GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Part Time)
Subject Code: 2971104
Semester – VII
Subject Name: Wireless Sensor Networks

Type of course: - The course addresses the fundamentals of Wireless Sensor Networks (WSN) and provides an overview of existing and emerging protocols for Wireless Sensor Networks. It covers various routing & MAC protocols, security protocols as well as the aspects of low-rate wireless personal area networks (LR-WPANs) standard IEEE 802.15.4. This course ranges from the design aspects of WSN which includes architecture and prototypes to the latest issues & challenges in WSN with different operating systems involved for WSN.

Prerequisite: - It is desirable that student is familiar with following domains: Introductory knowledge of data communication, Electronic measurements, measuring instruments & transducers, Digital and Analog Communication, Signals & Systems.

Rationale: - The course will provide fundamental about many theoretical & practical concepts that form the basis for Wireless Sensor Networks (WSN). The students will learn starting from the fundamentals of WSN to the various protocols i.e. routing protocols, MAC protocols, includes S-MAC, B-MAC as well as the real-time traffic & security protocols for WSN. Students will also get an exposure to design principles for WSN with single-node architecture and its prototypes for various applications of WSN. The course also covers overview of different operating systems i.e. TinyOS, nesC. The student will be acquainted with recent issues & challenges for WSN by learning enabling technologies for WSN as well.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Total Hrs
1.	Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks.	02
2.	Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks	04
3.	Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee	06

4.	Dissemination protocol for large sensor network, Data dissemination, data gathering and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.	07
5.	Design Principles for WSNs, Gateway Concepts, Need for gateway, WSN to Internet Communication and Internet to WSN Communication.	05
6.	Single-node architecture and prototypes i.e. The IMote Node Architecture, The XYZ Node Architecture, The Hogthrob Node Architecture. Hardware components i.e. Temperature sensors, Pressure sensors, Displacement sensors, MEMS sensors etc. & design constraints.	06
7.*	Operating systems and execution environments, Introduction to OS: TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERLANDS, PicOS and nesC. • This topic should be covered during laboratory hrs.	00

Suggested Specification table with Marks (Theory):

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

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. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", By John Wiley & Sons Publications, 2011

2. Sabrie Soloman, "Sensors Handbook" by McGraw Hill publication. 2009

3. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks", Elsevier Publications, 2004

4. Kazem Sohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science

5. Philip Levis, And David Gay "TinyOS Programming" by Cambridge University Press 2009

6. Kazem Sohrby, Daniel Minoli, Taieb Znati "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-India Edition

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Course Outcome: After completion of this course students will be able to…

Sr. No.	CO statement	Marks % weightage
CO-1	Understand emerging research areas in the field of sensor networks.	20
CO-2	Understand MAC protocols used for different communication standards used in WSN.	30
CO-3	Explore new protocols for WSN resource management.	25
CO-4	Design of WSN for different applications.	25

List of Experiments:-

Experiments and Problems will be based on Concept & implementation of Wireless Sensor Networks (WSN), Mobile Ad-hoc Networks ((MANETs), IEEE 802.15.4 & ZigBee standard, Implementation of various protocols i.e. Routing, MAC, Traffic & security protocols etc., Programming languages i.e TinyOS, nesC etc.

Following are the examples of Experiments from the various part of syllabus topic. Same or similar Experiments may be given to the students based on availability of resources in Wireless Sensor Networks laboratory of the institute.

Experiments based on WSN development/ trainer Kit

- To study and understand the concepts of Wireless Sensor Networks.
- To learn various network topologies i.e. Point-to-Point, Mesh, Star etc.
- To study various sensors i.e. Temperature Sensor, Humidity sensor, Accelerometer, Infrared Sensor etc.
- To interface & analyze the different sensors with WSN environment.
- To perform WSN to Internet Communication, and Internet to WSN Communication using gateway.
- To study and understand the single node architecture and its prototypes.

Experiments :-

- Write a program to simulate Wireless Sensor Networks (WSN) environment.
- Write a program to simulate Mobile Ad-hoc Networks (MANETs) environment.
- Write a program for different wireless sensor nodes and routing algorithms.
- Write a program to evaluate S-MAC and B-MAC protocols under WSN.
- Write a program to configure various sensors with end-to-end devices and routers.
- Write a program to configure various network topologies i.e. Point-to-Point, Mesh, Star etc.

- Write a program to implement various protocols i.e. Routing, MAC, Traffic & security protocols etc.

Major Equipments: WSN development/ trainer Kit, ISM band transceiver, Sensors i.e. Temperature Sensor, Humidity sensor, Accelerometer, Infrared Sensor etc., Network Simulator-NS2, MATLAB /SCILAB , Digital Storage Oscilloscope (DSO), Spectrum Analyser, Power Supply, Function Generator etc.

List of Open Source Software/software/learning website:-

Students may use NETSIM, NS2, SCILAB, MATLAB, and NPTL Videos, MIT open course website, Virtual Labs (Source:http://vlab .co.in), AICTE SWAYAM Portal etc.