GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3173216
WIRELESS SENSOR NETWORKS
B.E. 7th Semester

Type of course: Professional Elective

Prerequisite: Basic knowledge of Data, Communication and Networks, Mobile Networks

Rationale: The course introduces Sensor networks fundamentals, wireless transmission technology, sensor-node architecture, major areas of thrust, energy efficiency, routing, security, and applications. Wireless sensor networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Sr. No.	Content	Total Hrs.	% Weightage
1	**Introduction:** Wireless Networks, Protocol Suites and Standards, Adhoc Networks, Comparison of Adhoc and Sensor Networks, Applications of Sensor Networks, Challenges and Hurdles in Sensor network design.	05	10%
2	**Wireless Transmission Technology and Systems:** Bluetooth; IEEE 802.11a/b/g/n series of wireless LANs; ZigBee; Radio- frequency identification (RFID).	06	10%
3	**Sensor-node Architecture:** Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, Physical layer and transceiver design considerations in Wireless Sensor Networks.	05	10%
4	**Medium Access Control Protocols for Wireless Sensor Networks:** Fundamentals of MAC Protocols, Performance Requirements, Types of MAC protocols - Schedule-Based and Random Access-Based Protocols, Sensor-MAC, Zebra-MAC.	06	15%
5	**Routing Protocols for Wireless Sensor Networks:** Fundamentals of Routing Protocols, Performance Requirements, Routing Strategies in Wireless Sensor Networks - Flooding and its variants, LEACH, Power-Efficient Gathering in Sensor Information Systems, Directed diffusion, Geographical routing.	06	20%
6	**Transport Control Protocols for Wireless Sensor Networks:** Traditional Transport Control Protocols-TCP, UDP; Feasibility of Using TCP or UDP for WSNs, Transport Protocol Design Issues, Existing Transport Control Protocols- CODA (Congestion Detection and Avoidance), ESRT (Event-to-Sink Reliable Transport) Performance of Transport Control Protocols.	06	20%
7	**Middleware for Wireless Sensor Networks:** WSN Middleware Principles, Middleware Architecture, Existing Middleware-MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services).	06	10%
8	**Time Synchronization and Localization:** Time synchronization protocols based on sender/receiver synchronization, Localization approaches- proximity, trilateration and triangulation.	05	05%

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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**15**	**10**	**10**	**10**	**05**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Holger Karl, Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley.
2. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, John Wiley.
3. Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong, Wireless Sensor Networks, Signal Processing and Communications Perspectives, John Wiley.
4. C. S. Raghavendra, Krishna M. Sivalingam, Taieb Znati, Wireless Sensor Networks, Kluwer Academic.
5. Bhaskar Krishnamachari, Networking Wireless Sensors, Cambridge University Press.

Course Outcome: After learning the course the students should be able to:

Sr. No.	CO Statement	Marks % Weightage
CO-1	Understand the wireless sensor network systems and transmission technologies.	25
CO-2	Evaluate the performance of schedule based and random Medium Access Control protocols.	15
CO-3	Analyze the performance of routing and transport control protocols for wireless sensor networks.	25
CO-4	Understand middleware for wireless sensor networks.	10
CO-5	Analyze various critical parameters in deploying wireless sensor networks.	15
CO-6	Design a wireless sensor network for given sensor data.	10

Suggested List of Experiments:

1. Introduction to network simulators used for wireless Sensor Networks.
2. Introduction to TCL scripting: demonstration of one small network simulation script.
3. To study various trace file formats of network simulators.
4. To implement and compare various MAC layer protocols.
5. To implement routing algorithms.
6. To implement signal strength-based link management routing protocols.
7. To calculate and compare average throughput for various TCP variants.

8. To implement and compare various routing protocols for wireless sensor networks.

Design based Problems (DP)/Open Ended Problem:

Design based problems / Open ended problems should be sensor-based designing of wireless network either through simulation or hardware implementation.

Major Equipment: Computer, Laptop, Simulator for wireless sensor networks

List of Open-Source Software/learning website: NPTEL, NS2, Multisim