

GUJARAT TECHNOLOGICAL UNIVERSITY

Wireless Sensor Networks
SUBJECT CODE: 3710217

Type of course: Elective

Prerequisite: None

Rationale: Advancements in the areas of sensor design, information technologies and wireless networks have evolved the wireless sensor networks. The wireless sensor networks connect the physical world to computing world. WSN is useful in developing a large number of applications, including the protection of civil infrastructure, habitat monitoring, agriculture, health care. However, the design, operation and performance is a challenging task.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction –Motivation, Definitions and background, challenges and constraints, Applications	2	2
2	Single Node Architecture – Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, examples of sensor nodes	3	3
3	Network Architecture – Sensor network scenarios, optimization goals, design principles, service interfaces,gateway concepts	4	5
4	Physical layer – Introduction, wireless channel and communication fundamentals,physical layer and transceiver design considerations in WSNs	3	5
5	MAC protocols – Fundamentals of MAC protocols, Low duty cycle protocols and wakeup concepts, contention based protocols, schedule based protocols, The IEEE 802.15.4 MAC protocol	4	10
6	Link Layer Protocols – Tasks and requirements, Framing, Link Management	4	5
7	Naming and addressing – Fundamentals, address and name management, Assignment of MAC address, Distributed assignment of locally unique addresses, content based and geographic addressing.	4	10
8	Time Synchronization, Localization and positioning – Time synchronization problem, protocols, properties of localization and positioning procedures, lateration problem, single hop localization, positioning in multihop environments	4	10

9	Routing protocols – Forwarding and routing, MANET protocols, gossiping and agent based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, Mobile nodes	8	20
10	Data centric and content based networking –Introduction, Data centric routing, Data aggregation, data centric storage	4	10
11	Transport layer and quality of service – The transport layer and QoS in wireless sensor networks, Coverage and deployment, Reliable data transport, single packet delivery, block delivery, congestion control and rate control	4	10
12	Security – Challenges of security, security attacks, Protocols and mechanisms for security, IEEE 802.15.4 and ZigBee Security	4	10

Reference Books:

- 1) Holger Karl and Andreas Willig, “Protocols and Architectures for wireless sensor networks, WILEY
- 2) W. Dargie and C. Poellabauer, “Fundamentals of Wireless Sensor Networks –Theory and Practice”, Wiley 2010
- 3) KazemSohraby, Daniel Minoli and TaiebZnati, “wireless sensor networks -Technology, Protocols, and Applications”, Wiley Interscience 2007
- 4) Takahiro Hara, Vladimir I. Zadorozhny, and Erik Buchmann, “Wireless Sensor Network Technologies for the Information Explosion Era”, springer 2010
- 5) Jun Zheng, Abbas Jamalipour, “ Wireless Sensor Networks – A networking perspective”, WILEY
- 6) Kazem Sohraby, Daniel Minoli, Taieb Znati, “wireless sensor Networks Technology, Protocols and applications”, WILEY
- 7) Jr. Edgar H. Callaway, Wireless Sensor Networks: Architecture and Protocols, Auerbach, 2003
- 8) Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S. Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley
- 9) Azzedine Boukerche, Handbook of Algorithms for Wireless Networking and Mobile Computing, Chapman & Hall/CRC, 2006
- 10) Philip Levis, “ TinyOS Programming”

Course Outcomes:

After completion of course, students would be able to:

- Describe and explain radio standards and communication protocols for wireless sensor networks.
- Explain the function of the node architecture and use of sensors for various applications.
- Be familiar with architectures, functions and performance of wireless sensor networks systems and platforms.

List of Experiments:

- 1) Implement a campus sensor communication application for assignment file transfer using Bluetooth.
- 2) Implement a campus sensor communication application for assignment file transfer using wireless LAN.
- 3) Implement a campus sensor communication application for assignment file transfer using ZigBee.
- 4) Implement a campus sensor communication application for assignment file transfer using WiMax/hotspot.

- 5) Implement TinyOS. Perform analysis of various routing protocols
- 6) Perform analysis of various routing protocols on sensor network simulator.
- 7) Perform analysis of various MAC protocol on sensor network simulator and find how it affects the energy efficiency.

Major Equipment:

Computer systems having following minimum technical configurations

Processor:i3 or i5 or higher

RAM : minimum 4 GB

HDD : 1 TB

Internet and wifi connectivity

Licence Window/Linux operating system

List of Open Source Software/learning website:

- 1) nptel.ac.in