Low-Power and Lossy Networks formation and the routing requirements.	(16)	CO3	BTL 4	Analyzing
16.	Describe the primary purpose of RPL and explain the control messages used in it.	(16)	CO3	BTL 4	Analyzing
17.	Explain the concept of border routing in 6LoWPAN and its importance in IoT networks.	(16)	CO3	BTL 3	Applying

UNIT-V : TOOLS

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming

PART A

Q.No	Questions	CO	BT Level	Competence
1.	List the challenges of sensor network programming.	CO5	BTL 1	Remembering
2.	How does TinyOS support Berkeley mote?	CO5	BTL 1	Remembering
3.	Summarize the features of Node-Level Software Platforms	CO5	BTL 2	Understanding
4.	Mention the application example of TinyOS.	CO5	BTL 2	Understanding
5.	Illustrate the need for nesC language for sensor network programming	CO6	BTL 2	Understanding
6.	Interpret about the component interfaces of nesC.	CO6	BTL 2	Understanding
7.	Classify the components of nesC based on the implementation level.	CO6	BTL 2	Understanding
8.	Justify that the language nesC directly reflects the TinyOS execution model.	CO6	BTL 2	Understanding
9.	Write the classification of the nesC code.	CO6	BTL 1	Remembering
10.	How TOSSIM simulator in used in modelling the wireless network?	CO6	BTL 1	Remembering
11.	What is TOSSIM?	CO6	BTL 1	Remembering
12.	Summarize the significance of the node-level simulator.	CO6	BTL 2	Understanding
13.	Name the components of node-level simulator.	CO6	BTL 1	Remembering
14.	What is Cooja Simulator?	CO6	BTL 1	Remembering
15.	Illustrate the structure of Contiki OS.	CO5	BTL 1	Remembering

16.	Define the communication stack in Contiki.		CO5	BTL 1	Remembering
17.	Mention the main components of Contiki OS architecture.		CO5	BTL 2	Understanding
18.	What is RPL in Contiki?		CO5	BTL 1	Remembering
19.	Illustrate the term protothreads.		CO5	BTL 2	Understanding
20.	List the layers in Contiki communication stack.		CO5	BTL 1	Remembering
21.	In Cooja simulator what does the term mote denotes?		CO6	BTL 2	Understanding
22.	Mention the parameters that can be analyzed in Cooja simulation.		CO6	BTL 2	Understanding
23.	Name the types of nodes that can be simulated in Cooja.		CO6	BTL 1	Remembering
24.	Summarize the different radio medium models supported by Cooja.		CO6	BTL 2	Understanding
	PART B				
1.	(i)Explain the architecture and key features of TinyOS in detail. (ii)Illustrate why TinyOS is suitable for wireless sensor networks.	(16)	CO5	BTL 3	Applying
2.	Analyze the layers of operating system TinyOS that supports sensor network applications on Berkeley motes hardware platforms and demonstrate its Field Monitor application for sensing and sending measurements.	(16)	CO5	BTL 4	Analyzing
3.	(i) Elaborate the split-phase operation concept in TinyOS with examples. (ii) Analyze why split-phase operations are essential for resource-constrained sensor nodes.	(8) (8)	CO5	BTL 4	Analyzing
4.	(i)Describe the interface and configuration of nesC language. (ii) Justify that nesC supports the components and applications of TinyOS.	(8) (8)	CO6	BTL 4	Analyzing
5.	Explain the components and implementation models of Timer functions in nesC.	(16)	CO6	BTL 3	Applying
6.	(i)Name a dedicated simulator for TinyOS applications and explain. (ii)Point out the components of node centric programming models.	(8) (8)	CO5	BTL 3	Applying
7.	Describe the two primary concurrency mechanisms in TinyOS: Tasks and Events.	(16)	CO5	BTL 4	Analyzing
8.	Illustrate the handling of concurrency in nesC with the component Sense and Send.	(16)	CO6	BTL 3	Applying
9.	Briefly explain the core concept of a nesC component, differentiating between modules and configurations.	(16)	CO6	BTL 4	Analyzing
10.	Explain timers and event handling in Contiki OS	(16)	CO5	BTL 3	Applying

11.	Explain the TOSSIM simulator in detail. Discuss its features, advantages, and how it is used for debugging TinyOS applications.	(16)	CO6	BTL 4	Analyzing
12.	Describe the Contiki communication stack with neat diagram	(16)	CO5	BTL 3	Applying
13.	Explain the process concept in Contiki and how it differs from traditional threading.	(16)	CO5	BTL 4	Analyzing
14.	Describe the process management model in Contiki OS. Explain the concepts of protothreads, events, and polling mechanisms.	(16)	CO5	BTL 3	Applying
15.	Explain the Cooja simulator in detail. Discuss its features, user interface, and capabilities for simulating wireless sensor networks.	(16)	CO6	BTL 4	Analyzing
16.	Describe the different simulation levels available in Cooja (network level, operating system level, and machine code level). Explain how these levels interact with each other.	(16)	CO6	BTL 3	Applying
17.	Analyze the various radio medium models available in Cooja based on their characteristics, use cases, and how they model real-world radio propagation.	(16)	CO6	BTL 3	Applying